Mariners
WEATHER LOG

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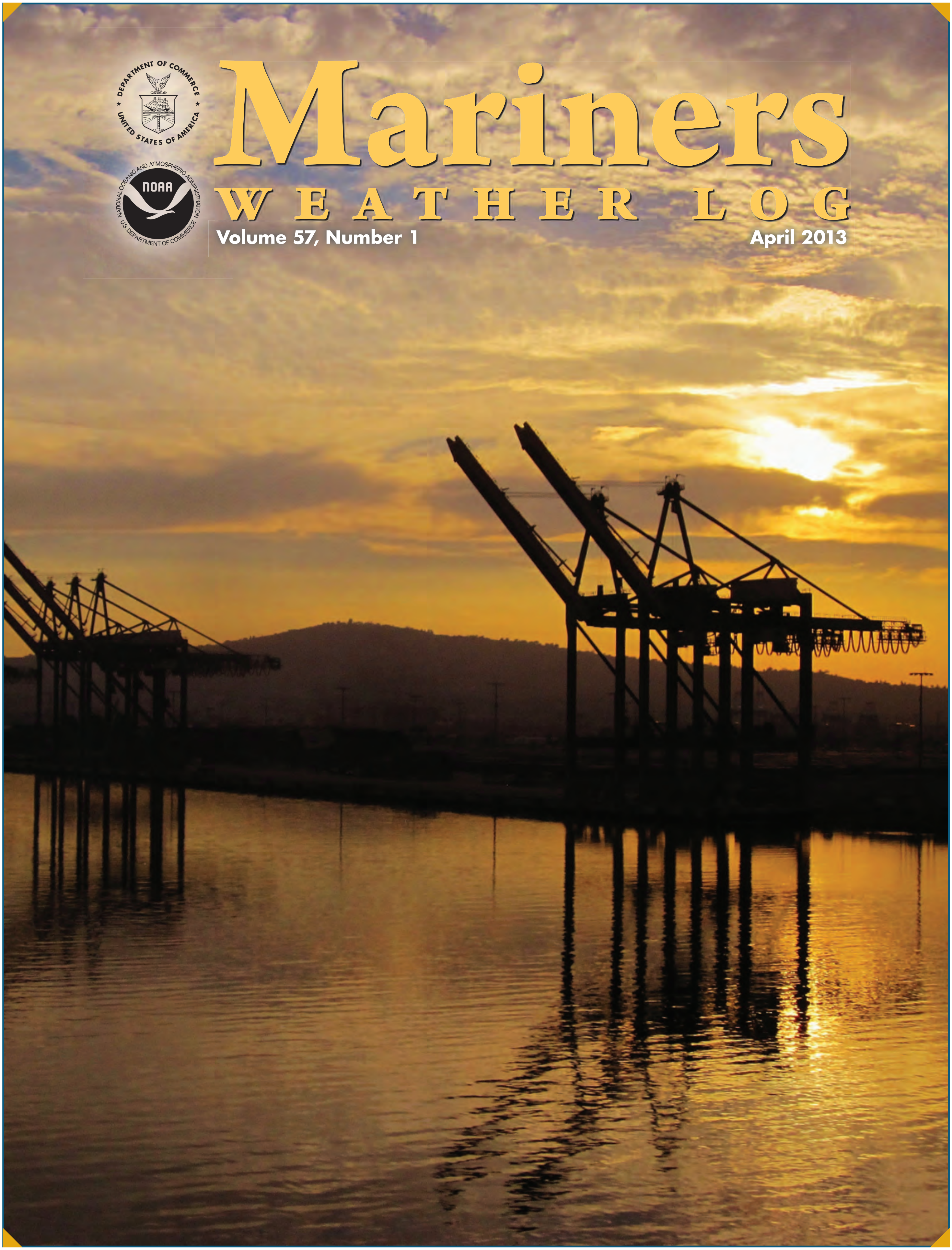

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Some Important Web Page Addresses:

NOAA
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http://www.weather.gov

National Data Buoy Center
http://www.ndbc.noaa.gov

AMVER Program
http://www.amver.com

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Marine Dissemination
http://www.nws.noaa.gov/om/marine/home.htm

U.S. Coast Guard Navigation Center
http://www.navcen.uscg.gov/marcomms/

See these Web pages for further links.

From the Editor

Paula Rychtar

Hello again and welcome to the April issue of the Mariners Weather Log. April showers bring May flowers as well as a lot of stormy conditions out at sea….so please remember; only YOU know the weather!

We have a great article on the Horizon Line Ships, the RELIANCE and SPIRIT. Funny how things start out, this article evolved over a single photograph. I always request photos and stories of interest for the MWL and Judy Plotz decided to send in a beautiful photo, which happens to be our cover story, the Pineapple Run. I hope you find it interesting and enjoyable as well as learning a bit about all the science that takes place out on the open water.

In addition to the Pineapple Run, one of our international colleagues, Sarah North sent a wonderful article on what I believe to be the oldest UK VOS ship, with 50 years of service! I think this is just incredible, this ship contributed so much over the years.

I would like to report that in recent days, VOS Management, here at the National Data Buoy Center had a discussion among our PMO's on a program called VOSClim. This is a worthy program which requires minimal extra effort on the ship's part. To be a part of this elite team of ships you must have compliant software and input just a few extra parameters. I will mention that the software you would need to use at this time is TURBOWIN, which was developed by the Netherlands. This software is very intuitive and the PMO's are as familiar with it as they are with SEAS. (In time our AMVER/SEAS will have the necessary archive format needed to use with the VOSClim ships.) When using TURBOWIN, it is only a matter of adding a couple of parameters for each observation-the only significant one being the distance from the waterline to the summer load line. TURBOWIN does the rest, so it only adds a few seconds for the observers to do the observations. So if you are interested, please contact you're PMO and they can get you set up. Most of the work would be for your PMO, as they will need to collect metadata, take photos of your instrumentation used in taking observations, a photo of your ship and a schematic of the ship in PDF format. If your ship is mobile, equipped with sufficient certified meteorological instruments for making marine weather observations, transmits regular and timely reports, has compliant software (Turbowin) and your ship has *at least* a barometer, a thermometer to measure SST, a psychrometer for measuring air temperature, a barograph and *possibly* an anemometer, you could participate in our elite class of ships. I hope you will consider joining the VOSClim ships program!

I want to report that our on-line format of the Mariners Weather Log has gained popularity. With this format it is possible to reach out to so many more people of varied interests and backgrounds where it was not possible before. In addition, it is a "green" way to do things and we all need to do our best to be environmentally friendly. NOAA, after all, needs to take the lead. However, I do want to insure that our readers out at sea can obtain our issues. If you are having trouble obtaining our online MWL, contact your PMO, or me….we will work with you. With this format, you can share these issues with your family and friends, giving them a great perspective of all the things you do. As always, I encourage you to send me photos and articles.

Lastly, I am sad to have to include yet another tribute in our MWL. Julie Fletcher, a friend, colleague and a person whom I looked to for guidance in all things VOS, has passed. I miss her and think of her every day.

Paula

On the cover:
Cover photo taken by:
Judith Lynn Plotz Brannigan

Taken from the Ship HORIZON SPIRIT, Leaving the Los Angeles Harbor on July 13, 2012 heading back to Hawaii.

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The "Pineapple Run"

by Paula Rychtar

Judy Plotz Brannigan sent me a beautiful photo of a sunset over the port of Long Beach, California (cover photo). I always encourage photos and articles of interest that hold a mariner's twist and so with that, I contacted Judy on the details of her photo so that I might include it in a future MWL. After a few back and forth emails, it turns out that Judy is the National Director for the U.S. Navy League and the Vice President of the local chapter in Honolulu, Hawaii. In addition to that, she happens to be a very accomplished amateur photographer. Her husband, Kevin Brannigan, is a retired Commander Master Chief Petty Officer of the U.S. Navy (32 years). Kevin now actively works with emergency management, military and civilian teams in Honolulu, Hawaii. As luck would find it, while they were attending a USCG Foundation Dinner, Judy and Kevin won a silent auction to sail, round trip, from Honolulu to Long Beach California(known to mariners as the Pineapple Run) on the Horizon Line ships (Trip details). On the first leg from Honolulu to Long Beach they rode upon the HORIZON RELIANCE under the watchful eye of Captain Costanzi and on return, HORIZON SPIRIT was charged with Captain Crawford at the helm. With the knowledge of the ships that were involved in providing Judy and Kevin transportation, giving Judy the opportunity to take such a great photo, the article just blooms from there. As it would happen, the Horizon ships RELIANCE and SPIRIT are active participants in the U.S. Voluntary Observing Ship Program (VOS), providing meteorological and oceanographic observations for NOAA's National Weather Service; both of these ships are regular recipients of U.S. VOS awards for their superior quality and dedication to our program. In addition to the VOS Program, the Horizon Line ships, HORIZON SPIRIT AND HORIZON HAWK to be exact, are participants in other data collection programs. This article will attempt to highlight those programs and projects with emphasis on the HORIZON SPIRIT.

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Judy and Kevin leaving Hawaii on the HORIZON RELIANCE. Photo courtesy of Judy Plotz

Left to Right: 3rd Mate Jack Walker, Chief Mate Steve Itson, Captain Barry Costanzi, 2nd Mate Paul Greppo of the HORIZON RELIANCE. Photo: Courtesy of Judy Plotz

In today's world, it is a fact that there are many concerns pertaining to climate change as well as the conservation and sustainability of our world's natural recourses. NOAA heads the effort by compelling those within the agency as well as outside of the agency to become "stewards" of our planet. For that effort to be successful, it

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Jessica Raymond loading the XBT Launch.
Photo: courtesy of Scripps

is necessary for various in-depth climate studies to be performed to better gauge the health and well being of our planet. NOAA promotes interagency cooperation as well as collaboration from private sectors and universities. The HORIZON SPIRIT is a perfect example of that effort. Not only does this ship take marine weather observations on a regular basis for U.S. VOS, which is an international program, the SPIRIT works with Scripps Institution of Oceanography http://sio.ucsd.edu/ as one of the many vessels that participate in another international program, Ship of Opportunity Program (SOOP) http://www.jcommops.org/soopip/ . In the SOOP program, ships such as the SPIRIT launch high resolution expendable Bathythermograph probes at prescribed intervals on know cruise tracks giving a temperature/depth profile. http://www-hrx.ucsd.edu/intro.html These data points are collected using a windows based software AMVERSEAS developed by NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) http://www.aoml.noaa.gov/ and the Sippican data acquisition system. In my correspondence with Judy, it was mentioned to me that there was a scientist on the ship who she noticed using the equipment on the stern of the ship and she believed that she worked with NOAA, so I further investigated. I contacted Glenn Pezzoli, Manager of SOOP, and Scripps Institution of Oceanography, to find out the identity of the scientist and with his help I was able to identify Jessica Raymond, a Marine Technician from Scripps Institution, who has done 6 of the last 10 transects aboard the SPIRIT. Others that I would like to mention from Scripps who have done this particular transect include Lucian Parry, Natalia Ribeiro Santos, Gino Passalacqua, Corina Marks and Lindsey Loughrey. These "riders" are necessary to accomplish these projects and their dedication is to be acknowledged.

There are many transects and with that, many other ship riders assisting with XBT data collection that I have not mentioned in this article. Repeat high resolution expendable Bathythermograph (XBT) transects have been collected along a number of commercial shipping routes spanning the Pacific Ocean, the Drake Passage, and Tasmania to Dumont d'Urville. On each of the transects, generally four surveys are conducted per year. Temperature data are usually collected by a scientist on board the vessel using an automatic XBT launcher designed at Scripps Institution of Oceanography (SIO). The launcher holds 6 XBT probes which are pre-programmed to drop at specific locations (using GPS) or times. I encourage and invite all of you reading this article to visit the Scripps website on XBT transects to get a good grasp on the field of operation. http://www-hrx.ucsd.edu/ The data that is collected is used for the basis for climatological analysis and variability in Pacific Ocean circulation and heat transport. (http://www-hrx.ucsd.edu/ra.html)

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“MAGIC Cloud” Project

While collecting information on the HORIZON SPIRIT so that I could write this article, I corresponded with the Captain, Tom McCarthy. In one of the emails that I received from Captain McCarthy, he informed me of another project that they were involved in; this program is called “MAGIC”. **MAGIC** stands for: Marine ARM (Atmospheric Radiation Measurement) GPCI Investigations of Clouds. (http://www.bnl.gov/envsci/ARM/MAGIC/). The principle investor for this project is Brookhaven National Laboratory with the Atmospheric Scientist Ernie R. Lewis as the lead investigator. In this program the primary objective is to improve the representation of the stratocumulus to cumulus transition, an ever present phenomenon along this particular transect in climate models. So for the first time ever, a cloud monitoring system will be placed on a ship (SPIRIT) and will be gathering data at sea. Instruments will be operated continuously and will be accompanied by two full time technicians. This mobile facility is called the AMF2 and it consists of three 20-foot modified sea containers which will include radars and other instruments to measure properties of clouds and precipitation, aerosols, and radiation along with other meteorological and oceanographic conditions. Several modeling groups are interested in the data that will result from MAGIC. GPCI, the GCSS Pacific Cross-section Intercomparison (GCSS: GEWEX Cloud Systems Study; GEWEX: Global Energy and Water Cycle Experiment, a core project of the World Climate Research Programme) has long used a transect near the route taken by the SPIRIT. EUCLIPSE, the European Union Cloud Intercomparison, Process Study & Evaluation Project, a collaborative effort of 12 institutes in Europe, also uses the GPCI transect. CGILS, the CFMIP - GCSS Intercomparison of Large Eddy Models and Single Column Models, a joint project of the GCSS and the World Climate Research Programme Working Group on Coupled Modeling Cloud Feedback Model Intercomparison Project (CFMIP), compares results at specific locations along the GPCI transect. MAGIC got off the ground in September


Brett Bersche (AMF2 technician) launching balloon. Photo: courtesy of Ernie R. Lewis, Lead investigator of MAGIC

AMF2 technicians: (L to R) Mark Smith, Tom Flannery, Brett Bersche, and Pat Dowell. Photo: courtesy of Ernie R. Lewis, Lead investigator of MAGIC


Unknown dock worker aligning radar being loaded on radar van on HORIZON SPIRIT. Photo: courtesy of Ernie R. Lewis, Lead investigator of MAGIC


AMF2 technicians Pat Dowell and Brett Bersche launching balloon. Photo: courtesy of Ernie R. Lewis, Lead investigator of MAGIC


HORIZON SPIRIT First Mate Eric Sinkevich launching balloon. Photo: courtesy of Ernie R. Lewis, Lead investigator of MAGIC

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of 2012 with prospects of operating from October 2012 until September 2013. Short updates on MAGIC and topics related to it are written for non-scientists and scientists alike. These updates cover news relating to the MAGIC deployment, instruments involved in MAGIC and the science behind them, and other items relating to clouds, climate, and atmospheric sciences. Anyone wishing to be added to the distribution list should contact Ernie Lewis (elewis@bnl.gov) or go to:
http://www.bnl.gov/envsci/ARM/MAGIC/updates.php.

Ernie R. Lewis, Atmospheric Scientist, Lead investigator of MAGIC. Photo: Courtesy of Brookhaven National Laboratory

Gunnar Senum, scientist from Brookhaven National Laboratory. Photo: courtesy of Ernie R. Lewis, Lead investigator of MAGIC

HORIZON SPIRIT showing the radar van (with two radars on top) on the left and the ops van on the right. Photo: courtesy of Ernie R. Lewis, Lead investigator of MAGIC

Tsunami Marine Debris

While corresponding with Judy and looking at all her photos she took while documenting her trip on the HORIZON RELIANCE, I noticed she had photos of marine debris that may have come from the Japan tsunami. Judy mentioned that the crew diligently marked the position, notified the USCG and radioed in the sighting with the position to warn other ships in the vicinity. One of the programs that VOS assists with is the NOAA's Marine Debris Program http://marinedebris.noaa.gov/tsunamidebris/. Since VOS works with ships worldwide, we are able to get the word out to our mariners on the need for reporting any marine debris sightings. Please send reports to: disasterdebris@noaa.gov. The Marine Debris program collects and monitors fields of debris and using the climatology and the current observations from various methods (ships, satellites, buoys) analyzing ocean currents and storm force driven seas to detect the flow and movement of debris fields generated by the Japan Tsunami. The area where the SPIRIT and RELIANCE transects is a prime area where marine debris is found and their observations provide vital data for establishing a timeline for this debris to wash ashore. NOAA expects a portion of the tsunami debris to reach the U.S. and Canadian shores over the next several years. For the latest updates on observed Japan tsunami marine debris you can go to: http://marinedebris.noaa.gov/tsunamidebris/updates.html.

Photo: Courtesy of Judy Plotz

Photo: Courtesy of Judy Plotz

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Record Breaker — 50 Years of Discovery and Voluntary Observations

Sarah North, Marine Networks Manager, UK

RRS Discovery leaves Southampton for the final time (image courtesy of Barry Marsh).

In December 2012 the Royal Research Ship DISCOVERY, the oldest UK Voluntary Observing Ship, was withdrawn from service and sailed from Southampton on its final voyage. This brought to an end a period of 50 years participation in the International VOS Scheme – a record for the UK observing fleet, and possibly a world record?

RRS DISCOVERY's long and distinguished observing career began on 16 January 1963 when she was formally recruited to the VOS Scheme. During the next half-century its officers, scientists and crew have contributed more than 34,000 highly valued weather observations.

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When RRS DISCOVERY was built in Aberdeen in 1962 there was no satellite navigation, man had yet to step foot on the moon, and John F Kennedy was the US President. Until 2006, she was the largest general purpose oceanographic research vessel in use in the UK, measuring 90 metres in length, and fitted with a wide range of oceanographic equipment.

The ship takes its name from the 1901 ship, RRS DISCOVERY, the three-masted sailing ship designed for Antarctic research, and famous for being commanded by iconic British hero and explorer Captain Robert Falcon Scott on his ill- fated expedition to be the first to reach the South Pole. Scott now immortalised as 'Scott of the Antarctic' led an expedition which reached the Pole on 17 January 1912, only to find he had just been beaten to the post by Roald Amundsen's Norwegian rival expedition. On their return journey, Scott and his comrades all died from a combination of exhaustion, starvation and extreme cold.

The illustrious DISCOVERY name will however continue in the future as a new, state-of-the-art Royal Research Ship, also to be called DISCOVERY, is currently being built in Spain and will be delivered later this year. The UK Met Office are already in discussions with the UK's National Oceanography Centre (NOC), who will operate the ship on behalf of the Natural Environment Research Council, to recruit this latest namesake to the VOS Scheme and to install one of its new Autonomous Marine Observing Systems (AMOS) on board.

To formally recognise RRS DISCOVERY's remarkable 50 year contribution a commemorate plaque was presented to its Master, Captain Peter Sarjeant by Sarah North, Ship Observations Manager at the Met Office. In due course the plaque will be mounted on a bulkhead on the new DISCOVERY as an ongoing reminder of its predecessor's outstanding observing record. In return Captain Sarjeant kindly presented a plaque of the DISCOVERY to the Met Office.

The opportunity was also taken to present Captain Sergeant with a marine barograph in recognition of his personal contribution and long service to the UK observing fleet, which began in the mid 1970's. Captain Sarjeant remarked that during his time at sea "there had been a continuous evolution

Captain Sarjeant and Sarah North exchange plaques

Lalinda Namalarachchi, Southampton Port Meteorological Officer, presents Captain Sarjeant with a marine barograph

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and development of navigational aids and systems, but undoubtedly the most enduring and symbolic instrument has been the barograph". He added that "a glance at the barograph trace gives that quiet nudge, that reminder, as to the weather's 'state of play ' and to what is in store".

During his visit to the Met Office Headquarters in Exeter Captain Sarjeant was also invited to view some of the historic hardcopy logbooks which are stored in the Meteorological Archive. Many of these logbooks were submitted during his service as an officer, and later as Master, of the RRS DISCOVERY. He was also invited to view other famous and historical ships logs that are held in the archive, including the original logs of the HMS Beagle, famous for being the ship which under the command of Vice-Admiral FitzRoy took Charles Darwin on his voyages of scientific DISCOVERY and which led to him formulating his controversial (at the time) theory on the origin of species. The log containing Admiral Sir Francis Beaufort's original wind scale was also displayed and was examined with great interest by Captain Sarjeant.

Captain Sarjeant examines one of the first logbooks submitted during his seagoing career

Besides its notable contribution to the field of meteorology, RRS DISCOVERY has undertaken hundreds of missions to push the boundaries of ocean science. During its many voyages around the globe it has surveyed the ocean floor, measured the ocean currents, monitored climate change and discovered new biological species. Her final cruise investigated changes to the Atlantic Ocean currents collecting data from an array of moorings between the Canaries and the Bahamas.

It is therefore with a little sadness but with great gratitude that we wave farewell to the UK's oldest research vessel, and longest serving voluntary observing ship.

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NOAA Marine Debris Program

Anna Manyak, NOAA Office of Response and Restoration

The NOAA Marine Debris Program continues to request reports of at-sea and shoreline sightings of suspected Japan tsunami marine debris to DisasterDebris@noaa.gov. All reports are catalogued by Marine Debris Program staff, with significant sightings being shared with the proper response agency. From October through December 2012, the Marine Debris Program received 107 total reports, 12 of which were reports of items floating at sea.

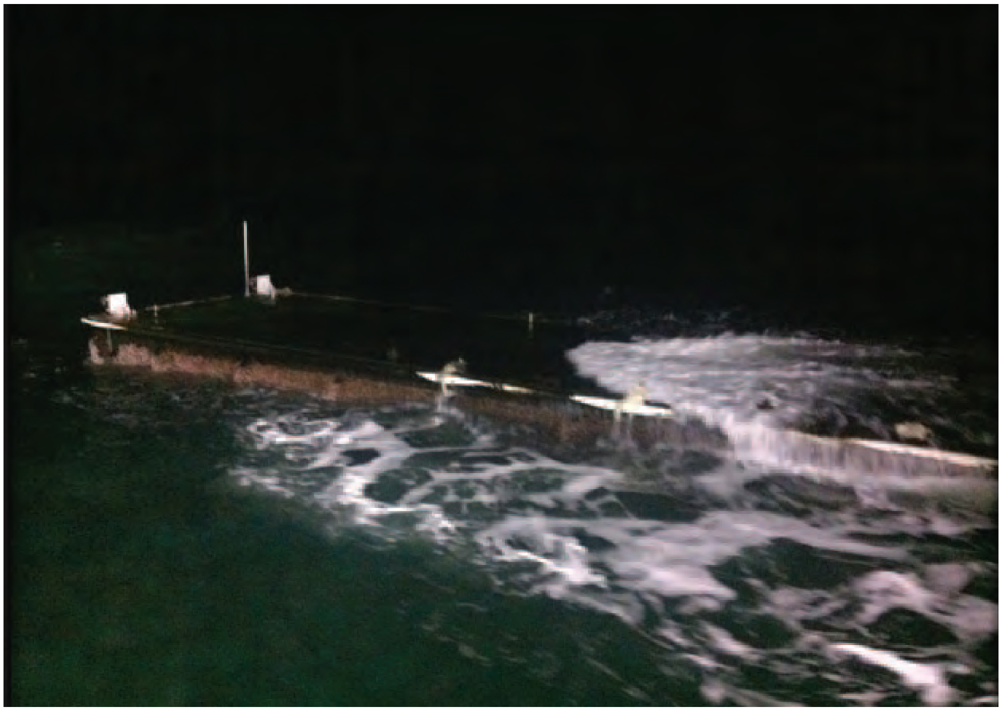

Photo caption: Confirmed tsunami debris: Floating dock observed off the coast of Washington in December 2012. The dock later ran aground along the coast of Olympic National Park, where the response is currently underway.

A Call to All Mariners for Video Clips of Sea State!!!

Would you like to help out the National Weather Service marine forecasters learn more about the sea state that you experience and how the sea state your experiencing actually looks? Now is your chance! I am looking for submissions of any and all sea states that you catch on small video clips. As you know, our forecasters provide guidance and marine forecasts for the wide open oceans as well as the Great Lakes. Anything that we can do to help them gain more expertise on that in order to provide better forecasts for you is what we strive for…but as always we need your help. So, if you would like to send in your video clips for this new interactive sea state matrix that is under development, send them to:

vos@noaa.gov **subject line:** sea state video clip.

In the body of the email, please indicate the sea state and all pertinent information in regards to your video clip. By sending in your video clip, you give us permission to use this in our sea state tool. Also, once this tool is available online, I will put a hyperlink on the Mariners Weather Log so that you can view this sea state tool for your use as well. Cheers!

Storm Surge in New York Harbor during Hurricane Sandy in 2012

Professor S. A. Hsu, Coastal Studies Institute, LSU, Baton Rouge. LA.
Email: sahsu@lsu.edu

Abstract: In October 2012 Hurricane Sandy caused extensive damages in New York and New Jersey region including massive flooding in the New York Harbor. Characteristics of meteorology, wave height and direction, storm surges and storm tides are presented. By applying the physics of wind-wave interaction for the storm surge, it is found that during Sandy, $S = 0.253$ Hs where S is the storm surge in feet in New York Harbor and Hs is the significant wave height in feet at the entrance of the Harbor. Since the formula can explain 93% of the total storm surge, it is recommended for operational applications. A comparative study is also made during Hurricane Gustav in 2008 to further verify this operational formula.

1. Introduction

According to Wikipedia (www.wikipedia.org), the effects of Hurricane Sandy in New York in 2012 were severe, particularly in New York City, its suburbs, and Long Island. Sandy's impacts included the flooding of the New York City Subway system, many suburban communities, all road tunnels entering Manhattan except the Lincoln Tunnel, and the closure of the New York Stock Exchange for two consecutive days. Numerous infrastructures related to the New York Harbor were affected by Sandy. For the storm track of Sandy, see www.nhc.noaa.gov.

The purposes of this study are to delineate the meteorological characteristics during Sandy, to depict the wave direction, to describe storm surge and storm tide, and finally to provide an operational formula to estimate the storm surge in New York Harbor from the significant wave height at the entrance of the Harbor.

2. Meteorological Characteristics

All met-ocean stations operated by the National Data Buoy Center (NDBC) and the National Ocean Service (NOS) as shown in Fig. 1 are employed in this study.

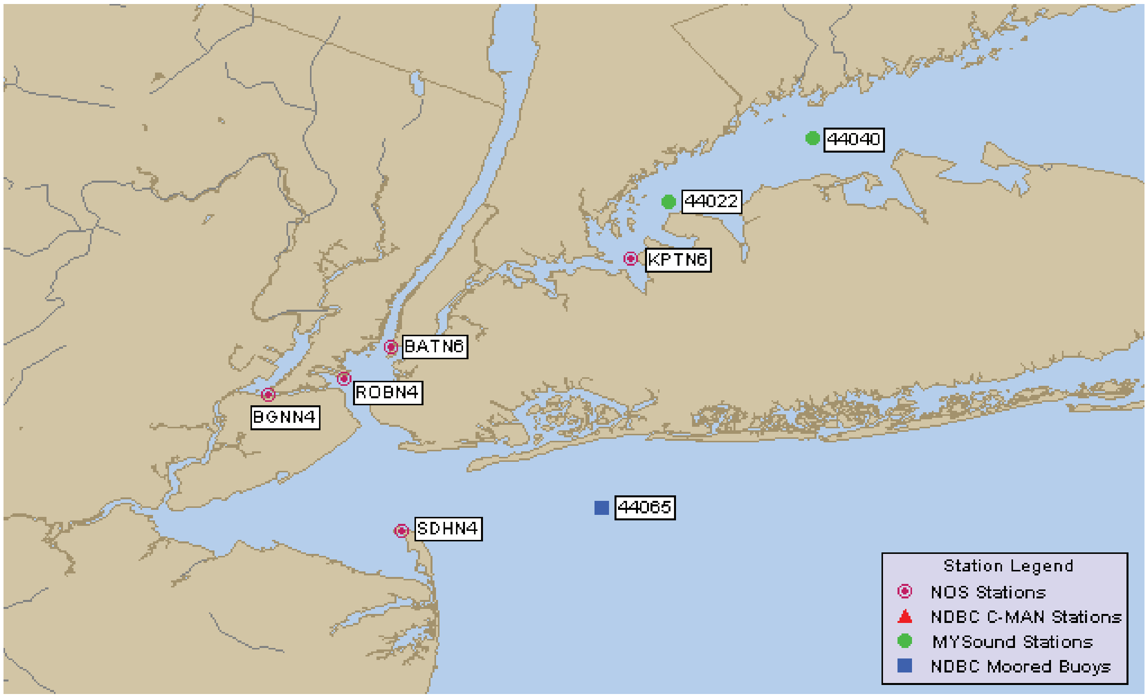

Figure 1. Met-ocean stations in the study area during Hurricane Sandy in 2012 (see www.ndbc.noaa.gov).

In order to delineate meteorological characteristics for Sandy, measurements at Robbins Reef, NJ (see ROBN4 in Fig. 1) are provided in Figures 2 and 3 for the barometric pressure and wind speed and direction and wind gust, respectively. It is shown that the minimum sea-level pressure was approximately 962mb whereas maximum sustained wind speed and peak gust reached 54 and 78 knots, respectively.

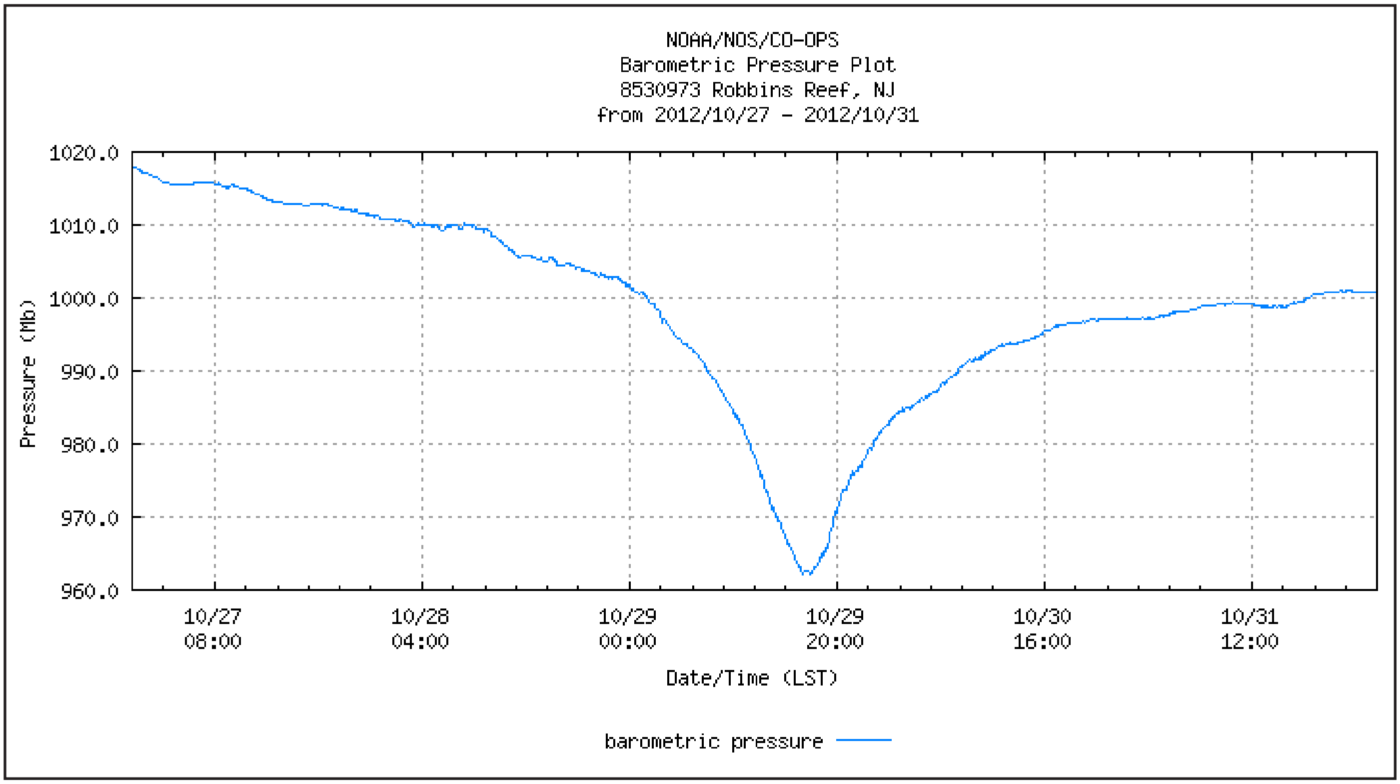

Figure 2. Measurement of sea-level pressure at Robbins Reef, NJ during Hurricane Sandy.

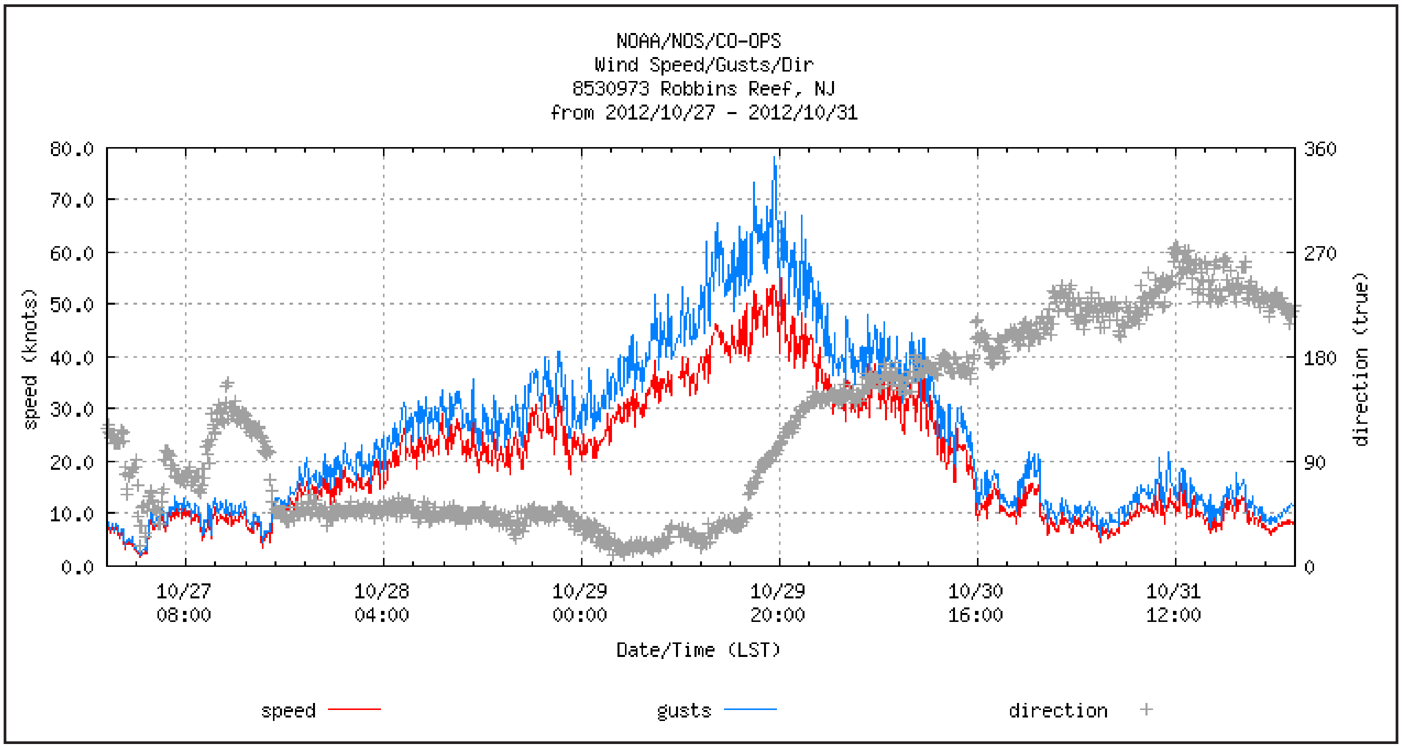

Figure 3. Measurements of wind speed and direction and wind gust at Robbins Reef, NJ during Sandy.

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3. Dominant Wave Direction

In order to flood the New York Harbor the water-level setup by the wind stress and waves must come from offshore. This is indeed the case since the dominant wave direction was from 80 to 180 degrees as depicted in Figure 4. Note that, beginning at 00 UTC on Oct.28, 2012, we had 95 hour long duration when the wave direction was from the southeast. As shown in Fig.1, the entrance of New York Harbor is bordered north by Long Island and west by New Jersey. Therefore, the funneling effects of these southeasterly waves can enhance the massive flooding in New York Harbor.

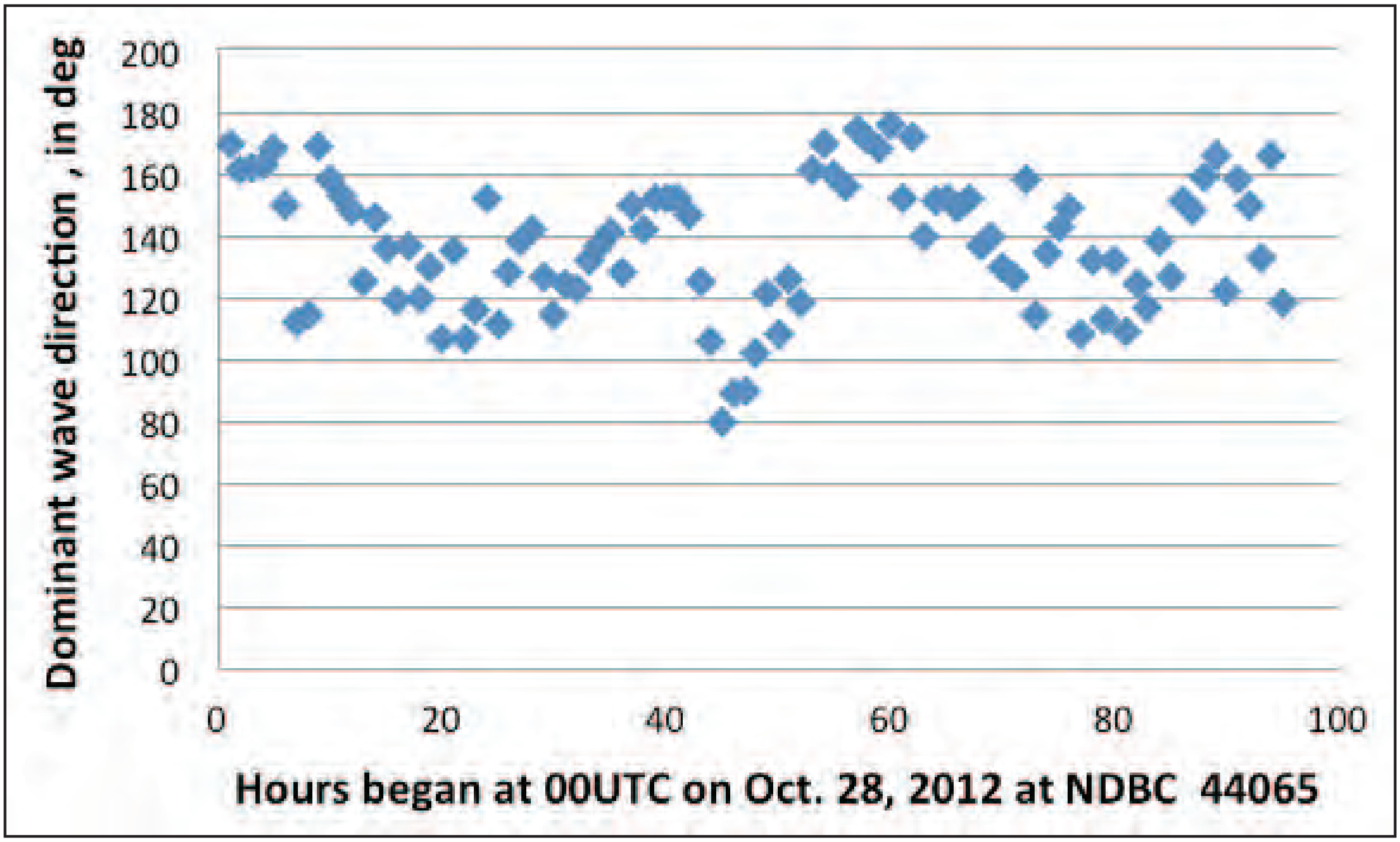

Figure 4. Timeline of the dominant wave direction as measured at NDBC 44065.

4. Storm Surge and Storm Tide

Characteristics of storm surge and storm tide are shown in Figs. 5 through 8. At Kings Point, NY, peak storm surge and storm tide were approximately 13 and 14 ft, respectively. At Sandy Hook, NJ, they were 8.8 and 13.5 ft before the station was damaged. In the upper reaches of the Harbor they were 9.5 and 14 ft at the Battery, and 9.8 and 14.5 at Bergen Point, respctively. Note that, according to the National Hurricane Center (see www.nhc.noaa.gov), storm surge is water height above normal astronomical tide level and storm tide is referenced above North American Vertical Datum of 1988 (NAVD88).

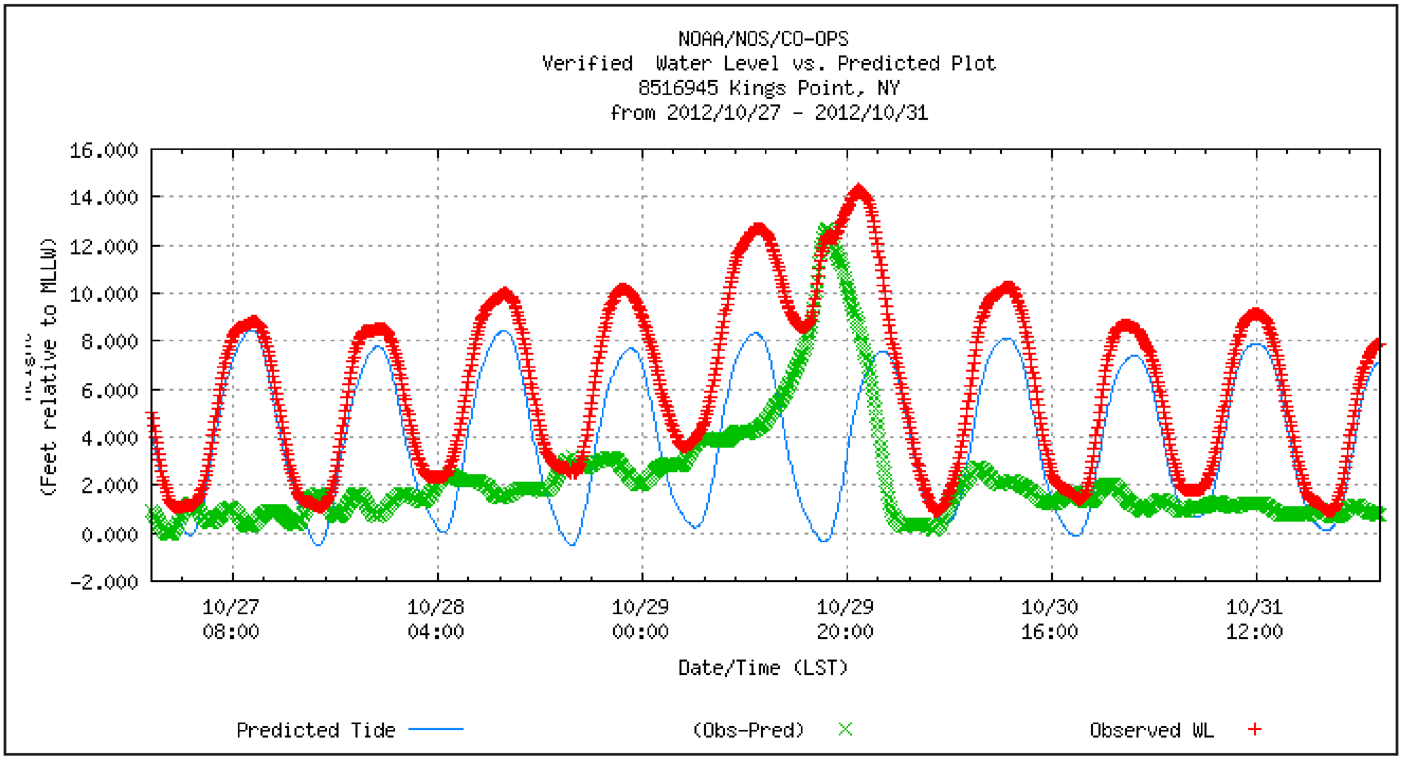

Figure 5. Water-level measurements at Kings Point, NY during Sandy. Storm surge is in green, storm tide is in red, and astronomical tide is in blue.

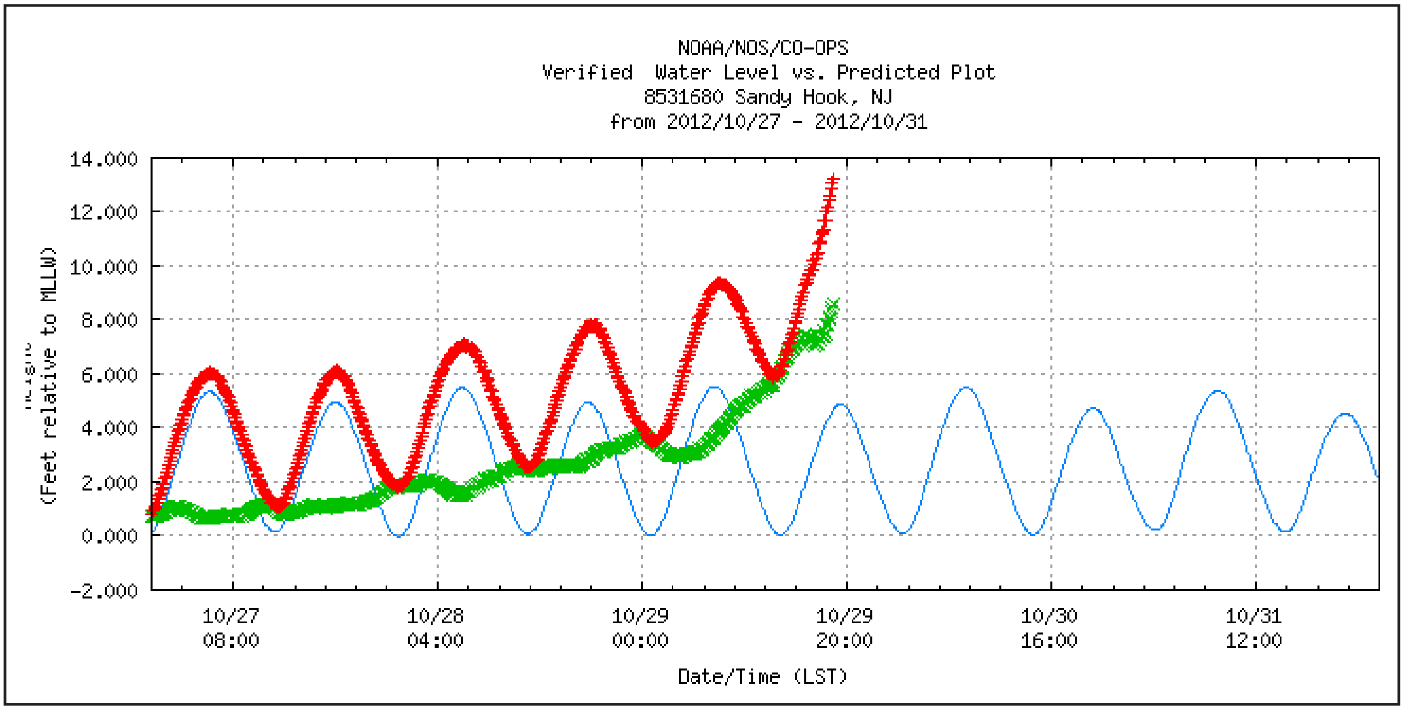

Figure 6. Water-level measurements at Sandy Hook, NJ, before it was damaged by Sandy.

Since the hydrographs related to the storm surges at upper reaches of the New York Harbor at the Battery and Bergen Point shown in Figs.7 and 8 are similar, the spatial variation is provided in Fig. 9. It indicates that the magnitudes of the storm surge at these two locations are indeed nearly the same.

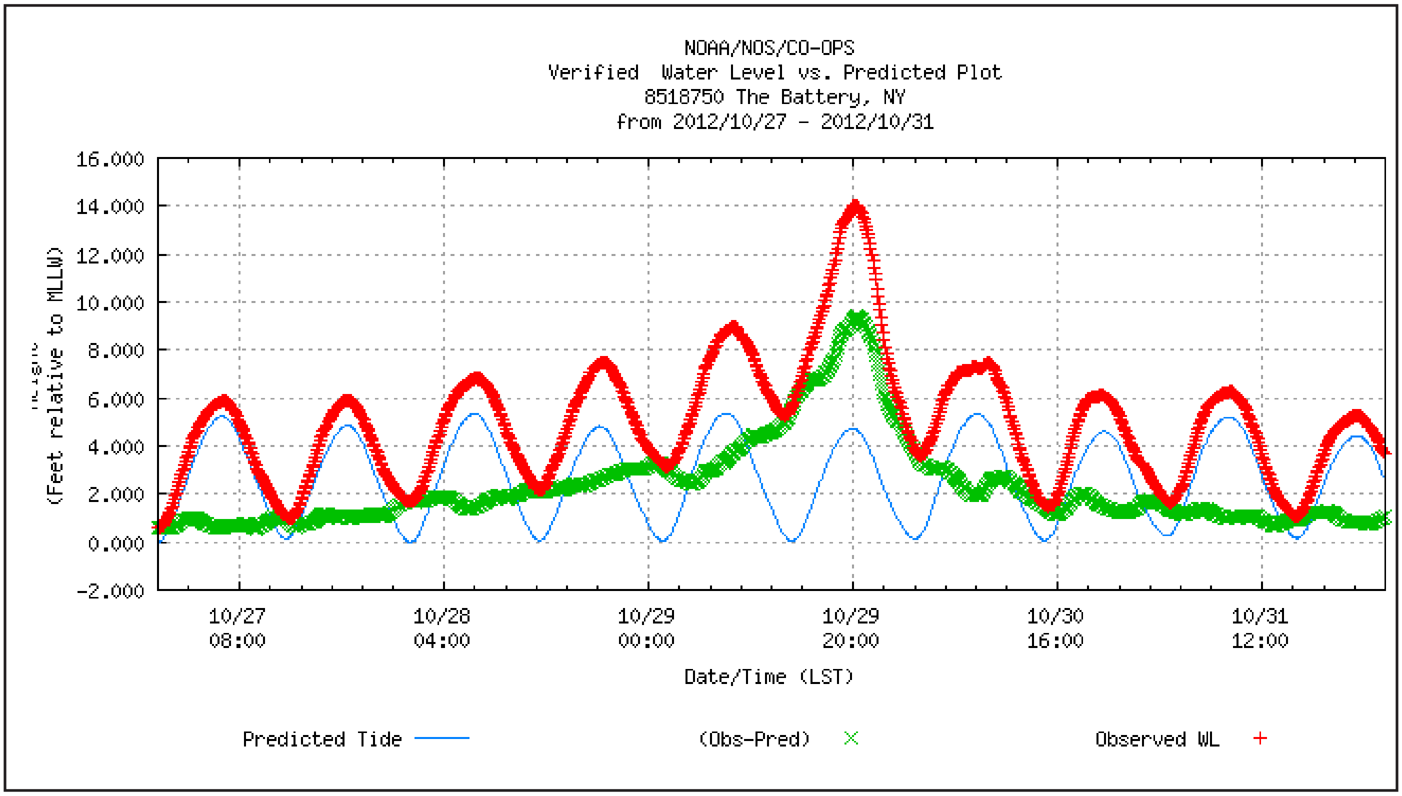

Figure 7. Water-level measurements at the Battery, NY during Sandy.

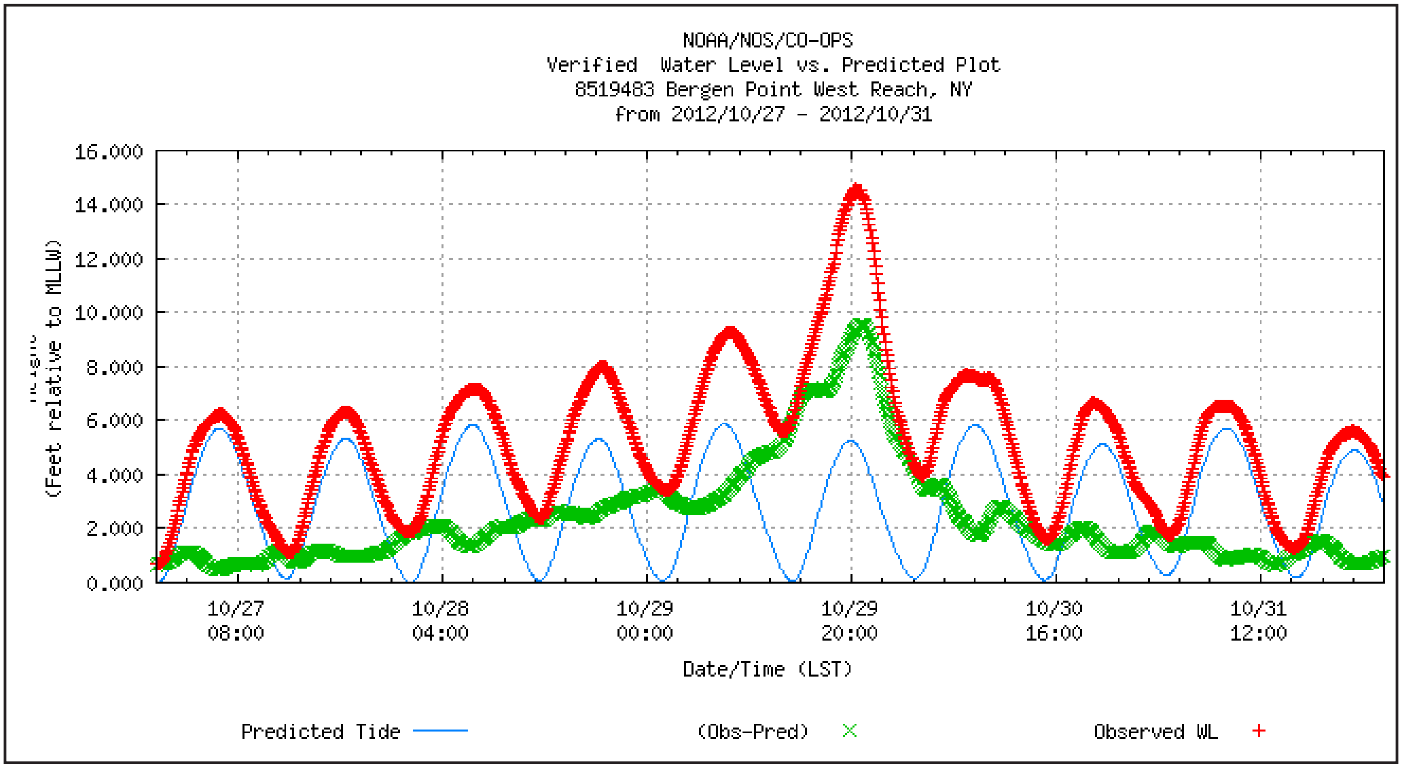

Figure 8. Water-level measurement at Bergen Point, NY during Sandy.

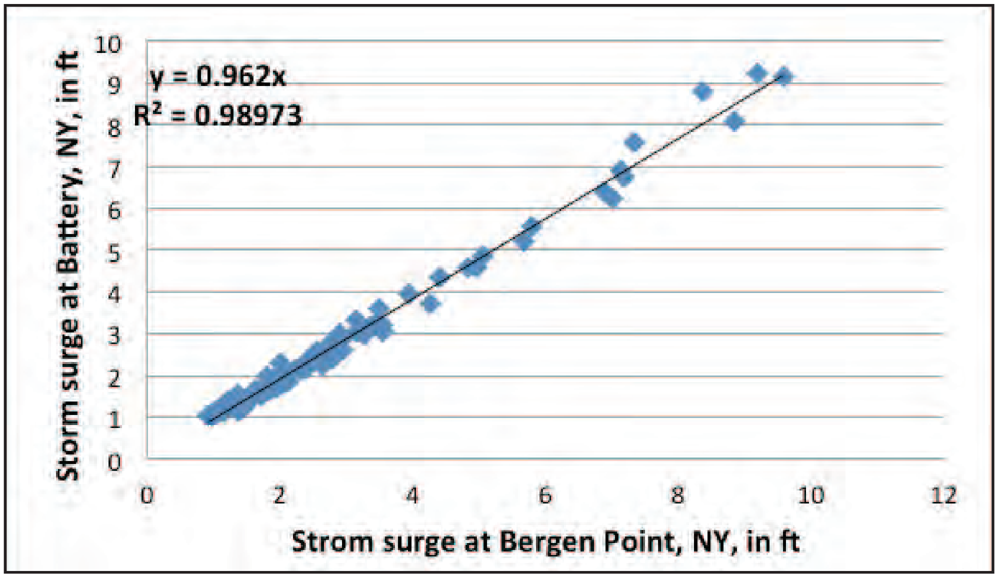

Figure 9. Relationship between storm surges at Bergen Point and the Battery.

5. Operational Formula for Storm Surge Estimates

On the basis of the applied physics of wind and wave interaction, Hsu (2004) has developed an operational formula to estimate the storm surge along the right-hand side of the hurricane track such that,

$S = A*Hs$ (1)

Where S is the storm surge and Hs is the significant wave height. Note that the units for S and Hs are the same. Note also that the dimensionless coefficient, A, is related to other factors such as normalized friction velocity and shoaling depth.

Eq. (1) has been verified during Hurricane Georges in 1998, which affected Mississippi Gulf coast that (see Hsu, 2004),

$S = 0.285\ Hs$ (2)

Fig.10 shows our results that during Hurricane Sandy, we have

$S = 0.253\ Hs$ (3)

With R^2 = 0.93

Or R = 0.96

Where R^2 is the coefficient of determination and R is the correlation coefficient.

Since R^2 = 0.93, this means that 93 % of the total variation in storm surge in New York Harbor can be explained by the wave forcing from offshore.

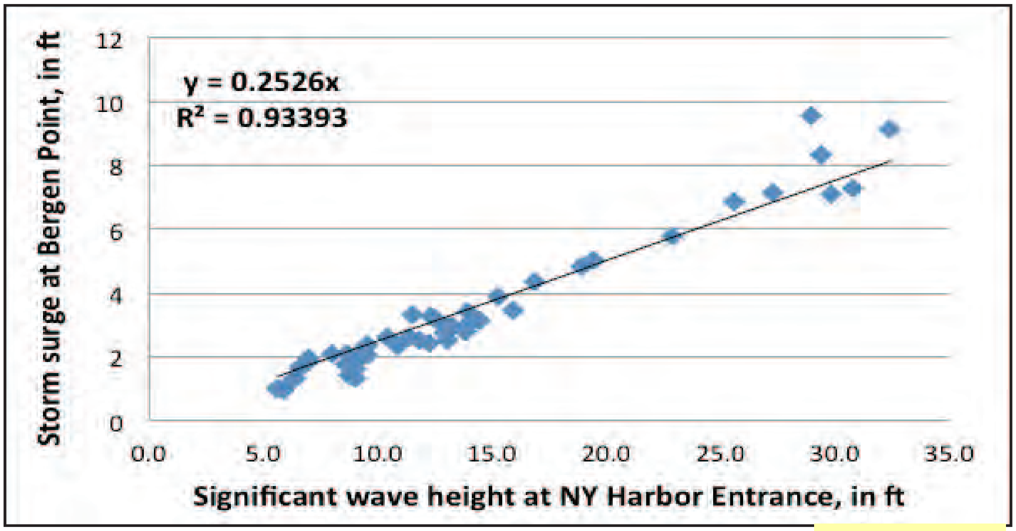

Figure 10. Relationship between storm surge at Bergen Point and significant wave height at NY Harbor Entrance (NDBC Buoy 44065) during Sandy.

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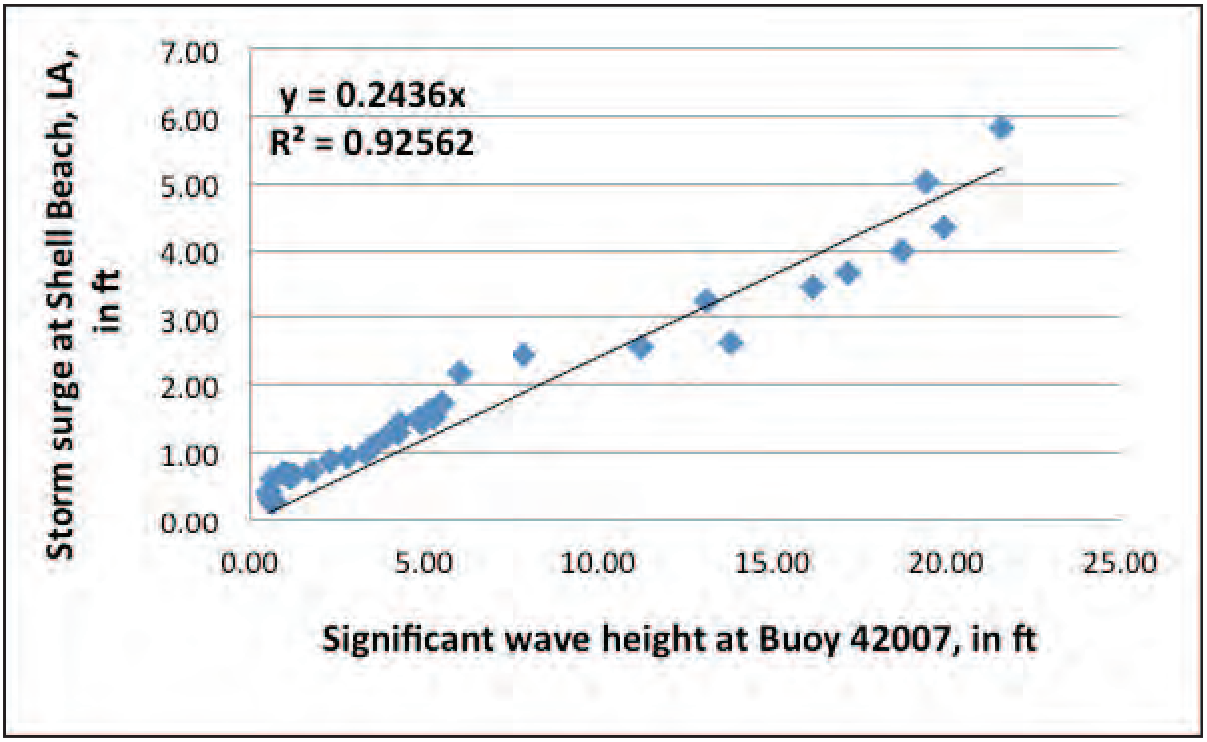

Figure 11. Relationship between storm surge at Shell Beach, LA and Buoy 42007 in the Gulf of Mexico during Hurricane Gustav in 2012 from 08/31/00UTC to 09/01/11UTC.

In order to further verify Eq. (1) a comparative study is provided in Fig. (11). During Hurricane Gustav in 2008, simultaneous measurements of storm surge at Shell Beach, LA (SHBL1) and significant wave height at NDBC Buoy 42007 in the Gulf of Mexico were available for the investigation. For storm track and station locations (see www.ndbc.noaa.gov). Figure (11) shows that

$$S = 0.244\ Hs \qquad (4)$$

With R^2 = 0.93

Or, R = 0.96

Again, since 93% of the total storm surge at Shell Beach, LA can be explained by the offshore wave forcing at Buoy 42007 and since the difference between Equations (3) and (4) is only 3.6%, Eq. (3) is recommended for operational use.

6. Conclusions

On the basis of aforementioned analysis, it is concluded that 93% of the total variation of the storm surge in New York Harbor during Hurricane Sandy in 2012 was caused by the funneling of offshore waves into Harbor. An operational formula, Equation (3), is recommended for practical application. This formula is also verified during Hurricane Gustav in 2008, which affected Louisiana and Mississippi Gulf Coast.

Acknowledgements

Many thanks go to NDBC and NOS for providing essential data needed for this study.

Reference

Hsu, S. A., 2004: A wind-wave interaction explanation for Jelesnianski's open-ocean storm surge estimation using Hurricane Georges' (1998) measurements. National Weather Digest, vol. 28, 25-31, December, 2004.

North American Ice Service Iceberg Information and Services

The North American Ice Service (NAIS), a partnership comprised of the International Ice Patrol (IIP), the Canadian Ice Service (CIS), and the U.S. National Ice Center (NIC), provides year-round maritime safety information on iceberg and sea ice conditions in the vicinity of the Grand Banks of Newfoundland and the east coast of Labrador, Canada. The daily NAIS Iceberg Limit, valid at 0000Z, along with the daily Sea Ice Limit, valid for 1100 EST the previous day, will be distributed as a NAVAREA IV warning in the format of a text Iceberg Bulletin and as a graphic Iceberg Chart in accordance with Table 1.

The purpose of the NAIS Iceberg Bulletin and Chart is to advise mariners of the estimated iceberg extent within the region. On the Chart, numbers within each grid sector inside the Iceberg Limit are intended to provide mariners an awareness of the relative density of icebergs. For more information on the Iceberg Bulletin and Iceberg Chart visit http://www.navcen.uscg.gov/iipCharts. NAIS reconnaissance is focused near the Grand Banks of Newfoundland and the east coast of Labrador, ice conditions south of Greenland are not monitored by NAIS. (For iceberg conditions south of Greenland visit the Danish Meteorological Institute’s website at http://www.dmi.dk/dmi/en/gronland/iskort.htm.) While NAIS strives to be as accurate as possible in reporting the presence of icebergs to mariners, it is not possible to ensure that all icebergs are detected and reported. There is no substitute for due vigilance and prudent seamanship, especially when operating near sea ice and icebergs.

Reports of icebergs in the North Atlantic originate from various sources, including passing ships, reconnaissance flights, and spaceborne reconnaissance. Once position, time, size, and shape of icebergs sighted are received, the data is entered into a computer model that predicts iceberg drift and deterioration. As the time after sighting increases, so does the uncertainty in estimated positions. This uncertainty is taken into account when the Iceberg Limit is determined.

If an iceberg or radar target is detected and reported outside the published NAIS Iceberg Limit, a Notice to Shipping (NOTSHIP) will be sent by the Canadian Coast Guard

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Marine Communications and Traffic Service (MCTS) and an urgent NAVAREA IV message will be distributed on SafetyNET via the U.S. National Geospatial-Intelligence Agency (NGA) as the NAVAREA IV Coordinator. These warnings will remain in effect for 24 hours. Iceberg products will be revised shortly after notification between 1200Z and 0000Z or by 1400Z if reported between 0000Z and 1200Z.

Ships are encouraged to immediately report sightings of icebergs or stationary radar targets that may likely be icebergs to the nearest Canadian Coast Guard MCTS Station or through INMARSAT using Service Code 42, as there is no charge when using this code. See Table 2 for MCTS contact information. Vessels participating in a Voluntary Observing Ship (VOS) program should continue to report weather and sea surface temperature (SST) to their respective programs. Vessels interested in providing weather and SST reports to U.S. National Oceanic and Atmospheric Administration's VOS program can contact vos@noaa.gov or visit www.vos.noaa.gov for guidance.

When making iceberg reports, please include **SHIP NAME** and **CALL SIGN**, **ZULU TIME**, **SHIP POSITION** (latitude, longitude), **COURSE**, **SPEED**, **VISIBILITY**, **ICEBERG/RADAR TARGETS POSITION** (Specify either the geographic coordinates or range/bearing from ship's position), **ZULU TIME OF SIGHTING**, **METHOD OF DETECTION** (Visual, Radar, or Both), **LENGTH** (in meters), **SHAPE OF ICEBERG** (See Table 3), and **VESSEL CONTACT INFORMATION.**

International Ice Patrol in New London, CT
Phone: (860) 271-2626
Toll free: (877) 423-7287
Fax: (860) 271-2773
Email: iipcomms@uscg.mil
Web: http//www.navcen.uscg.gov/IIP
Office hours: 1200Z – 0000Z

Canadian Ice Service in Ottawa, ON
Phone: (877) 789-7733
Fax: (560) 451-6010
Email: cis-scg.client@ec.gc.ca
Web: http//www.ice-glaces.ec.gc.ca
Office Hours: 0730 – 1730 EST

NORTH AMERICAN ICE SERVICE (NAIS) – ICEBERG BULLETIN INFORMATION SHEET

The North American Ice Service (NAIS), a partnership that includes the Canadian Ice Service (CIS), the International Ice Patrol (IIP), and the U.S. National Ice Center (NIC), distributes a joint iceberg bulletin to define the extent of the iceberg danger for the waters in the vicinity of the Grand Banks of Newfoundland and along the east coast of Labrador. The bulletin will be updated each day by 0000Z and when changing ice conditions require a revision. A brief description of the bulletin's features is provided below. For additional ice information or more information regarding products and services, please visit IIP at http://www.navcen.uscg.gov/iip or CIS at http://ice-glaces.ec.gc.ca. For iceberg conditions south of Greenland, visit the Danish Meteorological Institute at http://www.dmi.dk/dmi/en/gronland/iskort.htm.

NAIS Iceberg Bulletin is valid for 24 hours or until revised due to reports of icebergs outside limit.

Iceberg Limit identifies the estimated extent of the iceberg population based on recent reconnaissance and computer simulated iceberg drift. Drifted iceberg positions have an area of uncertainty that is fully encompassed by the Iceberg Limit.

Western Iceberg Limit identifies the western boundary of iceberg danger. Used only when the iceberg population extends south of the Strait of Belle Isle.

Stationary Radar Targets will not be used to establish the Iceberg Limit but still represent a potential hazard to the mariner. When a stationary radar target's estimated position is outside the Iceberg Limit, it's estimated position will be listed here.

Sea Ice Limit represents the estimated extent of at least 1/10 sea ice coverage and is valid for 1100 EST on the day prior to the date on the bulletin. More recent and detailed sea ice information is available from CIS.

Significant Expansion or Reduction will be noted when the Iceberg Limit changes by one degree (of latitude or longitude) or greater from the previous day's Iceberg Limit. The significant change will be noted here.

Ships are encouraged to immediately report sightings of icebergs or stationary radar targets that may likely be icebergs to the nearest Canadian Coast Guard MCTS Center or through INMARSAT using Service Code 42, as there is no charge when using this code.

If an iceberg is detected and reported outside the published NAIS Iceberg Limit, a Notice to Shipping (NOTSHIP) will be sent by the Canadian Coast Guard Marine Communications and Traffic Service (MCTS) and an urgent NAVAREA IV message will be distributed on SafetyNET by the U.S. National Geospatial-Intelligence Agency (NGA) as the NAVAREA IV Coordinator. These warnings will remain in effect for 24 hours. Iceberg products will be revised shortly after notification between 1200Z and 0000Z or by 1400Z the following day if reported between 0000Z and 1200Z.

NAIS reconnaissance is focused near the Grand Banks of Newfoundland and the east coast of Labrador. Ice conditions south of Greenland are not monitored by NAIS. Icebergs in this area are not included in this bulletin.

Revised 31JAN12

Daily Bulletin:

```
NAVAREA IV
NORTH AMERICAN ICE SERVICE (NAIS) ICEBERG BULLETIN
1. DDTTTTZ MMM ICEBERG LIMIT:
   XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
   XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
   XX-XXN XX-XXW, XX-XXN XX-XXW.
2. WESTERN ICEBERG LIMIT:
   XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW.
3. RADAR TARGETS OUTSIDE ICEBERG LIMIT:
   XX-XXN XX-XXW, XX-XXN XX-XXW.
4. SEA ICE LIMIT:
   A. XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
      XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
      XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW.
   B. XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
      XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
      XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW.
5. NOTE THE SIGNIFICANT (EXPANSION OR REDUCTION)
   OF THE ICEBERG LIMIT SINCE DD0000Z MMM
   BULLETIN DUE TO (RECENT ICE SIGHTING/RECENT
   RECONNAISSANCE/PREDICTED DETERIORATION).
6. REPORT POSITION AND TIME OF ANY ICEBERGS OR
   STATIONARY RADAR TARGETS THAT MAY LIKELY BE
   ICEBERGS TO THE NEAREST CANADIAN COAST GUARD
   MARINE COMMUNICATIONS AND TRAFFIC SERVICE STATION
   OR USING INMARSAT CODE 42.
7. CANCEL THIS MESSAGE DD0000Z MMM YY.
```

Revised Bulletin:

```
NAVAREA IV
REVISION-nn NORTH AMERICAN ICE SERVICE (NAIS) ICEBERG
BULLETIN
1. DDTTTTZ MMM ICEBERG LIMIT:
    XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
    XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
    XX-XXN XX-XXW, XX-XXN XX-XXW.
2. WESTERN ICEBERG LIMIT:
    XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW.
3. RADAR TARGETS OUTSIDE ICEBERG LIMIT:
    XX-XXN XX-XXW, XX-XXN XX-XXW.
4. SEA ICE LIMIT:
    A. XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
       XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
       XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW.
    B. XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
       XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW,
       XX-XXN XX-XXW, XX-XXN XX-XXW, XX-XXN XX-XXW.
5. NOTE THE SIGNIFICANT (EXPANSION OR REDUCTION)
    OF THE ICEBERG LIMIT SINCE DD0000Z MMM
    BULLETIN DUE TO (RECENT ICE SIGHTING/RECENT
    RECONNAISSANCE/PREDICTED DETERIORATION).
6. REPORT POSITION AND TIME OF ANY ICEBERGS SEA
    ICE OR STATIONARY RADAR TARGETS THAT MAY LIKELY
    BE ICE TO THE NEAREST CANADIAN COAST GUARD MARINE
    COMMUNICATIONS AND TRAFFIC SERVICE STATION OR
    USING INMARSAT CODE 42.
7. CANCEL NAVAREA IV nnn/YY.
8. CANCEL THIS MESSAGE DD0000Z MMM YY.
```

NORTH AMERICAN ICE SERVICE (NAIS) – ICEBERG CHART INFORMATION SHEET

The North American Ice Service (NAIS), a partnership that includes the International Ice Patrol (IIP), the National Ice Center (NIC) and the Canadian Ice Service (CIS), distributes a joint iceberg chart to define the extent of the iceberg danger for the waters in the vicinity of the Grand Banks of Newfoundland and along the East Coast of Labrador. The chart will be updated each day by 0000 UTC and when changing ice conditions require a revision. A brief description of the chart's features is provided below. For additional ice information or more information regarding products and services, please visit IIP at http://www.navcen.uscg.gov/iip or CIS at http://ice-glaces.ec.gc.ca. For iceberg conditions south of Greenland, visit the Danish Meteorological Institute at http://www.dmi.dk/dmi/en/gronland/iskort.htm.

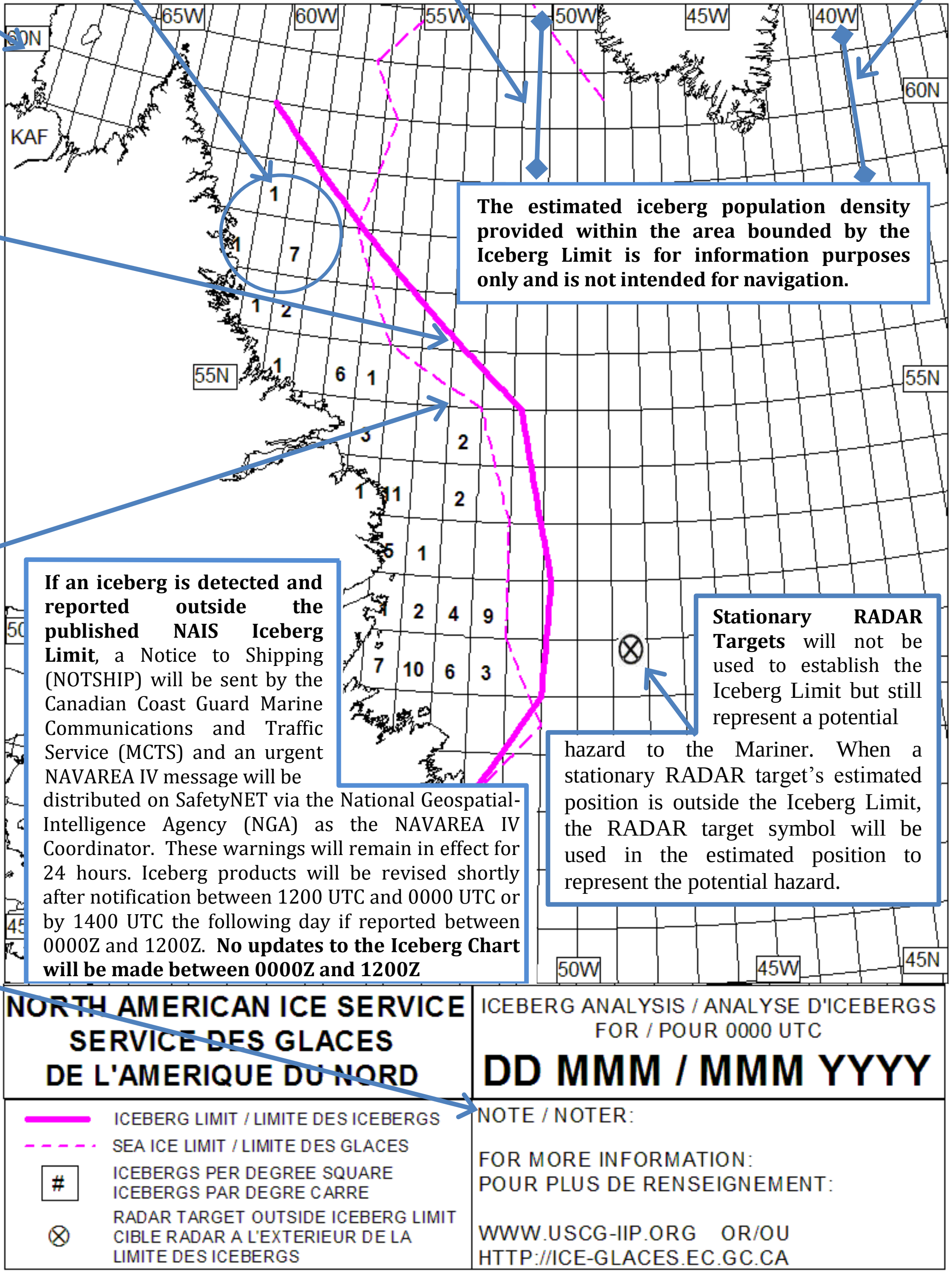
Numbers on the chart represent the total number of icebergs including; growlers, bergy bits, and radar targets, whose estimated position is within the respective area bounded by one degree of latitude and one degree of longitude.

NAIS reconnaissance is focused near the Grand Banks of Newfoundland and the east coast of Labrador. Ice conditions south of Greenland are not monitored by NAIS. Icebergs in this area are not included in this bulletin.

These letters are for NAIS internal use only

Iceberg Limit is denoted by the solid line and represents the estimated extent of iceberg population based on recent reconnaissance and computer simulated iceberg drift.

Drifted iceberg positions have an area of uncertainty that is fully encompassed by the Iceberg Limit.



The estimated iceberg population density provided within the area bounded by the Iceberg Limit is for information purposes only and is not intended for navigation.

Sea Ice Limit is denoted by the dashed line and represents the estimated extent of at least 1/10 sea ice coverage. The Sea Ice Limit is valid for 1100 EST on the day prior to the date on the chart. More recent and detailed sea ice info is available from CIS.

If an iceberg is detected and reported outside the published NAIS Iceberg Limit, a Notice to Shipping (NOTSHIP) will be sent by the Canadian Coast Guard Marine Communications and Traffic Service (MCTS) and an urgent NAVAREA IV message will be distributed on SafetyNET via the National Geospatial-Intelligence Agency (NGA) as the NAVAREA IV Coordinator. These warnings will remain in effect for 24 hours. Iceberg products will be revised shortly after notification between 1200 UTC and 0000 UTC or by 1400 UTC the following day if reported between 0000Z and 1200Z. **No updates to the Iceberg Chart will be made between 0000Z and 1200Z**

Stationary RADAR Targets will not be used to establish the Iceberg Limit but still represent a potential hazard to the Mariner. When a stationary RADAR target's estimated position is outside the Iceberg Limit, the RADAR target symbol will be used in the estimated position to represent the potential hazard.

The **NOTE / NOTER** block will be used to indicate if a special situation applies to the chart. Examples include a chart revision (when information is received that affects the accuracy of the chart), a significant (defined as at least one degree of change from the previous Iceberg Limit) expansion or a significant reduction of the Iceberg Limit.

Revised 19JAN12

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SHIPWRECK: Meaford

By Skip Gillham

MEAFORD inbound for the Welland Canal at Port Colborne, Ontario, in 1967 – Skip Gillham

This fall marks the 100th Anniversary of "The Great Storm" that swept through the Great Lakes region in November 1913. The solitary ship to survive down bound passage on Lake Huron during the three days of wild weather was the J.H. SHEADLE. All others disappeared or stranded. Not only did J.H. SHEADLE survive the storm, it carried on for another 66 years, under several different names, until a grounding spelled the end of active service in 1979.

The storm, which developed in the Midwest, swept through the Great Lakes region on November 7 – 10, 1913. It was the prolonged high winds that whipped the lakes into a fury and resulted in the loss of so many ships. Twelve vessels were lost with all hands and a total of close to 250 sailors died. Other lakers came ashore and were badly damaged.

Captain S.A. Lyon of the J.H. SHEADLE had loaded a cargo of grain at Fort William, Ontario, and departed on November 6. After going to anchor in Whitefish bay, due to fog, the vessel went through the Soo Locks on November 8. The ship ahead was the JAMES CARRUTHERS and the one behind was the HYDRUS. Both disappeared with all hands on Lake Huron. Only a miracle saved the J.H. SHEADLE as it took on water through broken windows and the skylight above the engine room.

Out on the lake, Capt. Lyon battled a blizzard, mountainous waves and, at time, zero visibility. When his soundings led him to believe they were near the southern end of Lake Huron and the St. Clair River, he was able to get his ship turned around, through the deadly trough, and head back up the lake and into the storm. The ship, the engine and the steering gear all held during the ordeal and when conditions calmed down, the vessel was able to reach safety.

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The 552 foot long by 56.2 foot wide J.H. SHEADLE was built by the Great Lakes Engineering Works and launched at Ecorse, Michigan, in September 29, 1906. It entered service in October and was part of the Cleveland-Cliffs fleet.

The steering gear failed while backing from the ore dock at Marquette, Michigan, on November 20, 1920, and the ship was run on the rocks by the current. The rudder was lost, the ship's hull was punctured and it settled on the bottom. While refloated on November 29, it spent the winter at Marquette and had wait until spring to receive the much needed repairs.

Cliffs sold the vessel to the Forest City Steamship Co. in 1925 and it was renamed F.A. BAILEY. A grounding in the Detroit River on November 13, 1925, due to low water levels, required some grain to be lightered before the ship could float free. It was taken to Buffalo for repairs.

In 1930, this ship was repossessed by Cleveland-Cliffs and returned to work in their colors as LASALLE. It made the news as the first ship of the season into Buffalo on March 24, 1937, arriving with a cargo of coal. But an additional grounding, this on a reef outside Port Arthur, Ontario, on November 11, 1940, required another visit to a shipyard for repairs.

The original triple expansion engine generated 1665 horsepower and it was replaced in 1951 with a 3,300 horsepower DeLaval steam turbine engine that improved speed and efficiency. Two new water tube boilers were installed instead of the original scotch boilers.

LASALLE was idle in 1962-1963 and then joined Upper Lakes Shipping, a Toronto, Ontario, based company, in 1966. While unloading its first cargo at Toronto in April, the name was changed to MEAFORD. It operated in the ore, grain and coal trades for the company and expanded its service east to take advantage of the St. Lawrence Seaway system that had opened in 1959.

MEAFORD operated for U.L.S. to the end of 1978 and when it finally fitted out in August 1979, the vessel was part of the Soo River Company and sailed under the name of PIERSON INDEPENDENT. Unfortunately, the service was brief. The ship was carrying corn from Toledo for the St. Lawrence when it hit bottom on the St. Lawrence near Brockville on October 28, 1979, and had to be beached. Temporary repairs allowed the ship to be refloated and carry on to Trois Rivieres to unload. A subsequent inspection at Port Weller Dry Docks in St. Catharines showed the ship to be a total loss.

PIERSON INDEPENDENT up bound in the Welland Canal in 1979 – Skip Gillham

After a tow to Hamilton, the PIERSON INDEPENDENT was laid up pending a sale for scrap. The hull was purchased by Spanish shipbreakers for dismantling overseas. Renamed COMPANY for the transatlantic tow, the ship arrived at Santander, Spain, on June 11, 1980, for recycling.

Some of the ships lost in the violent storm of a century ago have been found on the bottom of Lake Huron. But others are still missing and have eluded shipwreck hunters and their sophisticated equipment. In time, I suspect they will all be located but while they were cheated out of a long and successful sailing career, they are not forgotten.

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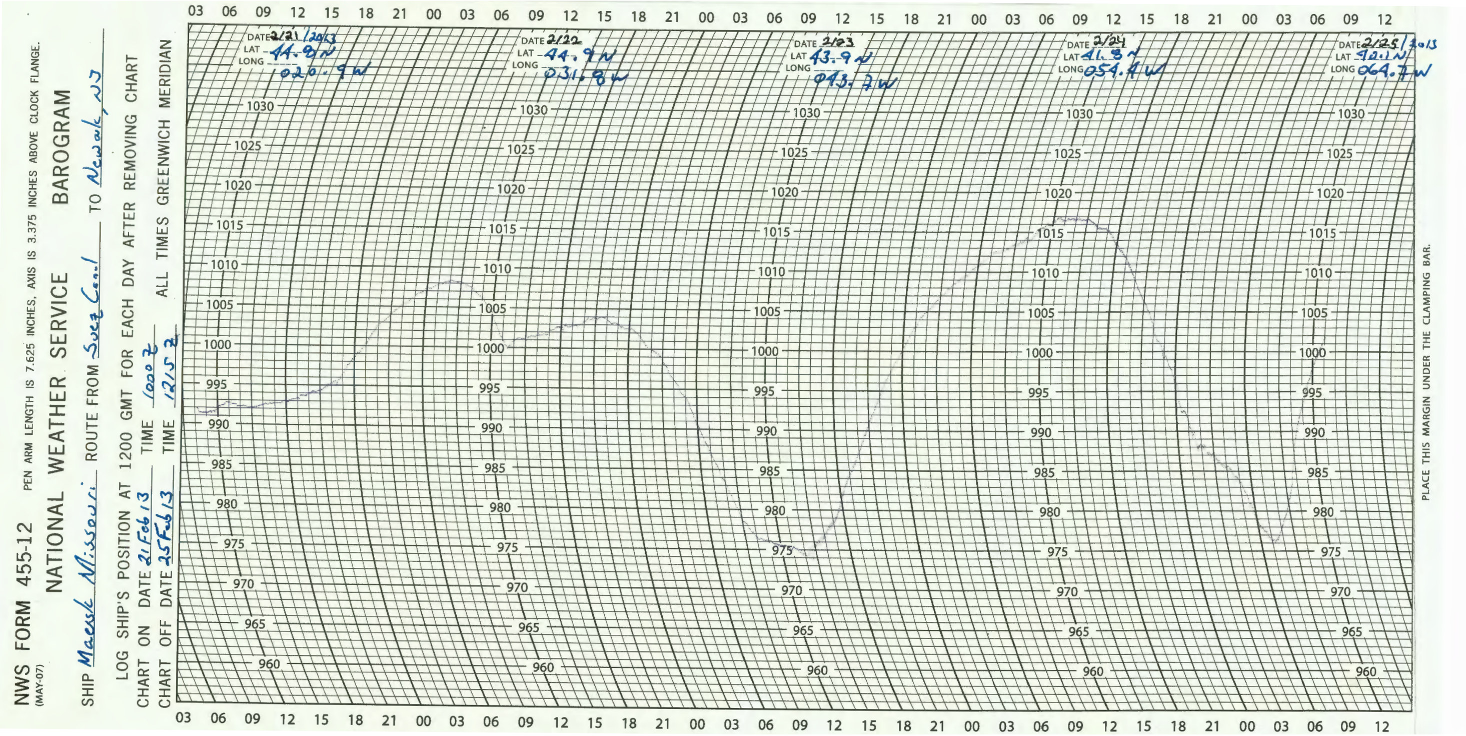
MAERSK MISSOURI…
a picture is worth a thousand words…

By Paula Rychtar

An interesting barogram was sent in from the Maersk Missouri in route from the Suez Canal to Newark NJ. PMO Jim Luciani said that the Chief Mate on this run logged that the anemometer topped out at 110 knot relative (as high as it would read, topping out!). So a very windy winter in the North Atlantic.

Thanks to Jim and the crew of the Maersk Missouri for sending this in!



NWS FORM 455-12 (MAY-07)
PEN ARM LENGTH IS 7.625 INCHES, AXIS IS 3.375 INCHES ABOVE CLOCK FLANGE.
NATIONAL WEATHER SERVICE BAROGRAM
SHIP Maersk Missouri ROUTE FROM Suez Canal TO Newark, NJ
LOG SHIP'S POSITION AT 1200 GMT FOR EACH DAY AFTER REMOVING CHART
CHART ON DATE 21Feb13 TIME 1000Z
CHART OFF DATE 25Feb13 TIME 1215Z
ALL TIMES GREENWICH MERIDIAN

DATE 2/21/2013
LAT 44.9N
LONG 020.9W

DATE 2/22
LAT 44.9N
LONG 031.8W

DATE 2/23
LAT 43.9N
LONG 043.7W

DATE 2/24
LAT 41.8N
LONG 054.4W

DATE 2/25/2013
LAT 42.1N
LONG 064.7W

A Tribute to a Dear Friend and Colleague: Julie Fletcher

I suppose I could go on and on about Julie and all her accomplishments work related. That her dedication to the VOS program was steadfast and her commitment to data quality was unwavering. Julie had such a strong posture in regards to her complete dedication in any and all of her tasks and always ready to assist and provide good advice towards that goal. Julie Fletcher was the manager of Marine Operations for the Meteorological Service of New Zealand. She was a dedicated leader and wore many hats being intricately involved in the many programs collecting valuable marine and atmospheric data. Those of us who knew Julie through work, knew that she was 100% dedicated to her cause… which was basically…improving the many ways of collecting data, making sure that data was reliable and accurate, providing avenues and opportunity for others who were new to the world of data collection and most of all being patient to those who took a little time "getting up to speed".

Julie Fletcher
1959 - 2013

As much as I would like to list all the very many positions that Julie held, I choose to celebrate something else, her role in life. From what I could tell from my all too short friendship with Julie and how she choose to spend the last little bit of time she had on this fine earth… she really valued the beauty of the world around her. She decided to surround herself with those things she valued the most, her partner, her beautiful roses and flowers that she took such great care tending too, her dear friends and family. Like everything else, she choose quality over quantity…what else can you say about that? That is how Julie lived her entire life. All of us who knew her will miss her. I still think about emailing her from time to time and have to close my door and regroup.

"The Dash"

The "dash" represents the time that Julie spent alive here on earth. And now only those who loved her know what that little dash is worth. For it matters not how much we own, the cars, the house, the cash. What matters is how we live and love and how we spend our "dash". So think about this long and hard, are there things you'd like to change? For you never know the time that's left, there's time to re-arrange. If we could just slow down enough to consider what's true and real. And always try to understand the way other people feel. And be less quick to anger and show appreciation more, and love the people in our lives like we've never loved before. If we treat each other with respect and more often wear a smile, remembering that this special "dash" might only last a while. So when your eulogy is read with your life's actions to rehash. Would you be pleased with the things they say about how you spent your "dash"?

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Mean Circulation Highlights and Climate Anomalies

September through December 2012

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

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

September-October 2012

September 500 hPa heights were above average over portions of western North America, the central North Atlantic, southeastern Europe, central Siberia, and the high latitudes of the western North Pacific. Below average heights were observed over the Bering Sea, Alaska, the Great Lakes region, and the high latitudes of the eastern North Atlantic (Figure 1). The sea level pressure (SLP) pattern mirrored the 500 hPa pattern (Figure 2).

Figure 1

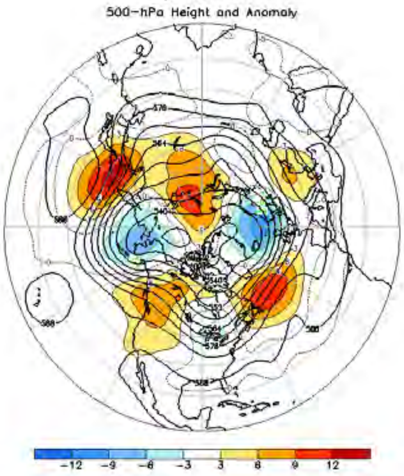
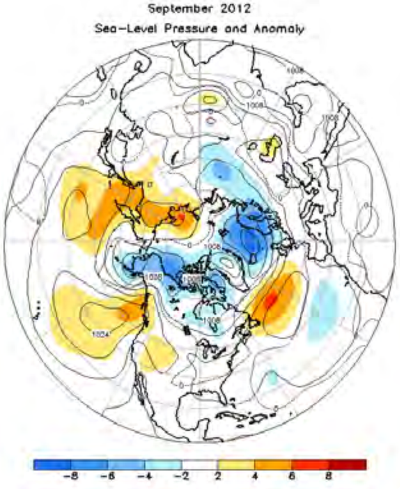

September 2012
500-hPa Height and Anomaly

Figure 2


September 2012
Sea-Level Pressure and Anomaly

October 500 hPa heights were above average over the polar region and below average over the middle latitudes (Figure 3). The SLP pattern largely mirrored the 500 hPa pattern (Figure 4). The above average heights across the high latitudes of both the North Pacific and North Atlantic Oceans indicates a disappearance of both the Aleutian and Icelandic Lows during this period.

Figure 3

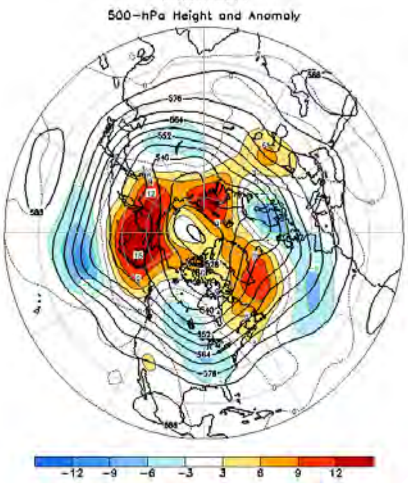
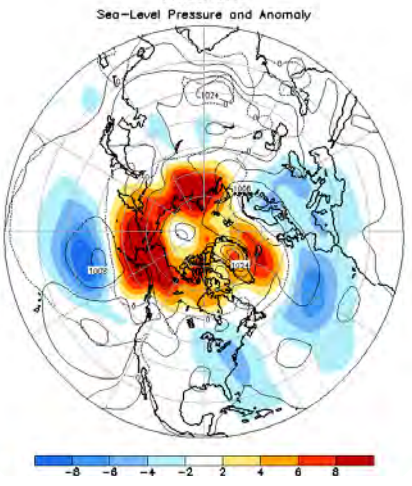

October 2012
500-hPa Height and Anomaly

Figure 4


October 2012
Sea-Level Pressure and Anomaly

The 2012 Atlantic Hurricane Season was unusually active (Reference 1), and will be remembered for many years to come by residents across the Northeast and Mid-Atlantic States. The most damaging hurricane of the season, Sandy, was in the process of transitioning to an extra tropical system off the East Coast in late October, when it came onshore in southern New Jersey (Reference 2). The most devastating impacts from Sandy included storm surge flooding and hurricane force wind gusts across western Long Island, the Rockaway's in southern Queens,

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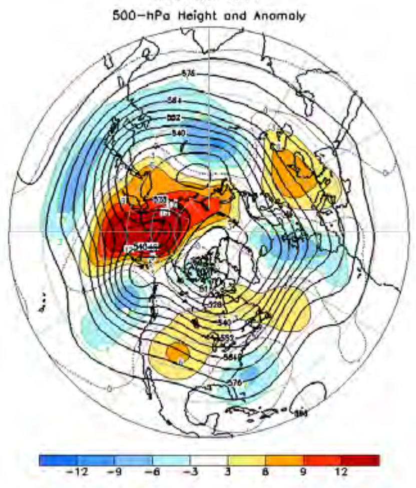
Staten Island, the New York City subway system, and Seaside Heights, NJ. In this last area, Seaside Heights, an iconic roller coaster from an amusement pier was dragged out into the nearby surf, where it remains partially submerged (Reference 3).

The Tropics

Slightly warmer than average sea surface temperatures (SST) were observed across the central and east central equatorial Pacific. The latest monthly Nino index values for the Nino 3.4 region were +0.5C (Sep) and +0.3C (Oct). The depth of the oceanic thermocline (measured by the depth of the 20C isotherm) remained near to slightly above average in the east central equatorial Pacific. Equatorial low level easterly trade winds remained close to long term averages across the east central and western equatorial Pacific. Enhanced convection was seen across the western equatorial Pacific and near the Date Line. Collectively, these oceanic and atmospheric anomalies reflect borderline ENSO-neutral/weak El Nino conditions.

November-December 2012

Figure 5



The 500-hPa circulation pattern during November 2012 featured below-average heights over the Gulf of Alaska, the southeastern US, the eastern North Atlantic, central Asia, and the western North Pacific. Above-average heights were observed over the high latitudes of the North Pacific Ocean, the west-central contiguous United States, and southwestern Russia (Figure 5). The sea-level pressure and anomaly map (Figure 6) mirrored the height anomaly pattern fairly well.

The month of December was characterized by above average heights near the Aleutian Islands, eastern Canada, Greenland, and Scandinavia. Below average heights were observed over western North America, across the east central North Atlantic and Europe, and over the middle latitudes of central and eastern Asia (Figure 7). The SLP and anomaly field (Figure 8) largely mirrored the middle tropospheric circulation pattern.

Figure 6

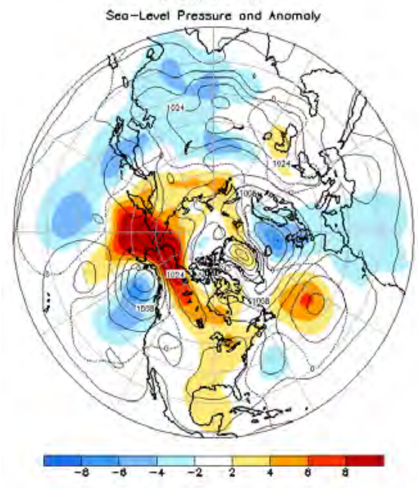


Figure 7

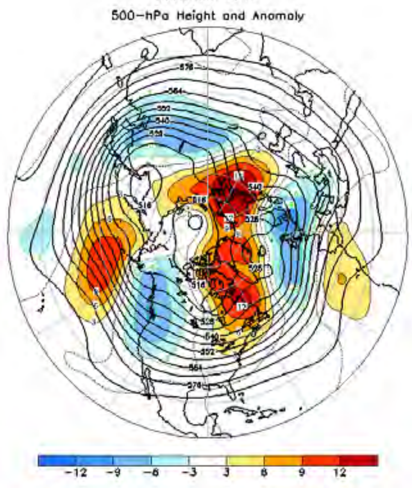
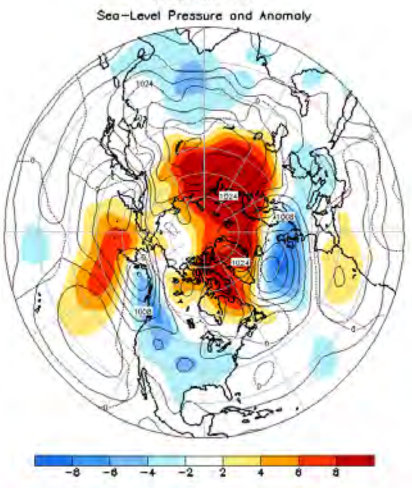


Figure 8



An early season nor'easter (November 7-8) brought wind, snow, rain, and storm surge to the Northeast states on the heels of Hurricane Sandy (Reference 4). Some inland areas received over 30cm of snow and more than twenty snowfall records were set, in some cases for the first time, at sites from Maryland up to Maine. For instance, Kennedy Airport in New York City reported nearly 11cm of snow, which was unusually early in the season for significant snowfall. High winds, with gusts to 50kt, downed already vulnerable trees and power lines.

According to the National Climatic Data Center (NCDC), arctic sea ice extent was 12.2 percent below the 1979-2000 average in November, and 8.7 percent below average in December. Antarctic sea ice extent was 2.4 percent above the 1979-2000 average in November, and 1.5 percent above average in December (Reference 5).

The Tropics

During November and December 2012, SSTs remained near to slightly above average across the central and east central equatorial Pacific, and colder than average over the far eastern equatorial Pacific. The latest monthly Nino indices for the Nino 3.4 region was +0.4C (November) and -0.1C (December). The depth of the oceanic thermocline remained near to slightly above average across the central and east central equatorial Pacific. Equatorial low level easterly trade winds remained slightly enhanced over the west central equatorial Pacific and near average across the east central equatorial Pacific. Enhanced thunderstorm activity and deep convective cloudiness was seen over the western equatorial Pacific in November. During December, convection was suppressed over the western and central equatorial Pacific. Collectively, these oceanic and atmospheric anomalies reflect ENSO-neutral conditions.

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http://www.ncdc.noaa.gov/sotc/national/2012/11

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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)

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.

Tropical Atlantic and Tropical East Pacific Areas

September through December 2012

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

Table 1 below shows the non-tropical warning events that occurred across the Tropical Atlantic, Gulf of Mexico, and Caribbean during the period September through December 2012.

Table 1. Non-tropical Warnings issued for the Atlantic Basin between 01 Sept 2012 and 31 Dec 2012.

Onset	Region	Peak Wind Speed	Duration	Forcing
1800 UTC 27 Oct	Gulf of Mexico	35 kts	12 hr	Cold front
0000 UTC 02 Dec	Central Atlc	35 kts	36 hr	Low pressure
0000 UTC 06 Dec	Central Atlc	50 kts	12 hr	Low pressure and cold front
1500 UTC 10 Dec	Gulf of Mexico	35 kts	15 hr	Cold front
1800 UTC 19 Dec	SW N Atlc	35 kts	48 hr	Cold front
1200 UTC 20 Dec	Gulf of Mexico	40 kts	30 hr	Cold front
0600 UTC 21 Dec	SW N Atlc and Central Altc	35 kts	24 hr	Cold front
1800 UTC 26 Dec	SW N Atlc	35 kts	09 hr	Cold front
0000 UTC 31 Dec	SW N Atlc and Central Altc	40 kts	24 hr	Cold front

Atlantic Highlights

The Atlantic Basin was very active with tropical cyclones during August of 2012, with three systems persisting into the first week of September (Isaac, Kirk, and Leslie). However Atlantic tropical cyclone activity became considerably less frequent during September, the peak month of the Atlantic hurricane season, with only two tropical cyclones developing during the month, major Hurricane Michael, and Hurricane Nadine, a long lived system. http://www.nhc.noaa.gov/2012atlan.shtml A middle to upper level trough prevailed across the eastern U.S. and Great Lakes region throughout much of the month of September, which limited intrusion of frontal systems deep into the Gulf of Mexico or into the tropical North Atlantic. Although the first cold front of the season entered the Gulf of Mexico on 9 Sept, no non-tropical warning events occurred across the TAFB Area of Responsibility (AOR) during the month. In fact, the first gale event of the season did not occur until 27 October.

27 October Gulf of Mexico Gale

The first gale warning of the season was issued for the western Gulf of Mexico at 1800 UTC 27 Oct. While most weather observers were focused on Hurricane Sandy moving northeastward out of the Caribbean and across the SW N Atlantic, a deep layered trough moved across the western then central U.S. and dragged a slow moving cold front that had been drifting across northwest Gulf quickly southeastward, stalling from the Florida Big Bend to the western Bay of Campeche by late afternoon on 27 Oct. A cold and reinforcing surge of northerly winds behind the front resulted in gales west of 95W and between 22N and 26N from 1800 UTC 27 Oct through 0600 UTC 28 Oct., before the upper trough shifted eastward and began to interact with Sandy. Strong northerly gales were reported from the early morning throughout the afternoon hours of 27 Oct by Shell Oil platform **Perdido Host** (42390), located across the Texas coastal waters. However, it wasn't until early afternoon that scatterometer passes showed a broad area of 30-35 kt surface winds that a gale warning was issued at 1800 UTC.

Brief comments on Hurricane Sandy

A very comprehensive summary of Sandy can be found at: http://www.nhc.noaa.gov/data/tcr/AL172012_Sandy.pdf During Sandy's passage across the western Atlantic, and prior to landfall and historic flooding across New Jersey and New York, Sandy generated an enormous area of high seas 20 ft and greater that are rarely seen with Atlantic hurricanes. The interaction of Sandy with an upper level low to its west, from 25 Oct through 27 Oct, led to an expansion of the wind field of Sandy, a hybrid thermodynamic structure, and created a wind and wave distribution surrounding Sandy that was extremely atypical of Atlantic hurricanes.

Wave growth theory indicates that waves are more efficiently created when wind and waves are moving in the same direction. Thus, for the Atlantic Basin, maximum wave heights are usually found in the right hand semicircle of tropical cyclones, relative to storm motion. This typically places maximum seas of an Atlantic tropical cyclone in the east or northeast semicircle, and relatively near the center within the zone maximum winds. However, this was not the case as Sandy moved across the SW North Atlantic. **Figure 1** below shows a screen capture of data used in real time by TAFB forecasters to evaluate sea state on 28 Oct. The 0655 UTC GOES-E IR satellite image is overlain with NOAA WWIII SWH contours every 3 ft. in white. Also shown, are Jason-1/-2 altimeter data, extending in a narrow path from northeast to southwest, displaying SWH in feet, as well as buoy observations of wave heights, in yellow numerals. Despite the fact that Sandy was only a category one hurricane moving in a northeast direction near 12 kt, maximum seas were not located on the right or eastern side, but instead wrapped around the west and south semicircles and well removed from the center. A 1200 UTC sea state analysis, not shown, revealed that the 30 ft. contour was well removed from the center of Sandy and wrapped from the northwest quadrant, off the North Carolina coast, cyclonically around the south semicircle to almost due east of the center. Maximum seas of 38 ft. were found within this band across the southeast quadrant, while seas to 34 ft were analyzed across the northwest quadrant, and were likely much higher in the Gulf Stream. Sandy proved to be a tremendous wave maker, and not only produced this enormous area of very high seas, but also affected the entire east coast of North America, the Bahamas, and the Atlantic coasts of the Caribbean Islands for several days with very large surf, coastal flooding, and beach erosion. Sandy will long be remembered throughout the entire region as an historic storm. The unusual

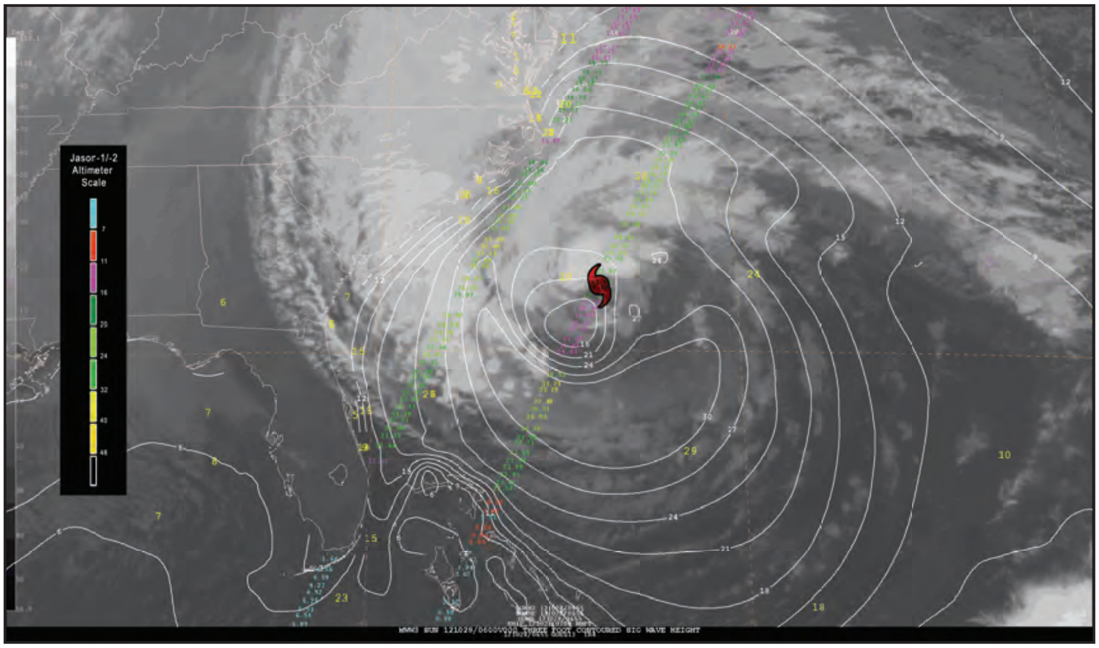

Figure 1. GOES-E 0655 UTC IR images, showing Category 1 Hurricane Sandy. NOAA WWIII SWH forecast valid 0600 UTC overlaid, in white (every 3 feet). 0600 UTC ship and NDBC buoy observations of wave heights indicated in yellow numerals (in feet). 0655 UTC Jason-1/-2 altimeter data in bright colors (in feet). Note 30 ft SWH contour extending from west through south semicircles, and NDBC buoy 41047 reporting 29 ft nearly 300 nm to southeast of center of Sandy.

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structure and resultant wind and wave fields should also serve as an example to all mariners that all hurricanes are not created equal.

2 December Atlantic Gale

In the wake of Hurricane Sandy, marine conditions across the TAFB AOR were considerably less energetic, with no non-tropical warnings issued during the entire month of November. A trough-ridge-trough upper level pattern prevailed across the Atlantic throughout November, with middle to upper level troughs extending into tropical waters between 10N and 20N on both sides of the Atlantic. A split upper jet flow pattern became established from the eastern U.S. seaboard into the western Atlantic during the last several days of the month, with the southern stream flow eventually reenergizing the eastern Atlantic upper trough 30 Nov through 2 Dec. This led to two warning events across northeast portions of the AOR in early December.

On 1 and 2 Dec, a southern stream jet max moved through the base of the eastern Atlantic trough centered between 20W and 40W, and generated a deep layered cyclone that resulted in a surface low. A lower tropospheric weakness, or inverted trough, that had persisted across this area for several days between 40W and 55W provided the genesis region for the surface cyclogenisis. By late morning of 1 Dec, satellite imagery and scatterometer data indicated that a 1009 hPa surface low had developed near 26.5N42W. A broad zone of fresh to strong south to southeast winds occurring east of the low level trough axis in the previous days was initiating numerous convection across this region, and combined with warm ocean waters to provide a moist and unstable environment for this surface low to strengthen. As the low deepened and become better organized late on 1 Dec, it began to drift north within the middle level trough. Freshening winds across the north and northeast semicircles of this low strengthened quickly during this time, and a gale warning was issued for the north semicircle by 0000 UTC 2 Dec, which had been indicated by global model guidance for several days. A 0012 UTC 2 Dec ASCAT pass, followed by a 0232 UTC OSCAT pass both revealed minimal gale force winds across the north semicircle of the low. **Figure 2** shows successive OSCAT passes across the area on 2 Dec, and reveals strong winds across the north semicircle during the overnight hours wrapping cyclonically around the western quadrant by the second 1433 UTC pass. The low continued to shift NNE and out of the area with gales ending by 1200 UTC 3 Dec.

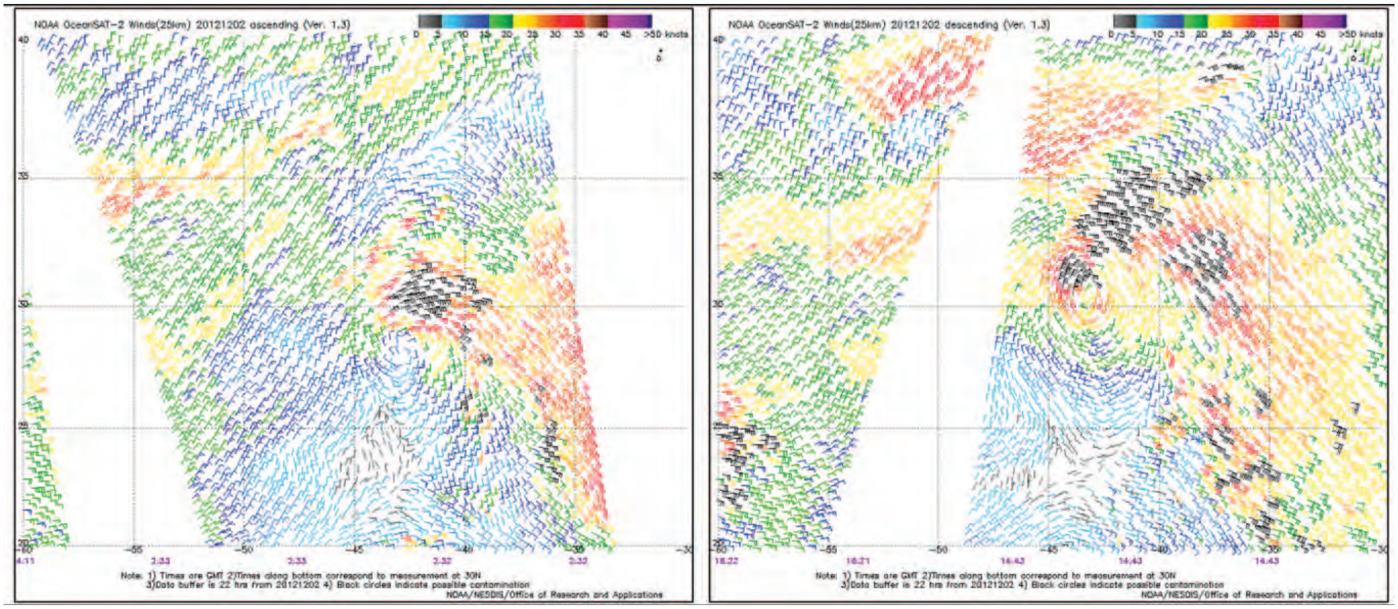

Figure 2. NESDIS OSCAT winds from 2 Dec across region of gale center, with 0233 UTC pass on left, and 1433 UTC pass on right. Note area of 20-30 kt winds across north semicircle on left nearly encircling the low center at right, confirming deepening of low center and improved organization.

6 December Atlantic Storm

This 2 Dec gale center gradually lifted N-NE into the north Atlantic 3 Dec through 5 Dec and intensified to a deep 984 hPa storm system, and briefly produced hurricane force winds. A frontal zone and low level trough remained across this original genesis area, extending through 31N49W to 18N51W by the morning of 5 Dec. The overall middle to upper level synoptic pattern remained unchanged from previous days, and a second speed maximum in the southern stream jet moved through the base of the lingering middle level trough, and generated a 1011 hPa surface low near 28N45W by 1200 UTC 5 Dec. Deterministic computer model guidance had suggested for several days leading up to the onset of the event that gale force winds would occur in both the northeast and northwest quadrants of the low. However, probabilistic model guidance suggested only a minimal chance (<=20%) of gales occurring in the cold air in the northwest quadrant of this low, and also well removed from the low center, in the warm southerly flow across the eastern semicircle of the low.

A gale warning was advertised to begin at 0000 UTC 6 Dec, but was upgraded prior to issuance, as several data sources revealed storm force winds occurring in the northwest quadrant of this low. **Figure 3** shows a 0045 UTC GOES-E IR image of the low with ASCAT scatterometer winds overlaid. Gale force winds forecast across this northwestern quadrant of the low appear to be enhanced by the burst of convection just to the north, with the ASCAT wind vectors revealing a significant area of 35-45 kt winds and a few embedded 50 kt vectors. A later 0234 UTC OSCAT pass also confirmed the existence of storm force winds in the western semicircle. Ongoing research and verification by the NOAA/NESDIS Ocean Surface Winds Team has shown that ASCAT winds have a slight low bias beginning at wind velocities around 30 kt, and thus this system likely had winds near 60 kt. An opportune overpass by Jason-1/-2 provided altimeter wave heights measurements across the zone of maximum southerly winds occurring east of the low, and revealed a significant area of seas 15 ft and greater with a max of 17 ft. (**Figure 4)**. Although moderate NW swell was present, gale force winds across this region were necessary to generate these 15-17 ft seas, and thus gales were also confirmed across the east semicircle of the low. This 996 hPa low center and associated gales lifted quickly north and out of the area by 1200 UTC 6 Dec, and became absorbed in a larger gale across the north Atlantic.

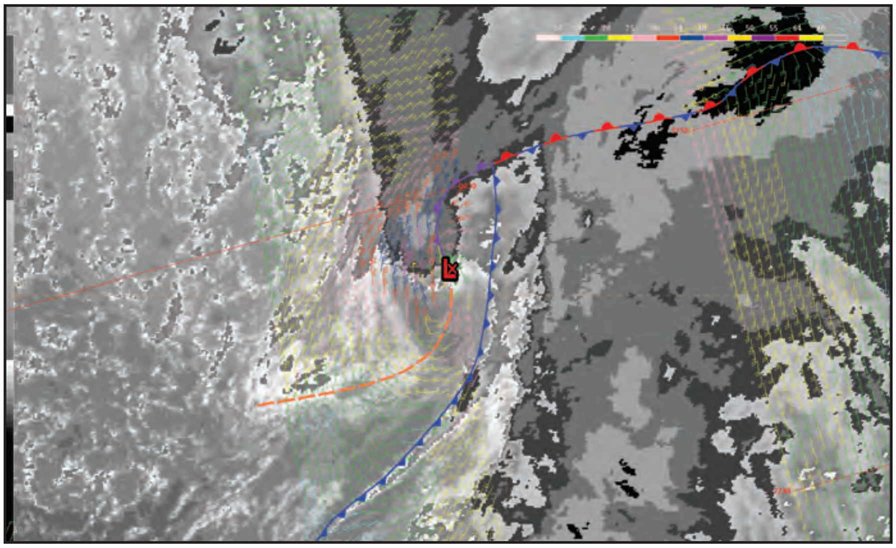

Figure 3. GOES-E 0045 UTC IR image with low and frontal positions. 0028 UTC ASCAT winds across the low reveal significant area of 35-45 kt winds across west semicircle (blue and purple barbs, with yellow 50 kt wind flag embedded within this area.

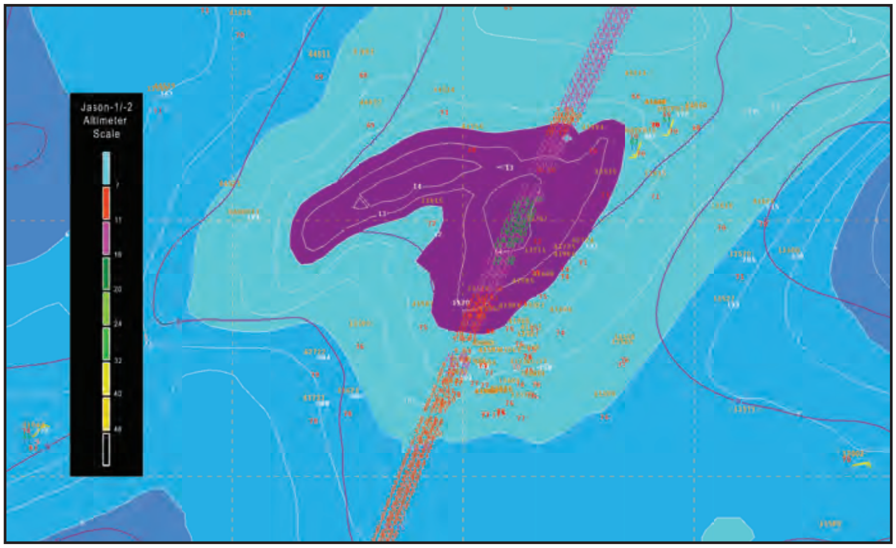

Figure 4. NOAA WWIII SWH forecast for 0000 UTC 6 Dec across region of storm center, with Jason-1/-2 altimeter data overlaid. Note area of 15-17 ft values nearly 240 nm long occurring across east semicircle of low, with highest values to 17 ft in green.

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10 December Gulf of Mexico Gale

The next non-tropical warning event of the season commenced at 1500 UTC 10 Dec behind a cold front dropping into the western Gulf of Mexico. This cold front moved off the Texas coast shortly before 1200 UTC, supported by a sharp upper level trough moving across the Great Plains and into the Great Lakes region. A brief blast of continental artic air forced the front southeastward during the day, with the front reaching from the extreme western Florida Panhandle to near Veracruz, Mexico by 0000 UTC 11 Dec. Northerly winds of 30-35 kt were observed immediately behind the front as it pushed through the Texas and Louisiana coastal waters, where the tanker **British Ensign** (MMER9) reported northerly gales to 35 kt near 28.9N94.5W at 1800 UTC. Gale force winds became more widespread across the Mexican coastal waters as the front shifted southward during the afternoon, as revealed by an 1803 UTC OSCAT pass. Upper level support began to lift northeast and away from the region after 0000 UTC, and without continued strong cold air advection, the gales behind the front ended by 0600 UTC 11 Dec.

19-21 December Gales

Three successive gale events occurred during this 3 day period as a series of cold fronts swept quickly across the AOR. Two southwesterly gale events were realized ahead of cold fronts moving across the Atlantic, while one northerly gale occurred in the Gulf of Mexico behind a cold front. On 19 Dec, a 994 hPa low center shifted southeastward off of New England and into the open northwest Atlantic, and deepened to a 984 mb low by 1800 UTC, with southwest gales commencing north of 30N ahead of the associated front stretched across the central Atlantic. As the low and associated front shifted eastward, gales developed by 1200 UTC 20 Dec in narrow zones on both sides of the front north of 29N. Upper level support for the low eventually lifted out across the northeast Atlantic, and gales ended ahead of the front by 0000 UTC 21 Dec, and then ended behind the front by 1800 UTC 21 Dec.

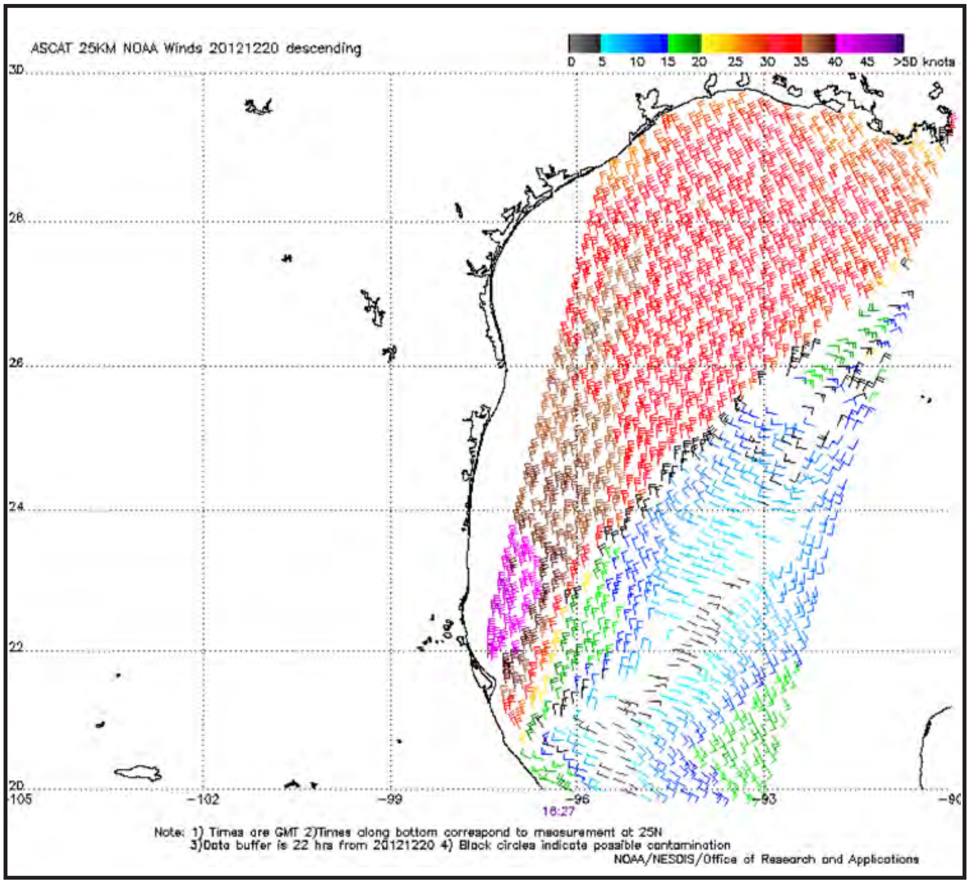

Figure 5. NESDIS ASCAT winds from 1627 UTC 20 Dec pass showing gales behind cold front in the Gulf of Mexico. Documented low bias of ASCAT at higher velocities suggests that winds could have been near 50 kt off Mexican coast near Tampico, in area of purple wind vectors.

Meanwhile, a cold front dropped into the northwest Gulf of Mexico after 0900 UTC 20 Dec, and gales commenced shortly after the front moved southeast and offshore, by 1200 UTC. By 1800 UTC, this front stretched from the Florida Panhandle to near Tuxpan, Mexico, with several observations of gales throughout the afternoon. The Discoverer Spirit (V7HC8) reported 39 kt near 27.3N90.8W at 1800 UTC, while Shell platform Auger - Garden Banks 426 (42361) reported 35 kt gales from 1630 to 1930 UTC and Perdido Host (42390) reported a peak wind of 43 kt at 1830 UTC. A 1627 UTC ASCAT pass, **Figure 5,** showed a large area of 30-40 kt winds behind the front and west of 94W, with peak winds offshore of Tampico, Mexico, of 40 to 45 kt. Given

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the known low bias of ASCAT at these wind speeds, storm force winds likely occurred there. By 1200 UTC 21 Dec the front had reached from the Florida Keys to the Yucatan Peninsula, with minimal gales still occurring across the western Bay of Campeche, before gales ended by 1800 UTC.

At 0600 UTC 21 Dec, minimal gales began north of 30N on both sides of this same frontal boundary, as it shifted eastward off of north Florida and into the Atlantic, and were captured later that morning by a 1425 UTC ASCAT pass. As the front continued to shift eastward, minimal gales continued in a narrow 90 nm zone north of 29N and east of the front through 1800 UTC, and north of 30N west of the front. Northwest gales of 35 kt were confirmed behind the front at 1800 UTC by the **Livorno Express** (ZCDV9) near 30N79.5W, before the gales shifted north of the area at 0600 UTC 22 Dec.

26 December Atlantic Gale

A short-lived gale event occurred across northwest portions of the TAFB Atlantic AOR as a 1000 hPa low center moved eastward across Texas, Louisiana and Mississippi on 25 Dec, and then moved northeastward across the southeast U.S. and to the North Carolina coast, deepening to a 993 hPa storm center. This system was spawned from a broad upper level trough across the central U.S. shifting northeastward, with a strong southern stream jet moving through the base of the trough, and across the northern Gulf, acting to gradually intensify the surface low. An associated cold front dragged across the Gulf of Mexico and then across Florida and into the SW North Atlantic during this period. South to southwest gales were observed ahead of the front by 1800 UTC on 26 Dec, as the front began to emerge off of NE Florida, with gales shifting northeast and out of the area within 9 hours.

31 December Atlantic Gale

The 31 December gale developed under a very similar synoptic pattern as the 26 December system. The surface low responsible for the 26 Dec gale continued to shift northeastward along the coast of the New England states, embedded within the base of the upper trough. This deep layered low pressure system then shifted northeastward into the Canadian Maritimes, became stationary and weakened 27 through 29 Dec. Left in its wake was another upper trough across the central U.S. However, in contrast to the previous gale development, the associated subtropical jet was located farther north across the Gulf coast states. Another surface low developed over Texas on 28 Dec. and shifted northeastward, reaching the South Carolina coast by 1200 UTC 29 Dec., then continued to shift northeastward and became absorbed in a 964 mb low along the coast of Nova Scotia by 1200 UTC 30 Dec. The associated cold front then extended from the low to just southeast of Bermuda to the far northwest Caribbean at that time. Minimal gales developed north of 30N on both sides of the front by 0000 UTC 31 Dec and increased briefly northwest of the front to 40 kt by 0600 UTC. The low over Nova Scotia remained relatively stationary and began to occlude by 1200 UTC, with the cold front moving eastward, from 31N53W to the Windward Passage. Gales east of the front shifted north of the area at that time, but continued north of 29.5N west of the front until shifting north of the area by 0000 UTC 1 Jan. Seas behind the front had built to 20 to 24 ft in northwest swell by this time.

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

The fall and winter months are an active time for gale and storm events in this portion of the Eastern Pacific. The majority of the events typically occur in the Gulf of Tehuantepec. True to form this 2012 season produced 11 Gulf of Tehuantepec gale and storm events, and one other Eastern Pacific gale event near 13N 133W. **Table 2** provides details on these events.

Table 2. Non-tropical cyclone Warnings issued for the East Pacific Basin between 01 Sep 2012 and 31 Dec 2012.

Onset	Region	Peak Wind Speed	GALE/ STORM Duration
1200 UTC 03 Oct	Gulf of Tehuantepec	40 kts	12 hr
0600 UTC 07 Nov	Gulf of Tehuantepec	40 kts	66 hr
1200 UTC 12 Nov	Eastern Pacific	35 kts	24 hr
0600 UTC 13 Nov	Gulf of Tehuantepec	35 kts	114 hr
1200 UTC 18 Nov	Gulf of Tehuantepec	35 kts	06 hr
0000 UTC 19 Nov	Gulf of Tehuantepec	35 kts	84 hr
1200 UTC 24 Nov	Gulf of Tehuantepec	40 kts	36 hr
0600 UTC 28 Nov	Gulf of Tehuantepec	45 kts	42 hr
0600 UTC 13 Dec	Gulf of Tehuantepec	35 kts	18 hr
1200 UTC 21 Dec	Gulf of Tehuantepec	50 kts	18 hr / 36 hr
0600 UTC 27 Dec	Gulf of Tehuantepec	35 kts	12 hr
0000 UTC 30 Dec	Gulf of Tehuantepec	50 kts	42 hr / 6 hr

Ship reports are a vital source of data in verifying gale and storm events. A few choice ship reports that directly verified some of this season's gales are enumerated in **Table 3**. Some wind speeds are not measured at the standard ten meter level and thus may be high.

Table 3. Ship reports that verified gale events over the Gulf of Tehuantepec between 01 Sep 2012 and 31 Dec 2012.

TIME/DATE	SHIP	LOCATION	WIND SPEED and SEAS
0300 UTC 03 Oct	Statendam (PHSG)	15.3N 94.8W	40 kts 12ft
1900 UTC 03 Oct	Island Princess (ZCDG4)	14.5N 95.7W	45 kts 9 ft
0200 UTC 04 Oct	Norwegian Pearl (C6VG7)	15.3N 94.9W	45 kts 18 ft
0300 UTC 09 Nov	Westerdam (PINX)	15.3N 95.1W	50 kts 3 ft
0200 UTC 14 Nov	Spruce Arrow (C6SD9)	15.6N 95.4W	51 kts 6 ft
1200 UTC 17 Nov	Hoechst Express (DHER)	14.1N 95.4W	44 kts 12 ft
1200 UTC 19 Nov	Conti Salome (A8LL8)	13.5N 95.5W	40 kts 6 ft
0800 UTC 22 Nov	Island Princess (ZCDG4)	14.9N 95.8W	50 kts 9 ft
1800 UTC 24 Nov	Elektra (9V8798)	14.3N 96.4W	35 kts 6 ft
2100 UTC 27 Nov	Celebrity Infinity (9HJD9)	14.8N 94.8W	40 kts 6 ft
1800 UTC 21 Dec	Clan Tribune (ELXU2)	14.9N 95.5W	51 kts 21 ft
1200 UTC 30 Dec	Ever Diadem (9V7955)	14.8N 95.0W	35 kts 20 ft
2300 UTC 30 Dec	Saga Future (VRKX8)	14.3N 96.0W	37 kts 15 ft

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The Gulf of Tehuantepec wind events are usually driven by mid-latitude cold frontal passages through the narrow Chivela Pass in the Isthmus of Tehuantepec. The northerly frontal winds from the southwest Gulf of Mexico produces gap wind events through the pass delivering stronger winds into the Gulf of Tehuantepec. The events are of various duration with the longer events associated with reinforcing secondary fronts in the Gulf of Mexico. The events are usually void of precipitation in the Gulf of Tehuantepec, thus scatterometer imagery does not have rain contamination problems. The gale events in October, November, and the first half of December 2012 were influenced by weaker frontal passages in the Gulf of Mexico that did not reach the Bay of Campeche. The frontal passages in the second half of December 2012 reached the Isthmus of Tehuantepec and produced storm-force wind events. A discussion of the most significant gale and storm events follows below.

21 December Gulf of Tehuantepec Storm Event

A gale event in the Gulf of Mexico behind a cold front on 21 Dec 2012 produced a storm event in the Gulf of Tehuantepec **(Figure 6)**. Note that the 1033 hPa High over south Texas significantly increased the surface pressure gradient over the Gulf of Mexico and southern Mexico. An Indian Oceansat-2 Scattereometer (OSCAT) pass captured the event in both the Bay of Campeche and the Gulf of Tehuantepec. A 50 kts wind barb was noted in the Gulf of Tehuantepec **(Figure 7)**. This event lasted a little more than two days. Storm conditions abated to gale conditions on the second day.

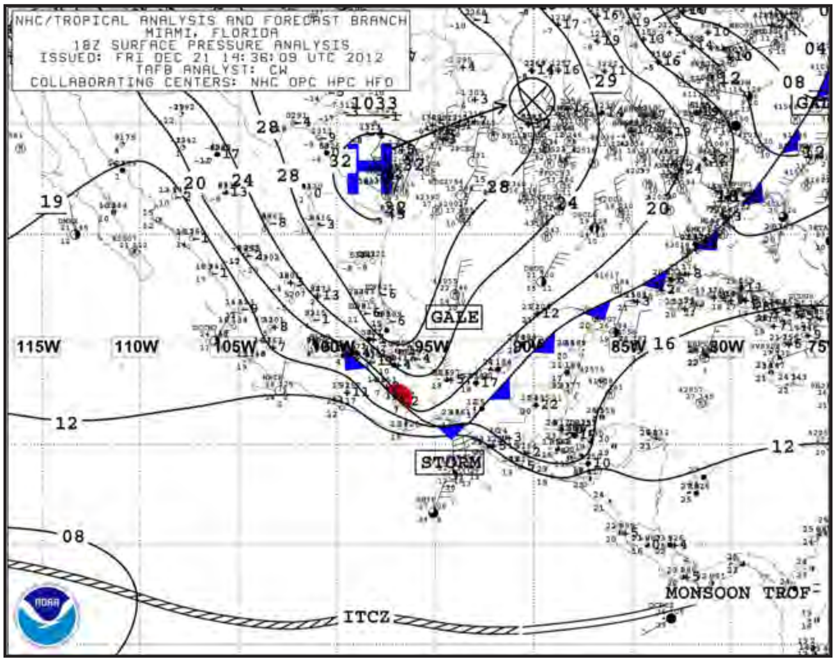

Figure 6. National Weather Service Unified Surface Analysis (USA) valid 1800 UTC 21 December 2012.

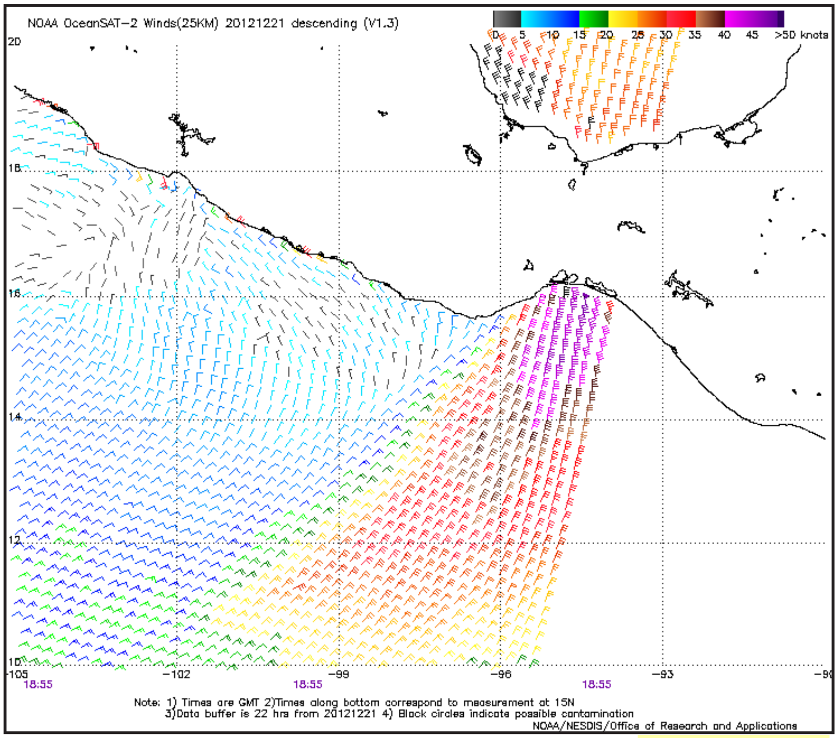

Figure 7. Indian Oceansat-2 Scatterometer (OSCAT) pass valid at 1855 UTC 21 December 2012. Note the 50 kts wind barb near the Gulf of Tehuantepec.

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30 December Gulf of Tehuantepec Storm Event

A cold front exited the Gulf of Mexico on 30 Dec 2012 **(Figure 8)**. This time a 1034 hPa High was farther north over Mississippi. The surface pressure gradient was not strong enough to produce a gale over the Gulf of Mexico, however, another Gulf of Tehuantepec gale/storm event started on 30 Dec 2012 and lasted two days. Storm conditions were experienced for a six hour period at the onset of the event. An OSCAT pass and a European Advanced Scatterometer (ASCAT) pass captured the event (**Figures 9 and 10**).

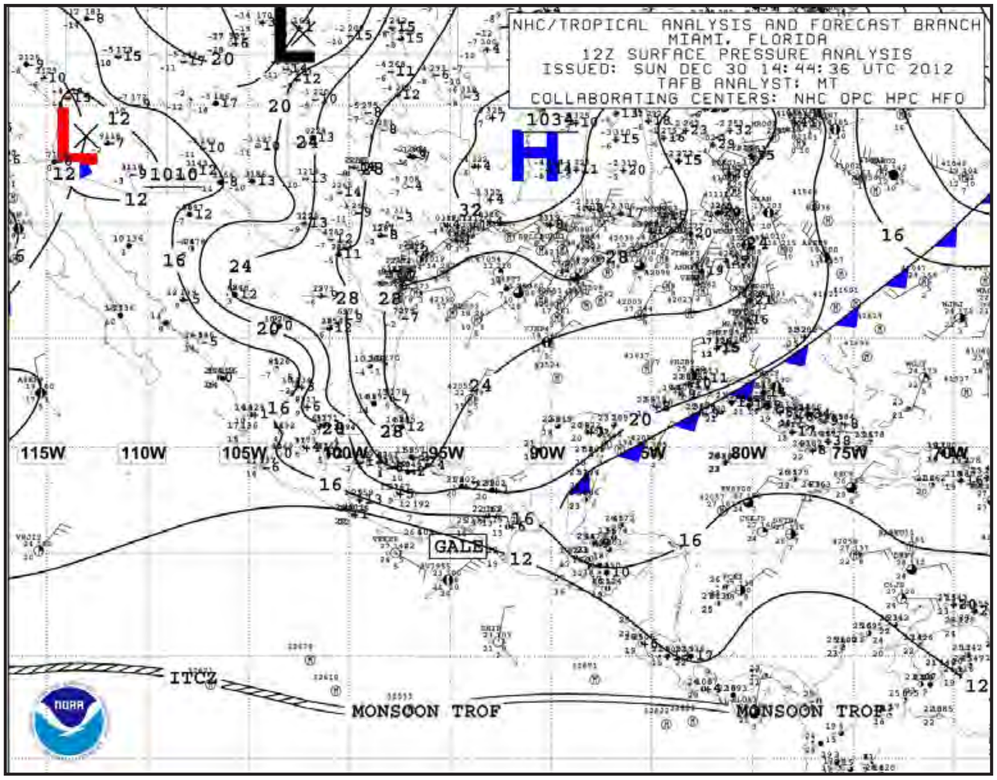

Figure 8. National Weather Service USA valid 1200 UTC 30 December 2012.

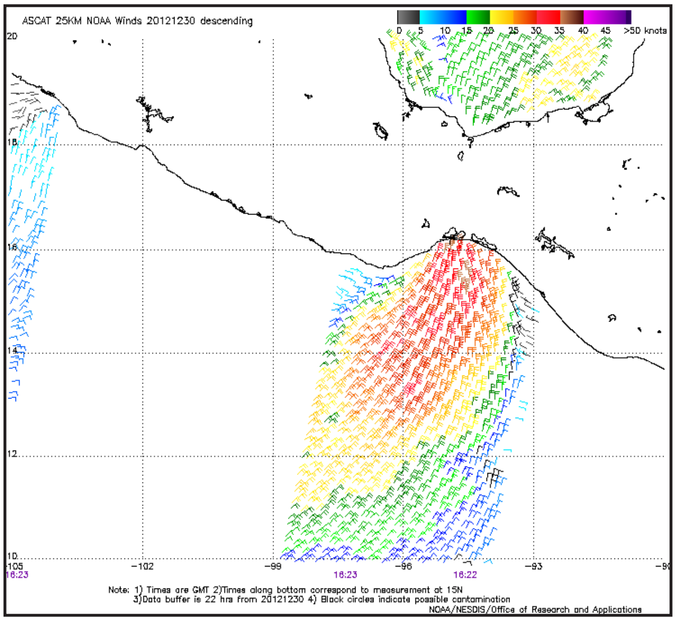

Figure 9. OSCAT pass valid at 0550 UTC 30 December 2012.

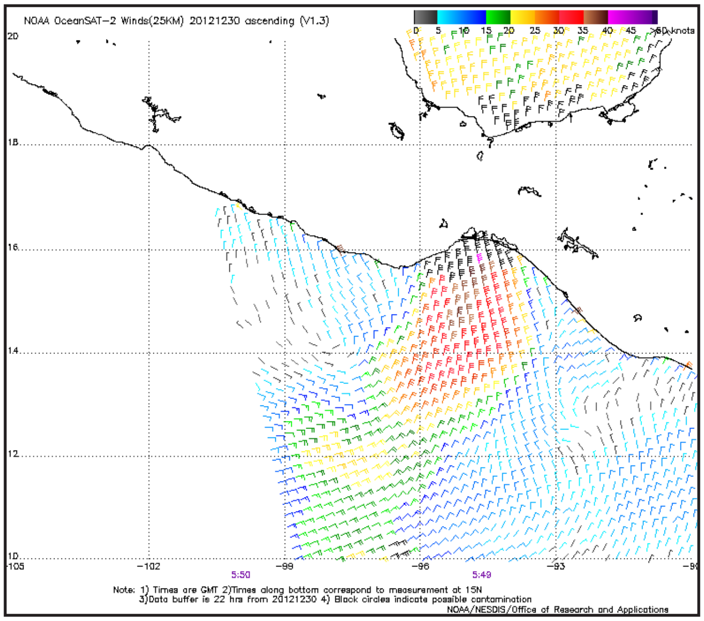

Figure 10. European Advanced Scatterometer (ASCAT) pass valid at 1623 UTC 30 December 2012.

12 November East Pacific Gale Event

A gale event occurred north of the intertropical convergence zone near 13N 133W on 12 Nov 2012 **(Figure 11).** A high amplitude trough extended from 15N 132W to 09N 136W moving west at 5 to 10 kts. 35 kts gale force winds were within 240 nm northwest of the trough. Winds east of the trough were only 10 kts. An area of very active convection was also over the trough. An OSCAT pass and an ASCAT pass captured the event, which lasted for about 24 hours **(Figures 12 and 13).**

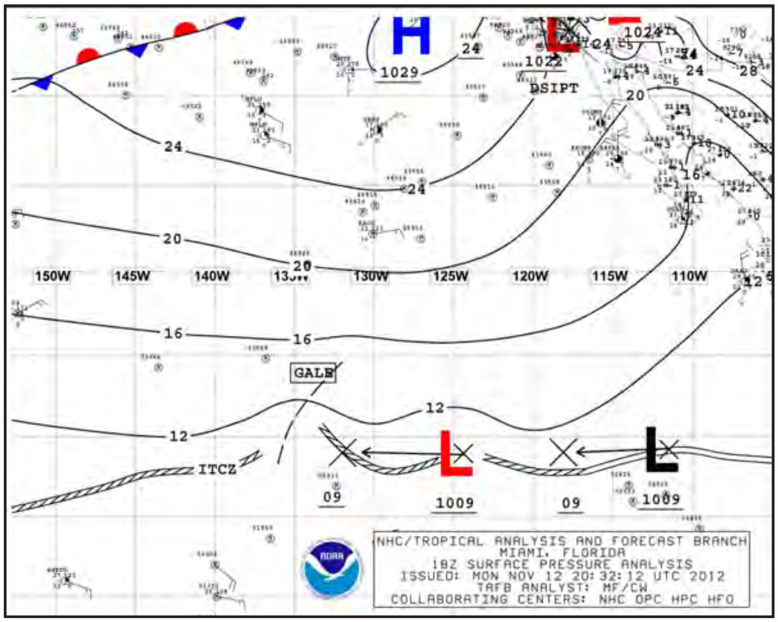

Figure 11. National Weather Service USA valid 1800 UTC 12 November 2012.

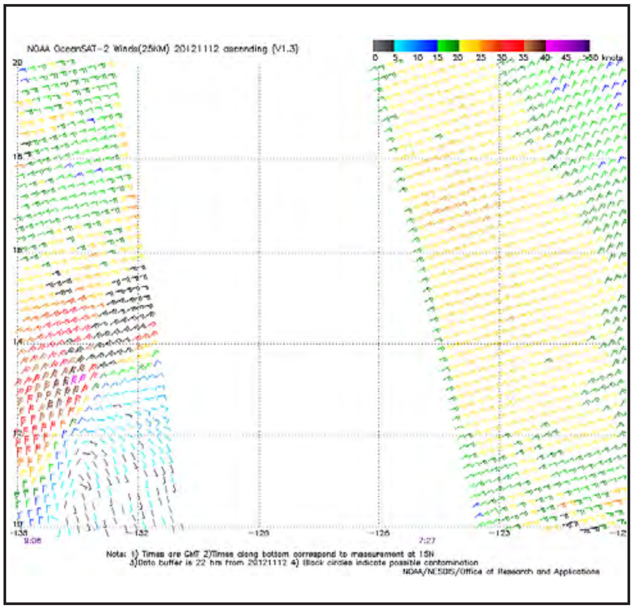

Figure 12. OSCAT pass valid at 0906 UTC 12 November 2012. Note the 35 kts winds along and to the west of the surface trough.

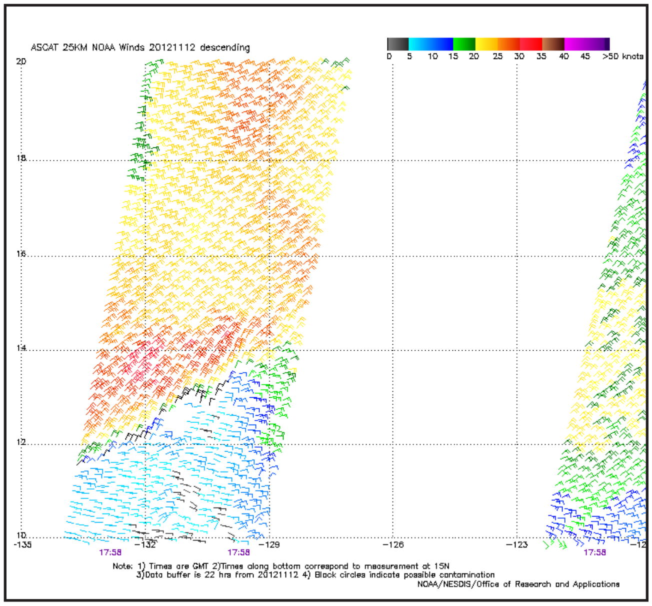

Figure 13. ASCAT pass valid at 1758 UTC 12 November 2012. Note the area of 25-30 kts winds along and to the northwest of the surface trough.

Acknowledgements

The authors would like to extend their sincere thanks for the outstanding graphical and editing support provided by NHC Scientific Illustrator, Joan David.

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Marine Weather Review – North Atlantic Area

July to October 2012

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Introduction

The pattern over the North Atlantic during this period was generally progressive with developing cyclones tracking northeast toward the area east of Greenland to the vicinity of Iceland. Several of these developed storm force winds while passing over northern waters especially in the late summer period of August and Septe hPaer, and in October. The first hurricane force lows of non tropical origin formed in the Labrador Sea south of Greenland in the second week of October and included the two deepest cyclones of the period.

After a quiet July in which no tropical cyclones formed, the August to October period was quite active with eight tropical systems crossing 31N into OPC's area of marine responsibility. This nu hPaer does not include those storms that affected only areas to the south of OPC's area. Six were hurricanes and two were tropical storms, generally moving north and then northeast into the Westerlies. An exception was Hurricane Sandy which made an unusual turn toward the west and made landfall on the mid Atlantic coast of the U.S., and Nadine spent more than two weeks on a looping path in the subtropics before entering the Westerlies becoming a post tropical low. Rafael and Sandy briefly developed hurricane force strength while transitioning into post tropical (extratropical) lows. More detailed information on tropical cyclones may be found in NHC's post season summaries (Reference 2).

Tropical Activity

Hurricane Gordon: Tropical Storm Gordon entered OPC's marine area near 31N 55W on the night of August 15 with maximum sustained winds of 35 kt. Early on the 18th Gordon became a 65 kt hurricane near 34N 41W with the peak intensity occurring on the evening of the 18th when Gordon developed top sustained winds of 95 kt while passing near 35N 34W. This was a strong Category 2 on the Saffir Simpson scale (Reference 3). Gordon then began to weaken while tracking northeast with its winds dropping to tropical storm strength on the afternoon of the 20th, and transition to a post tropical gale followed in the following evening as the center passed near 39N 20W. The remains of Gordon then turned toward the southeast and dissipated off Portugal late on August 21.

Hurricane Kirk: Hurricane Kirk passed near 51N 51W with maximum sustained winds 90 kt while accelerating northeast and beginning to weaken on the afternoon of August 31. Kirk weakened to a minimal hurricane (65 kt) the following night and to a 50 kt tropical storm on the evening of September1st while passing near 41N 42W. Figure 8 shows Tropical Storm Kirk at 1200 UTC September2nd twelve hours before becoming absorbed by an approaching cold front trailing from a rapidly developing low near Greenland.

Tropical Storm Leslie: Leslie, a hurricane well south of Bermuda on September 6th, moved north and passed just east of Bermuda on the afternoon of the 9th as a tropical storm with maximum sustained winds of 50 kt. The winds strengthened to 60 kt late on the 10th as the cyclone accelerated northeast toward the island of Newfoundland. The Canadian buoy 44139 (44.2N 57.1W) reported an east wind of 47 kt with gusts to 60 kt and 5.5 meter seas (18 feet) at 0500 UTC on the 11th, a pressure of 971.5 hPa two hours later and maximum significant wave heights of 10.0 meters (33 feet) at 0900 UTC September 11th. The Phoenix Light (HPHV) near 37N 57.5W reported southeast winds of 55 kt and 12.8 meter seas (42 feet) at 1800 UTC on the 10th. A Jason radar altimeter pass six hours later detected seas of

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41 feet north of that location near 41N 57W. The Norwegian Gem (C6VG8) encountered northwest winds of 55 kt and 7.9 meter seas (26 feet) near 46N 59.5W at 0700 UTC on the 11th. Figure 1 depicts Tropical Storm Leslie crossing the island of Newfoundland during transition to a post tropical storm. St. John's, Newfoundland reported south winds of 51 kt with gusts to 71 kt at 1300 UTC on the 11th. Hibernia Platform (46.7N 48.7W) reported south winds of 58 kt at an anemometer height of 139 meters at 1200 UTC on the 11th, and GSF Grand Banks (YJUF7, 46.7N 48.0W) encountered south winds of 53 kt three hours later, at a height of 82 meters. Leslie became a post tropical storm force low while passing northeast of Newfoundland at 1800 UTC September11. The second part of Figure 1 shows Post tropical Leslie passing east of Greenland with its lowest central pressure of 966 hPa at 1200 UTC on the 12th. The cyclone then passed near Iceland the next day and then became a large gale northeast of Iceland on the 14th.

Hurricane Michael: Michael approached from south of the area near 30N 41W late on September 6th with maximum sustained winds of 100 kt with gusts to 120 kt and was the only major hurricane of the season (Category 3 or higher on the Saffir Simpson scale). Michael drifted northwest over the subtropical waters well southwest of the Azores Islands with sustained winds of 85 to 90 kt on the 7th and 8th, before turning west near 34N 43W on the 9th with sustained winds of 80 kt. Michael then began to accelerate north ahead of an approaching cold front on September10th and its winds weakened to tropical storm strength the following night. Figure 1 shows Michael as a tropical storm southeast of the larger Leslie becoming a post tropical low on the front the next day. The remains of Michael then merged with post tropical Leslie to become the large gale northeast of Iceland mentioned above.

Hurricane Nadine: Figure 1 shows the beginnings of Nadine well south of OPC's marine area. Nadine became a long lived cyclone, spending the period from September 15th to October 4th in OPC's area. It became a hurricane on two separate occasions, on September 15th and later again on the 28th. The cyclone after initially moving east along 31N on the 15th and 16th, headed northeast toward the Azores Islands on the 17th and 18th and then made three loops over the subtropical waters to the southwest and south of the Azores from the 19th to October 2nd. During this time Nadine was a medium strength tropical storm and for a period from late on 21st through the 22nd was subtropical or post tropical before regaining tropical characteristics south of the Azores near 31N. After regaining hurricane strength near 33N 36W on the afternoon of the 29th, Nadine moved northwest and made a final loop while attaining a maximum intensity of 80 kt on the 30th. A weakening trend set in thereafter as the cyclone made a turn toward the east and then northeast on October 1st and 2nd, weakening to a tropical storm on the afternoon of the 1st and finally becoming a post tropical gale while passing north of the Azores on the 4th. The remains of Nadine merged with a larger low to the southwest by the 6th over the central North Atlantic. At 2100 UTC September20th the Maersk Utah (WKAB) reported northeast winds of 40 kt and 4.3 meter seas (14 feet) near 41N 28W. The Berge Nantong (VRBU6) near 33N 39W encountered west winds of 35 kt and 9.0 meter seas (30 feet) at 2000 UTC October 1st.

Hurricane Rafael: Rafael moved north northeast into OPC's marine area as a 75 kt hurricane late on October 16th ahead of an approaching cold front (Figure 2) and became a post tropical hurricane force low with a 972 hPa center near 40N 56.5W at 2100 UTC October 17th, when the National Hurricane Center issued the last advisory on Rafael. The second part of Figure 2 and an infrared satellite image (Figure 3) show Rafael three hours later with frontal features found in a non tropical low but still retaining a partial circular central dense overcast found in tropical cyclones. The Sea Land Meteor (WDB9951) near 41N 44W reported south winds of 45 kt and 4.9 meter seas (16 feet) nine hours later. Hibernia Platform (VEP717, 46.7N 48.7W) reported north winds of 59 kt at 1200 UTC on the 18th, while Terra Nova FPSO (VCXF, 46.4N 48.4W) encountered north winds of 48 kt and 4.0 meter seas (13 feet). Buoy 44011 (39.9N 61.4W) reported north winds 35 kt with gusts to 45 kt at 1500 UTC on the 17th, and highest seas 6.5 meters (21 feet) seven hours later. Extratropical Rafael then moved out over the North Atlantic and absorbed the storm in the Labrador Sea (Figure 2) by 0000 UTC October 20 near 56N 35W, when it developed its lowest central pressure of 966 hPa. The merged system then moved southeast and began to weaken with the winds decreasing to gale force on the morning of the 21st, near 49N 30W. The weakening center then drifted east along 41N from the 23rd through the 25th and passed inland over Portugal and Spain on October 26th.

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Hurricane Sandy: Sandy, like other tropical cyclones during this period originated south of OPC's marine area, but followed a track northward closer to the U.S. east coast and made the unusual westward turn to hit the heavily populated mid-Atlantic and northeast U.S. coast (Figure 4). The second part of Figure 4 shows Sandy when it was most intense off the U.S. coast with sustained 80 kt winds and a lowest central pressure of 940 hPa a few hours before landfall. The infrared satellite image of Sandy taken close to the 29/2100 UTC advisory time (Figure 5) reveals frontal features and an extensive cloud shield extending well inland as Sandy was becoming extratropical. Marine observations taken during Sandy listed in **Table 1** include numerous reports of winds above 50 kt and seas higher than 9 meters (30 feet). At 0000 UTC October 30th Sandy was onshore near 39.5N 75W as a post tropical hurricane force low. The cyclone then weakened inland over the mid-Atlantic states and its top winds diminished to gale force the next morning. Post tropical Sandy then drifted northwest and then north over the following two days and moved into Canada by November 1st.

OBSERVATION	POSITION	DATE/TIME (UTC)	WIND	SEA(m/f)
Sea Land Mercury (WKAW)	32N 78W	27/1800	N 72	
	33.5N 76W	28/1500	N 60	14.3/47
	35N 75W	29/0300	N 60	
Saimaagracht (PHCQ)	32.5N 79.3W	27/1800	N 55	
Maersk Kentucky (WKPY)	41N 67W	29/1800	SE 45	10.7/35
Buoy 41048	32.0N 69.5W	28/2300	SW 45 G56	11.5/34
		29/0000	Peak gust 60	
		29/0200	Maximum	12.0/39
Buoy 41002	31.9N 74.8W	28/1800	NW 47 G60	8.5/28
		28/2000	Maximum	9.0/30
Buoy 41001	34.6N 72.6W	29/0700	NW 52 G66	
			Peak gust 74	
		29/1400	Maximum	10.0/33
Buoy 44014	36.6N 74.8W	29/0700	Maximum	8.5/28
Buoy 44009	38.5N 74.7W	9/2100	W 45 G58	6.0/20
			Peak gust 66	
		29/1100	Maximum	7.5/25
		29/2100	Pressure 956.4	
Buoy 44025	40.2N 73.2W	29/1900	NE 49 G64	8.0/26
		29/2300	Maximum	9.5/31
Buoy 44008	40.5N 69.2W	29/1600	E 43 G56	9.5/31
		29/1700	Peak gust 58	
		29/2100	Maximum	11.0/36
Buoy 44005	43.2N 69.1W	29/2000	E 35 G45	7.0/23
		30/0500	Maximum	8.5/28
Cape Lookout (CLKN7)	34.6N 76.4W	28/1100	N 39 G48	
Matinicus Rock (MISM1)	43.8N 68.7W	30/0600	E48 G54	
			Peak gust 58	

Table 1. Selected ship, buoy and C/MAN platform observations taken during passage of Hurricane Sandy.

Tropical Storm Tony: Tony was a short lived cyclone entering OPC's marine area near 31N 36W on the morning of October 25th as a minimal tropical storm with maximum sustained winds of 35 kt. Tony moved east northeast and weakened to a post tropical 1004 hPa low near 32N 33W the following evening. The remains of Tony then drifted east over the following three days and dissipated late on the 28th while Hurricane Sandy was still off the U.S. east coast.

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Other Significant Events of the Period

North Atlantic Storm, July 20 22: An unseasonably deep low developed over the far northern Atlantic waters in late July with storm force winds, a time of year when the North Atlantic is least active. It originated as a frontal wave of low pressure over the western Gulf of St. Lawrence early on July 18th and tracked northeast off the southern Labrador coast by early on the 19th. Figure 6 depicts the development of this system over the following two and one half days, with the second part of Figure 6 showing the cyclone at maximum intensity. An ASCAT image at 2153 UTC on the 21st revealed remotely sensed winds to 45 kt on the northwest side. Due to the low bias of ASCAT, actual winds were likely at least 50 kt. The **Maasdam** (PFRO) near 58N 42W reported east winds of 45 kt at 2200 UTC on the 19th, followed by a report of east winds 40 kt and 6.0 meter seas (20 feet) near 58N 41W two hours later. The **Jenny N** (A8PQ7) near 51N 35W encountered southwest winds of 35 kt and 9.0 meter seas (30 feet) at 1200 UTC on the 21st. The cyclone subsequently weakened to a large gale southwest of Iceland on the 22nd before passing northeast of Iceland on July 24th.

Northeastern Atlantic Storm, August 14-16: A storm developed just southwest of the British Isles in mid-August from a merging of several low pressure areas over the eastern North Atlantic (Figure 7) over a twenty four hour period. The second part of Figure 7 shows the cyclone at maximum intensity in terms of central pressure. At 1000 UTC, August 15th the **Yorktown Express** (WDD6127) near 49N 14W reported northwest winds of 52 kt. The ship **BATFR54** encountered southwest winds of 43 kt at 1200 UTC on the 15th. Buoy 62023 (51.4N 7.9W) reported southeast winds of 48 kt with gusts to 58 kt and 5.5 meter seas (18 feet) at 1400 UTC on the 15th, and a peak gust 60 kt one hour later. The same buoy reported highest seas of 7.5 meters (25 feet) at 1600 UTC on the 15th. Buoy 62163 (47.5N 8.4W) at 0700 UTC on the 15th reported southwest winds 35 kt and 5.0 meter seas (16 feet), followed by a report of 7.0 meter seas (23 feet) four hours later. The cyclone subsequently made a counterclockwise loop west of the British Isles over the next three days with its winds dropping to gale force by the 16th. The cyclone then turned north and stalled for several days between Scotland and Iceland while weakening, and then dissipated off the coast of southern Norway by the 25th.

North Atlantic Storm, August 29-31: A new low formed near the southern Labrador coast with a 991 hPa center at 0600 UTC August 29th and moved northeast to 58N 46W over the following twenty four hours where it developed a lowest central pressure of 982 hPa. The center drifted northwest with a new center forming east of Greenland on the 30th and moving northeast. OPC analyzed this system as a storm force low from 0600 UTC on the 30th until 1200 UTC on the 31st. The cyclone then weakened and re-formed north of Iceland late on the 31st. The **Atlantic Cartier** (SCKB) reported southwest winds of 40 kt and 6.5 meter seas (21 feet) near 50N 39W at 1200 UTC on the 30th and the **Jaeger Arrow** (C6RM7) encountered similar conditions near 53N 26W) at 0800 UTC on the 31st.

Northeastern Atlantic Storm, September2-4: An open wave of low pressure off the southern coast of Greenland rapidly developed over the thirty six hour period ending at 0000 UTC September 4th while absorbing Tropical Storm Kirk (Figure 8). The central pressure fell 28 hPa in the twenty four hour period ending at 0000 UTC on the 4th resulting in a 962 hPa low just northeast of Iceland near 65N 13W in the second part of Figure 8, the deepest cyclone of the period up to this time. This rate of intensification qualifies this development as a meteorological "bomb" (Sanders and Gyakum, 1980). The **Stena Carron** (2BKQ8) reported southwest winds of 45 kt and 7.9 meter seas (26 feet) near 61N 3W at 0900 UTC on the 4th. The **West Navigator** (3ERR2) near 63N 5E encountered southwest winds of 45 kt at 1200 UTC on the 4th and, nine hours later, seas of 8.5 meters (28 feet). Buoy 64045 (59.1N 11.7W) reported west winds of 36 kt and 8.5 meter seas (28 feet) at 0900 UTC on the 4th, followed three hours later by a report of 9.5 meters (31 feet). The cyclone moved northeast from Iceland and weakened by the 5th.

North Atlantic Storm, September3-8: Originating as a low pressure wave over the southwestern waters near 37N 62W at 1800 UTC September 2nd, this cyclone passed 350 nm south of the island of Newfoundland late on the 3rd where it briefly developed storm force winds. The **Atlantis** (KAQP) near 41N 55W reported northeast winds of 45 kt at 2100 UTC on the 3rd. The cyclone then moved northeast out over the North Atlantic where it again became a storm,

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passing near 51N 37W with a 992 hPa central pressure at 1200 UTC on the 7th. The ship **VRY03** reported east winds of 50 kt and 4.0 meter seas (13 feet) near 54N 41W six hours later. The cyclone then tracked northeast and weakened to a gale the next day and then passed northeast of Iceland on the 9th.

Northwestern Atlantic Storms, October 11-16: Two intense cyclones developed in close succession over the northwestern waters in mid- October and became the first hurricane force lows of the period of non tropical origin. The first low originated near the mid-Atlantic coast on the morning of the 10th with the central pressure falling 36 hPa as it tracked from New Brunswick to 56N 58W in the twenty four hour period ending at 0600 UTC on the 12th , when it developed a lowest central pressure of 960 hPa. The cyclone drifted north in the following twelve hours and developed hurricane force winds off the southwest Greenland coast. The cyclone then drifted west and then southeast from the 12th into the 13th while new development occurred east of Newfoundland (Figure 9). The rapidly intensifying new low absorbed the old low and developed a lowest central pressure of 958 hPa off southern Greenland, the deepest in the North Atlantic in the four month period. The central pressure fell 41 hPa in the twenty four hour period ending at 1200 UTC on the 14th. The ASCAT imagery in Figure 10 reveals winds to 60 kt between the center and the southwest Greenland coast, and the retrieved winds have a low bias. The cyclone then drifted southeast over the following two days with winds weakening to gale force, before becoming absorbed by another low passing to the southeast late on the 16th.

Northeastern Atlantic Storm, October 30th-November 2nd: The initial developing of this system into a 963 hPa storm near the Faroe Islands is depicted in Figure 11. The cyclone was at maximum intensity at that time. Secondary development occurred on the front over southern England early on November 1st and moved rapidly north, developing a lowest central pressure of 964 hPa near 63N 9W at 0600 UTC November 2nd and replacing the old low. The Aleksandr Suvorov (UCAD) near 59N 4E reported south winds of 60 kt at 1200 UTC on the 1st. Six hours later the Mikhail Strekalovsky (UCKA) encountered southeast winds of 68 kt near59.5N 4E. Buoy 64045 (59.1N 11.7W) reported north winds of 35 kt and 7.5 meter seas (25 feet) at 0200 UTC on the 2nd, and 8.0 meter seas (26 feet) one hour prior. A 25 km ASCAT image at 1941 UTC on the 1st revealed north winds to 55 kt just east of Iceland. The cyclone then drifted to the southwest and then southeast and weakened over the British Isles on the 3rd and 4th.

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Marine Weather Review – North Pacific Area

July to October 2012

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Introduction

The weather pattern over the North Pacific started with a pattern more typical of midsummer with low pressure systems passing northeast across the northern waters of the Pacific toward the Aleutian Island, Bering Sea and Alaska. The weather in September and October became more active with the stronger cyclones developing storm or even hurricane force winds, with some of the strong systems tracking more toward the Gulf of Alaska as the season progressed into fall.

Tropical cyclones in the northwestern Pacific were most active from August to October and some of these became strong post tropical lows while re-curving northeast into the Westerlies especially in late September and October. Two of these developed hurricane force winds as post tropical (or extratropical) lows.

Tropical Activity

Tropical Storm Khanun: Tropical Depression 08W formed from a stationary non tropical low near 23N 139E south of Japan at 1800 UTC July 15th and moved west northwest, becoming Tropical Storm Khanun near 25N 134E at 1200 UTC on the 16th with sustained winds of 35 kt. The cyclone developed winds to 40 kt as it moved west of 130E by the 17th. OPC's oceanic radio facsimile chart area extends to 136E but the National Weather Service's Unified Analysis (http://www.opc.ncep.noaa.gov) extends to 130E.

Typhoon Bolaven: Tropical Storm Bolaven moved northwest and was well south of Tokyo near 17N 141E moving northwest and intensifying at 0600 UTC July 20th. Bolaven passed near 18N 140E as a 65 kt typhoon early on the 21st and continued to strengthen, attaining major typhoon status by 1800 UTC on the 23rd near 20N 133E with maximum sustained winds 105 kt with gusts to 135 kt. Bolaven passed west of the area shortly thereafter.

Typhoon Damrey: Damrey developed from a non-tropical low near 26N 147E southeast of Japan at 1200 UTC on July 28th when it became a tropical storm with sustained winds 40 kt. Damrey drifted west and varied in intensity, not exceeding 45 kt for sustained winds until early on the 30th when Damrey began to strengthen in earnest. Damrey became a 65 kt typhoon near 30N 131E late on July 31st and moved west of the area shortly thereafter.

Tropical Storm Haikui: A non-tropical gale force low developed near 23N 146E early on August 1st and remained nearly stationary, becoming Tropical Depression 12W on the afternoon of the 2nd and Tropical Storm Haikui 24N 140E six hours later, when it developed 35 kt sustained winds and began west northwest motion. Haikui strengthened and developed 45 kt sustained winds early on the 4th near 26N 131E as it passed west of the area. The **Green Ridge** (WZZF) near 34N 138E reported east winds 35 kt and 4.0 meter seas (13 feet) at 0600 UTC August 4th.

Tropical Storm Kirogi: A non-tropical low formed near 21N 157E early on August 1st and drifted east, developing gale force winds late on the 2nd near 24N 160E. The low became Tropical Depression 13W near 24N 162E at 1800 UTC on the 4th and a tropical storm twelve hours later near 24N 162E with sustained winds 35 kt. The cyclone took a turn toward the north and then northwest with intensity varying between 35 kt and 45 kt until early on the 8th. The cyclone developed a peak intensity of 45 kt for sustained winds while passing near 29N 162E at 0000 UTC August 7th before weakening to a 35 or 40 kt tropical storm from the 7th to early on the 9th and was named Kirogi at 0600 UTC on the 8th while passing near 32N 158E. Kirogi underwent extratropical transition on the 9th while continuing to gain latitude and

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became a post tropical gale near 41N 149E with a 1000 hPa central pressure by 0000 UTC on the 10th. The **Star Hidra** (LAVW4) reported east winds 35 kt and 4.3 meter seas (14 feet) near 44N 149E six hours later. Post tropical Kirogi then passed north and then northeast through the Sea of Okhotsk as a gale force low on the 10th and 11th, developing a central pressure as low as 987 hPa at 1800 UTC on the 11th before moving inland over Russia late on the 11th.

Tropical Storm Ewiniar: Tropical Depression 19W formed from a non tropical low near 16N 140E late on September 23rd and moved north, becoming Tropical Storm Ewiniar with 35 kt sustained winds near 21N 139E at 1200 UTC on the 24th. Ewiniar developed a maximum intensity of 55 kt for sustained winds while passing southeast of Japan near 32N 142E and turning toward the northeast at 1800 UTC on the 27th. The cyclone then began to weaken and became a post tropical gale east of Japan near 40N 151E with a 1001 hPa central pressure at 1800 UTC on the 29th. The remains of Ewiniar then passed east over the central North Pacific early in October before becoming absorbed on the 8th by the remains of another tropical cyclone Maliksi, to be described below.

Typhoon Jelawat: Typhoon Jelawat passed near 28N 130E late on September 28th with maximum sustained winds of 85 kt while moving northeast and weakening. A vessel with the call sign **SHIP** reported north winds of 50 kt and 5.2 meter seas (17 feet) at 0900 UTC on the 29th. Jelawat then weakened to a tropical storm while passing over southern Japan early on the 30th and to a post tropical gale force low near 42N 144E with a 994 hPa central pressure late on September 30th. The **Skaubryn** (3FZK3) encountered southwest winds of 47 kt near 35N 140E at 1500 UTC on the 30th. Post tropical Jelawat then re-intensified into a storm force low while passing just east of the central Kurile Islands early on October 1st and briefly developed hurricane force winds and a 980 hPa central pressure while passing south of the central Aleutian Islands near 49N 180W at 1800 UTC October 2nd. The **Ever Diamond** (3FQS8) near 44N 178W reported northwest winds of 55 kt and 3.0 meter seas (10 feet) at 0500 UTC on the 3rd. The ship **DCCM2** near 46N 177E, encountered southwest winds 45 kt and 7.3 meter seas (24 feet) at 1800 UTC October 2nd. Post tropical Jelawat then crossed the central Aleutians early on the 3rd and moved north through the Bering Sea with winds of storm force at times, developing a lowest central pressure of 972 hPa in the central Bering Sea early on the 4th. Figure 1 shows the post tropical cyclone passing north through the Bering Sea while the next development, Maliksi, occurs well to the southwest. Buoy 46035 (57.1N 177.8W) reported northwest winds of 35 kt with gusts to 47 kt at 0000 UTC on the 5th. The cyclone then weakened in the northern Bering Sea on the 5th and passed north of the Bering Strait on the 6th.

Tropical Storm Maliksi: Tropical Depression 20W moved northwest near 16N 149E early on September 30th and became a tropical storm near 19N 146E early on October 1st with sustained winds of 35 kt. The cyclone turned toward the north and was named Maliksi at 1800 UTC on the 2nd while passing near 23N 141E, with sustained winds up to 45 kt. Maliksi developed a maximum intensity of 50 kt for sustained winds as a tropical storm while passing near 35N 144E at 0000 UTC October 4th. The **APL Thailand** (WCX8882) reported north winds of 35 kt and 9.8 meter seas (32 feet) near 35N 141E at that time. Figure 1 shows Tropical Storm Maliksi merging with the front to the north and becoming an intense post tropical hurricane force low during the following thirty-six hours while re-curving northeast and then east into the mid latitude Westerlies. The cyclone developed a lowest central pressure of 964 hPa at 1800 UTC on the 5th. A vessel with the **SHIP** call sign reported southwest winds of 55 kt at that time, and a report of 8.5 meter seas (28 feet) three hours later. OPC analyzed this cyclone as a hurricane force low from 0000 UTC on the 5th through 0600 UTC on the 6th, when the center passed near 45N 171E with a 980 hPa central pressure. An ASCAT pass from late on the 5th returned winds up to 50 to 55 kt in the area of data coverage on the west side of the cyclone. The cyclone reformed as a new center to the north near the central Aleutian Islands on the 6th and moved southeast, passing near 39N 165W as a gale force low at 0000 UTC on the 9th. The remains of Maliksi then turned toward the northeast and dissipated near the Alaska Peninsula on the 11th.

Typhoon Prapiroon: A non tropical low near 19N 138E with a 1000 hPa center at 0000 UTC October 7th moved west and became Tropical Storm Prapiroon twenty four hours later near 18N 135E with sustained winds of 45 kt, and a 65 kt typhoon near 18N 133E 0000 UTC on the 9th. Its winds increased to 90 kt as it passed west of 130E early on the 10th. Prapiroon later returned on a northeastward track as a weakening typhoon, drifting northeast near 22N 131E at 1200 UTC October 13th with maximum sustained winds of 75 kt. The cyclone passed near 27N 132E as a 40 kt tropical storm at 1200 UTC on the 18th. The **APL India** (A8JX7) reported north winds of 55 kt and 7.9 meter seas (26 feet) near 31N

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132E at 0600 UTC on the 18th. Prapiroon became post tropical near 33N 146E at 0600 UTC on the 19th as a 996 hPa storm force low before weakening to a gale later that day. The remains of Prapiroon dissipated near 30N 171E on the 22nd.

Tropical Storm Maria: Tropical Storm Maria formed from a non-tropical low that was near 20N 147E at 0600 UTC October 12th. It drifted southwest over the following two days and became a tropical storm near 18N 143E at 1200 UTC on the 14th with maximum sustained winds of 40 kt. Maria turned northwest that day and on the 15th before turning northeast on the 16th. The cyclone developed a maximum strength of 55 kt for sustained winds while passing near 27N 141E at 0600 UTC October 16th. Maria weakened and turned toward the southeast on the 17th, becoming a depression late on the 18th and finally dissipating as a post tropical low near 30N 171E on the 22nd.

Other Significant Events

Bering Sea Storms, September 2-4: The initial development was from a gale moving across the Sea of Okhotsk on August 30th and then reforming as a new center in the western Bering Sea on the 31st. The gale force low then moved east near 55N to the southeast Bering Sea and briefly developed storm force winds there as a 980 hPa cyclone late on September 2nd before turning north up the west coast of Alaska and weakening on the 3rd. Figure 3 shows the cyclone in the eastern Bering Sea, moving almost out of the picture in the second part of Figure 3 as a stronger storm system approached. The stronger cyclone, shown at maximum intensity, originated as a wave of low pressure near the southern Kamchatka Peninsula at 1800 UTC September 2nd which deepened rapidly, by 31 hPa during the following twenty four hours. The WindSAT image of remotely sensed winds in Figure 4 reveals winds to 50 kt at least around the area of data coverage around the west side of the storm. The **Zim Ontario** (DFZB2) reported west winds of 45 kt and 6.0 meter seas (20 feet) near 46N 178E at 0000 UTC on the 4th. Buoy 46071 (51.1N 179.1E) reported west winds of 39 kt with gusts to 49 kt and a peak gust 52 kt, along with seas of 7.0 meters (23 feet) at 0500 UTC on the 4th. Seas reached 9.0 meters (30 feet) two hours later at that buoy. The cyclone turned northeast and then north later on the 4th and its winds diminished to gale force, and followed the previous low up the west coast of Alaska on the 5th.

Northeast Pacific and Bering Sea Storm, September 15-16: The first hurricane force low of the fall season developed from the merging of four lows in the northeastern Pacific and southeast Bering Sea as depicted in Figure 5. The second part of Figure 5 shows the cyclone at maximum intensity before it moved inland and weakened rapidly. **Table 1** lists some notable observations taken in the storm.

OBSERVATION	POSITION	DATE/TIME (UTC)	WIND	SEA(m/f)
S/r American Progress (KAWM)	60N 146.6W	16/1800	SE 65	10.7/35
Amsterdam (PBAD)	58N 143W	16/1000	S 50	3.7/12
Hamburg Express (DGXS)	54N 163W	16/1200	W 55	
OUUY2	54N 164W	16/1200	NW 50	
Attentive (WCZ7337)	60.3N 146.6W	16/1300	SE 55	8.5/28
Buoy 46075	53.9N 160.8W	16/1400 16/1500	W 35 G47 Maximum	6.0/20 7.0/23
Buoy 46060	60.6N 146.8W	16/2000 16/2300	SE 41 G51 Peak gust 56	3.0/10
Buoy 46082	59.7N 143.4W	16/2000 17/0000	SE 37 G47 Maximum	7.0/23 8.0/26

Table 1. Ship and buoy observations taken during the passage of a North Pacific and Bering Sea storm, September 15-16, 2012.

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Northeastern Pacific Storm, September 25-27: The next significant event was even stronger, developing from an open wave of low pressure south of the eastern Aleutians and absorbing another low in the southeastern Bering Sea within twenty four hours (Figure 6). The central pressure fell at an impressive rate of 44 hPa in a twenty four hour period ending at 1200 UTC on the 26th. This explosive development would qualify as a meteorological "bomb" (Sanders and Gyakum, 1980). The Polar Resolution (WDJK) near 55N 144W reported south winds of 55 kt and 6.5 meter seas (21 feet) at 1900 UTC on the 26th. The Amsterdam (PBAD) encountered northwest winds of 50 kt near 53N 165W at 1000 UTC on the 26th. Buoy 46001 (56.3N 147.9W) reported southeast winds of 41 kt with gusts to 51 kt and 6.0 meter seas (20 feet) at 1900 UTC on the 26th and highest seas 10.0 meters (33 feet) eight hours later. Buoy 46077 (57.9N 154.3W) reported northeast winds of 49 kt with gusts to 64 kt and 5.5 meter seas (18 feet) at 0200 UTC on the 27th. East Amatuli Island Light (AMAA2) 58.9N 151.9W reported northeast winds of 60 kt with gusts to 70 kt at the same time, and a peak gust 74 kt one hour prior. The cyclone subsequently weakened to a gale force low in the northern Gulf of Alaska on the 27th before dissipating over southern Alaska on the 29th.

North Pacific Storm, October 10-12: A relatively compact hurricane force low developed over the north central Pacific in early October from an open wave of low pressure near 35N 161E during a thirty six hour period as depicted in Figure 7. The strongest pressure fall was 26 hPa in the twenty four hour period ending at 1800 UTC October 10th. A high resolution ASCAT pass from 2236 UTC on the 10th (Figure 8) returned winds 50 to 60 kt in a small area of the southwest semicircle, and with the low bias of the imagery especially at higher wind speeds, the image indicates hurricane force winds. The lowest central pressure (968 hPa) occurred later, at 1800 UTC on the 11th as the top winds decreased to storm force. The system weakened to a gale while passing south of the eastern Aleutians on the 12th and became absorbed by a developing eastern North Pacific cyclone the next day.

Eastern North Pacific Storm, October 31st-November 2nd: The final event described, the first of two that occurred in early November, began in late October as a weak low over northern Japan early on October 25th and crossed the western and central waters between 38N and 42N, briefly strengthening into a storm early on the 29th near 40N 171E. Figure 9 shows the final development of this cyclone into a hurricane force low at maximum intensity. The central pressure fell 31 hPa from 0000 UTC November 1st to 0000 UTC November 2nd. ASCAT imagery showing a partial view of the circulation (Figure 10) reveals a swath of winds 50 to 55 kt on the southeast side of the cyclone but may not necessarily cover the strongest area of winds. The ship DEHZ (51N 141W) encountered southwest winds of 40 kt and 8.5 meter seas (28 feet) at 1700 UTC November 2nd. Buoy 46077 (57.9N 154.3W) reported northeast winds of 43 kt with gusts to 54 kt and 4.0 meter seas (13 feet) at 0600 UTC on the 2nd, a peak gust 58 kt at 1100 UTC on the 2nd and highest seas 5.0 meters seven hours later. The cyclone moved to the northern Gulf of Alaska on the 3rd and the 4th with winds weakening to below gale force, and dissipated by the 5th.

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VOS Program Awards

Chief Mate George Darley accepts the 2011 Annual award on behalf of Masters and crews of Horizon Trader.

Photo from the Deepwater Champion:
From Left to right:
Nicky Simpson Sr DPO
Barry Hughes Sr DPO
David Plazeski Sr DPO
Paul Scott DPO

Not pictured: Doug Banfield, Captain

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National Weather Service VOS Program New Recruits:

October 1, 2012 through February 13, 2013

Ship Name	Call Sign
Algoma Mariner	CFN5517
Algorail	VYNG
Algoway	VDFP
Alliance Richmond	WLMK
APL Shanghai	A8SN5
Bansui	3FMI5
Carnival Breeze	3FZO8
Celebrity Reflection	9HA3047
Columbine Maersk	OUHC2
Deepwater Champion	YJVM9
Eagle Beaumont	S6JO
Eagle Kangar	9V8472
Eagle Kinabalu	9V8779
Eagle Kinarut	9V8908
Eagle Klang	9V8640
Eagle Kuantan	9V8376
Eagle Tampa	S6NK6
Eagle Torrance	9VMG5
Eagle Tucson	S6NK5
Eagle Turin	9VMG6

Ship Name	Call Sign
Eships Falcon	A8VG7
Ever Envoy	VSQL9
Ever Strong	3EJG3
Federal Yukina	VRHN7
Ferdinand R. Hassler	WTEK
Green Point	WCY4148
Harvey Spirit	WDD4830
Horizon Consumer	WCHF
Lee A. Tregurtha	WUR8857
Mol Presence	9V8990
NYK Joanna	9VFC4
Ocean Wave	WDG3180
Overseas Santorini	WOSI
Sally Maersk	OZHS2
Star Lima	LAPE7
USCG Alder	NGML
Zim Chicago	A8SI9

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

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(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.

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