# Mariners
## WEATHER LOG

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http://www.ndbc.noaa.gov

AMVER Program
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AMVER/SEAS e-logbook software
upgrade pending

VOS Program
http://www.vos.noaa.gov

Mariners Weather Log
http://www.vos.noaa.gov/mwl.shtml

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

TURBOWIN e-logbook software
http://www.knmi.nl/turbowin/

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 everyone and welcome to another edition of the Mariners Weather Log.

At this point in the hurricane season, I am happy to report that so far so good. Here it is…the end of July and not much really to write about and that is just how we like it. In saying that, it is early in the season and the upcoming months are usually pretty active so I would like to remind everyone how important your timely and accurate marine weather observations are. The forecasts are only as good as the data that goes into them, so please give special attention to the elements that you report. Keeping your safety in mind, remember that you need to take into account the inherent errors in hurricane forecasting. To elaborate on these errors and to limit your potential of a close encounter between ship and storm…please refer to the National Hurricane Center "Marine Safety" web page so that you can remain current on the several methods to minimize your risks. http://www.nhc.noaa.gov/prepare/marine.php

More and more ships are sending their observations via the internet and with that said another quick reminder for you…please do not send your observation using HTML, use plain text or rich text. We have noticed an increasing number of ships observations being sent in unsuccessfully. Please be sure and check your settings for this common error, and as always if you need assistance contact your PMO, or VOS@noaa.gov.

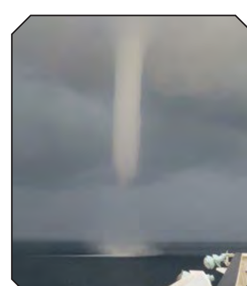
On the cover is a photograph of a waterspout on the northern end of the Strait of Malacca. This is a narrow stretch of water between the Malay Peninsula and the Indonesian island of Sumatra and one of the most important shipping lanes in the world. Waterspouts can fall under two categories, fair weather and tornadic. This particular photo and the accompanying photographs I received along with the ships location at the time, give indication of the tornadic type. NOAA's National Weather Service suggests the best way to avoid a waterspout is to move at a 90-degree angle to its apparent movement. Never move closer to a waterspout in order to investigate as some can be just as dangerous as tornadoes.

I hope you enjoy this edition of the Mariners Weather Log. We have an interesting article on the flow reversal of the Mississippi River during Hurricane Isaac. As always, our shipwreck article from Skip is a great read. I know our next issue in December will certainly have a PMO corner with another episode of our Charleston PMO Tim Kenefick and his trip teaching cadets marine weather observing on the SUNY Maritime Ship EMPIRE STATE. Lastly, please feel free to send any comments or suggestions as I am always looking to improve your Mariners Weather Log.

Paula

**On the cover:**

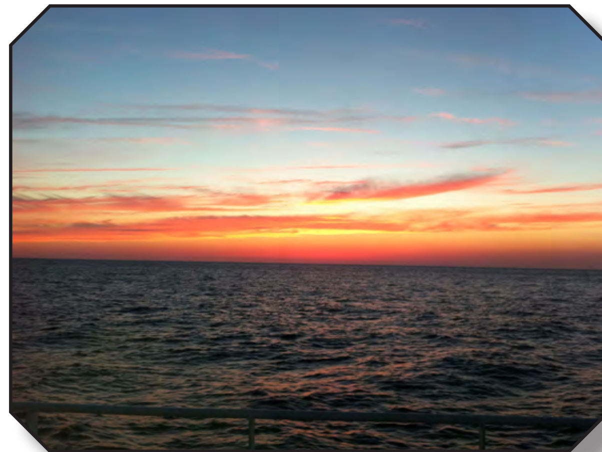
Photo taken by: Captain Ullanat Sethunath Krishnan from the ship FRONTIER ISLAND.



This impressive photo of a waterspout was taken while transiting the Straits of Malacca (northern end, outbound) on the 5th of December. Position at the time was 04 42N, 099 07.5 E and approximately 50-100 m in diameter.

# Mariners WEATHER LOG





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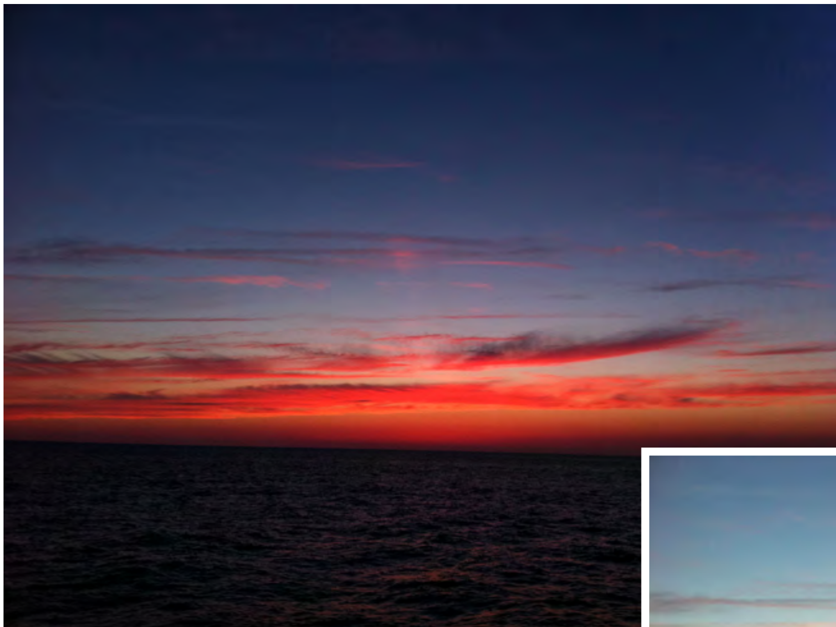
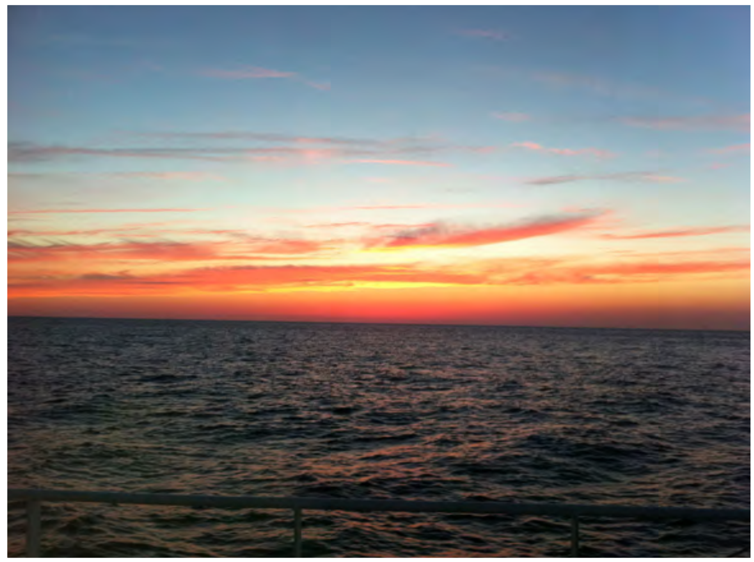
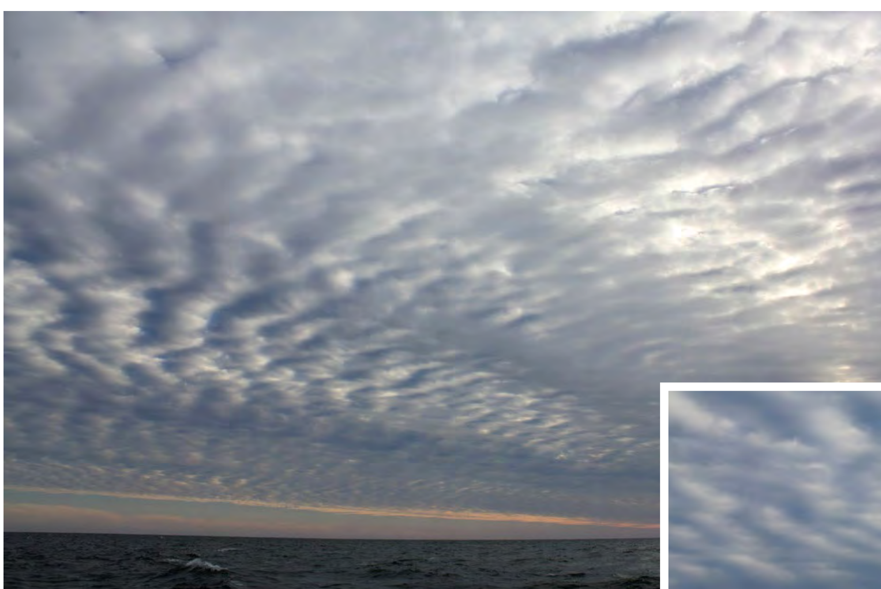




Sunset photos  taken by: Paula Rychtar onboard the NOAA  Ship GORDON GUNTER, Sunday, June 23rd, 2013 off the coast of Virginia.



Photos taken by:  Denice Drass Marine Biologist, 28 Feb 2013, onboard the NOAA SHIP OREGON II, Plankton Survey.

These photos were taken after a cold frontal passage on the afternoon of February 28th 2013. 29 50.573N 088 11.486W

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# Mississippi River Flow Reversal during Hurricane Isaac in 2012: A Physical Explanation

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

Abstract: During the passage of Hurricane Isaac in 2012 the Mississippi River experienced flow reversal. Evidence is presented to delineate this phenomenon. A physical explanation is provided and verified. Since 98% of the storm surge in the river's delta area, which causes the flow reversal, can be explained by the combination of both wind-stress forcing and inverse barometric effect, a formula is provided for operational use.

## 1. INTRODUCTION

During Hurricane Isaac in 2012 the Mississippi River flow was reversed. Since this phenomenon was not common, the riverine traffic was not prepared for this potentially hazardous navigation. Therefore, many ocean-going vessels and numerous barges along the river were caught by surprise. The purposes of this study are to: (1) delineated the flow reversal phenomenon: and (2) provide a physical explanation so that a formula can be developed for future forecasting applications through the port meteorologist responsible or New Orleans and Baton Rouge ports, in case similar phenomenon may occur again.

## 2. THE MET-OCEAN SETTING

Before the flow reversal is discussed, the meteorological and oceanographic (met-ocean) setting induced by Hurricane Isaac needs to be delineated. In order to facilitate the description a map shown in Fig.1 (see www.ndbc.noaa.gov) may be helpful. For the storm track of Isaac, see Tropical Cyclone Report by Berg (2013).

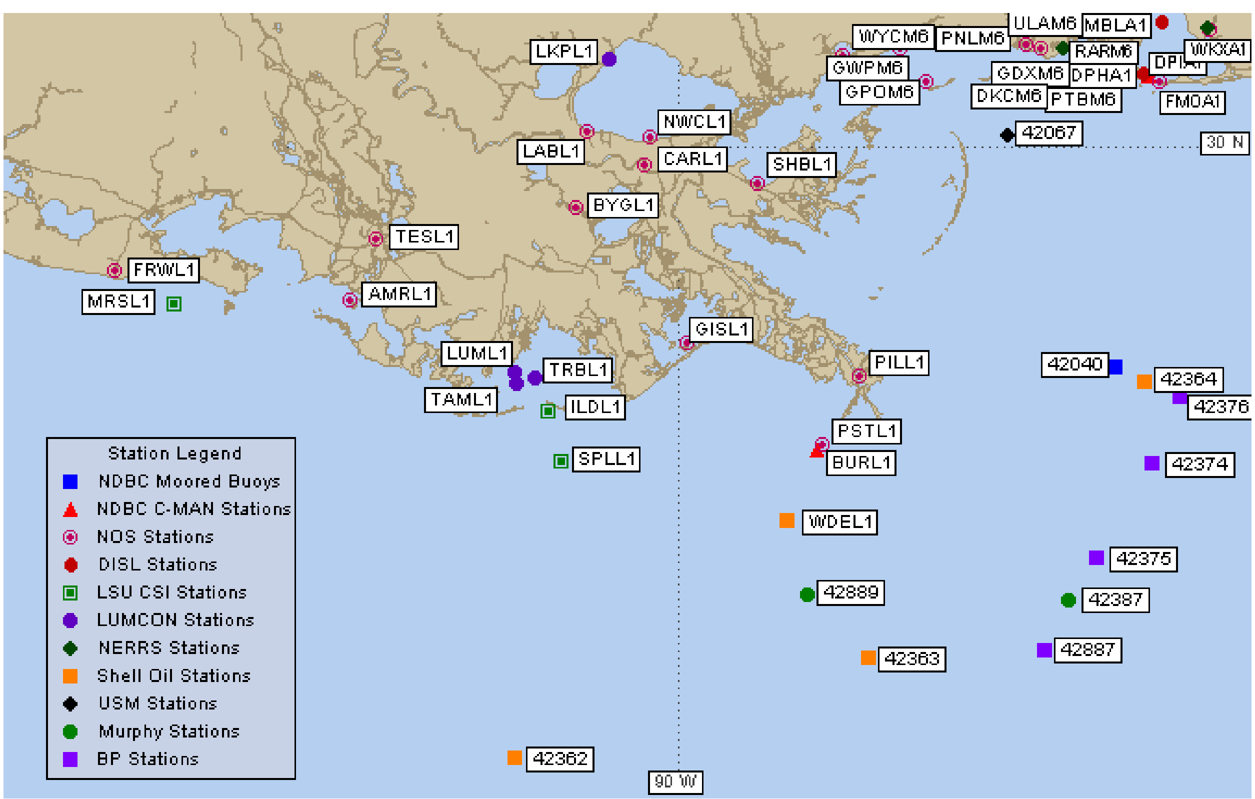


Fig.1. The lower Mississippi River and some of the meteorological and oceanographic (met-ocean) stations used in this study (see www.ndbc.noaa.gov).

Since the Mississippi River Delta region is near the storm track, typical met-ocean conditions occurred as shown in Figs.2 and 3. The minimum pressure was at 970 mb. Prior to the arrival of this low barometric reading the wind direction was mainly from the SE. The peak wind speed was approximately 55 kts and gusted to 70 kts. Right after the passage this minimum pressure, the wind direction changed abruptly to southwesterly. Now, the speed increased to 60 kts with gusts up to 80 kts. Storm surges at PSTL1, PILL1 and CARL1 induced by Isaac are shown in Figs. 4 through 6, respectively. Note that the storm surge was higher further upstream than that at the river mouth, indicating the river flow could be reduced or even reversed.

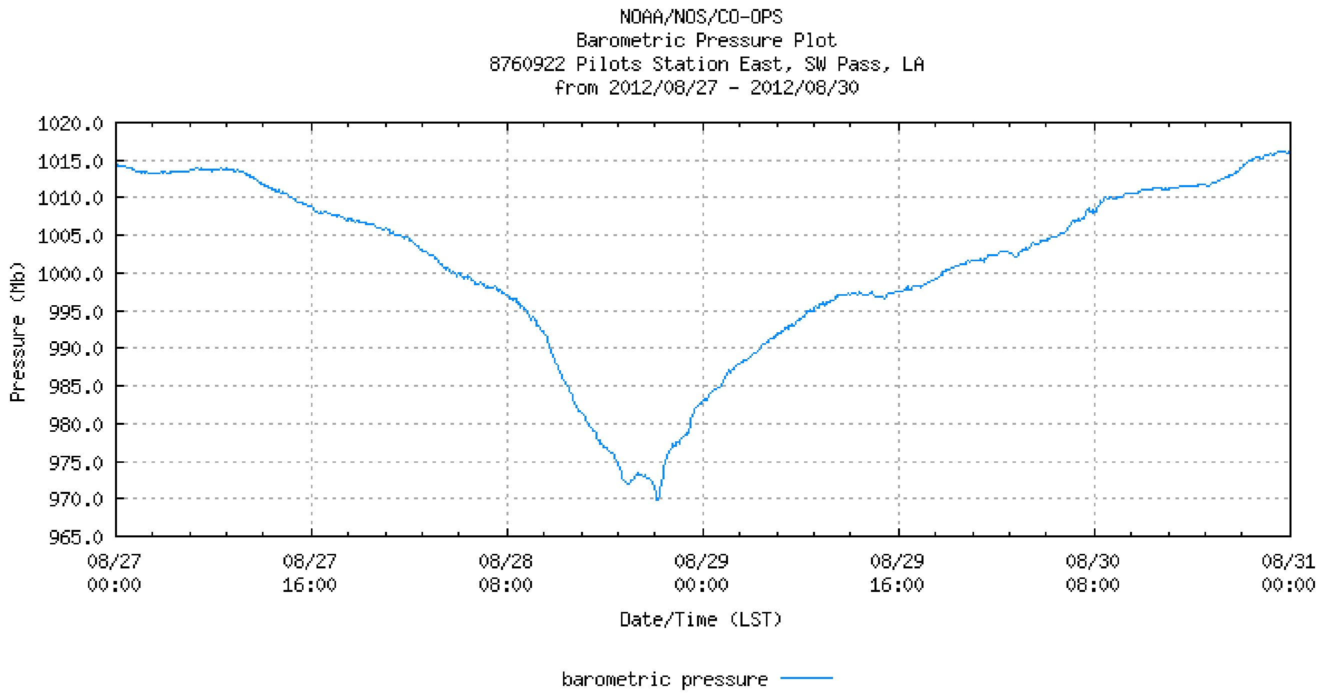


Fig. 2. Barometric records at PSTL1 during the passage of Isaac.

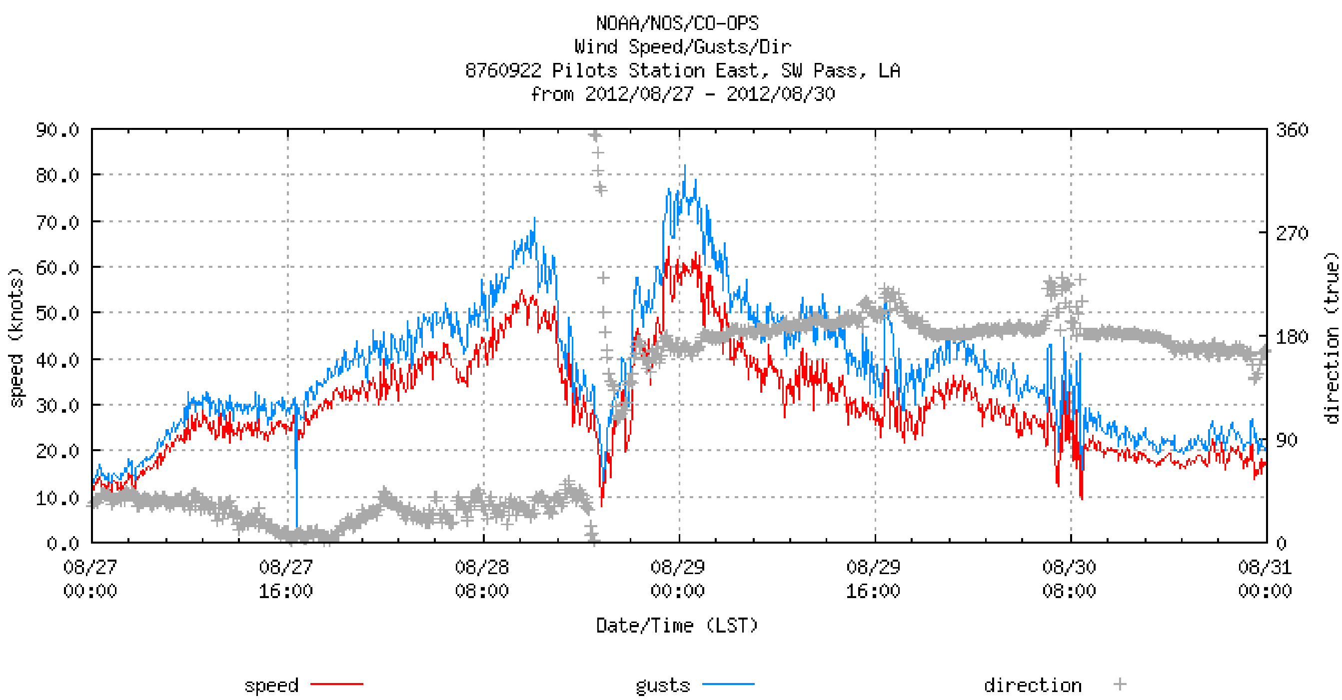


Fig. 3. Wind speed and direction and wind gust at PSTL1 during Isaac.

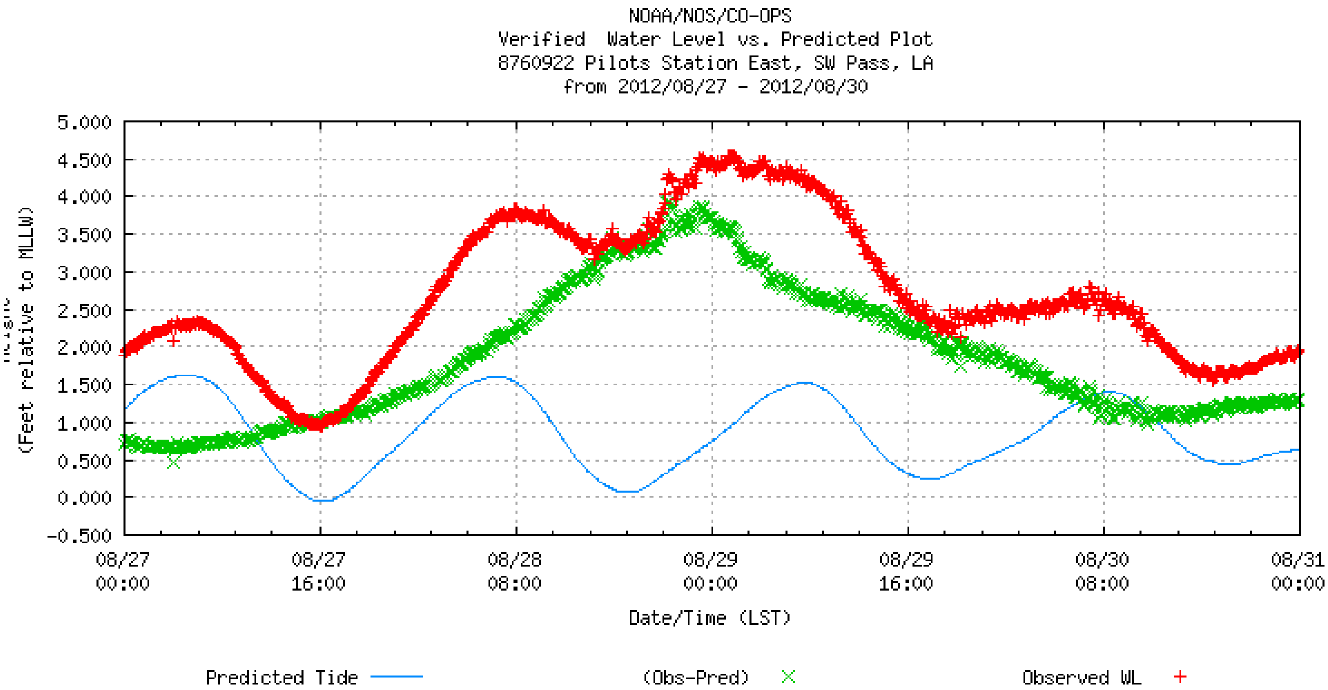


Fig.4. Storm surge at PSTL1 during Isaac.

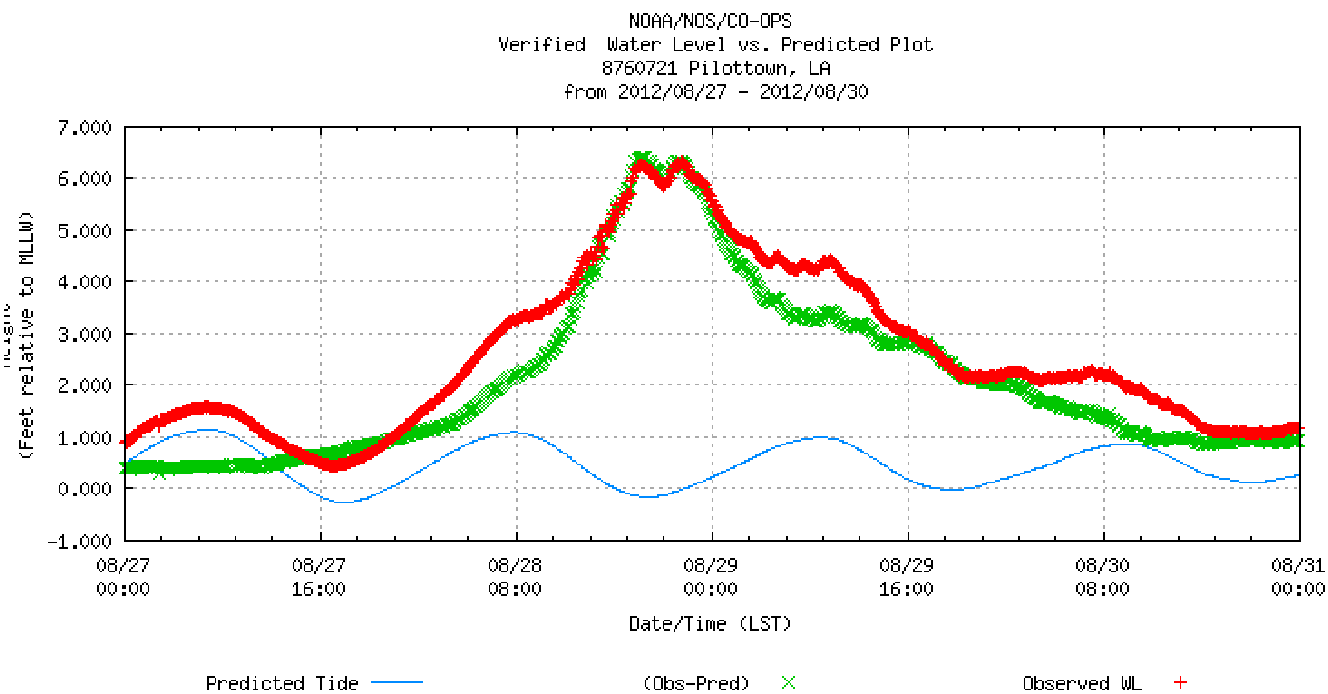


Fig. 5. Storm surge at PILL1 during Isaac.

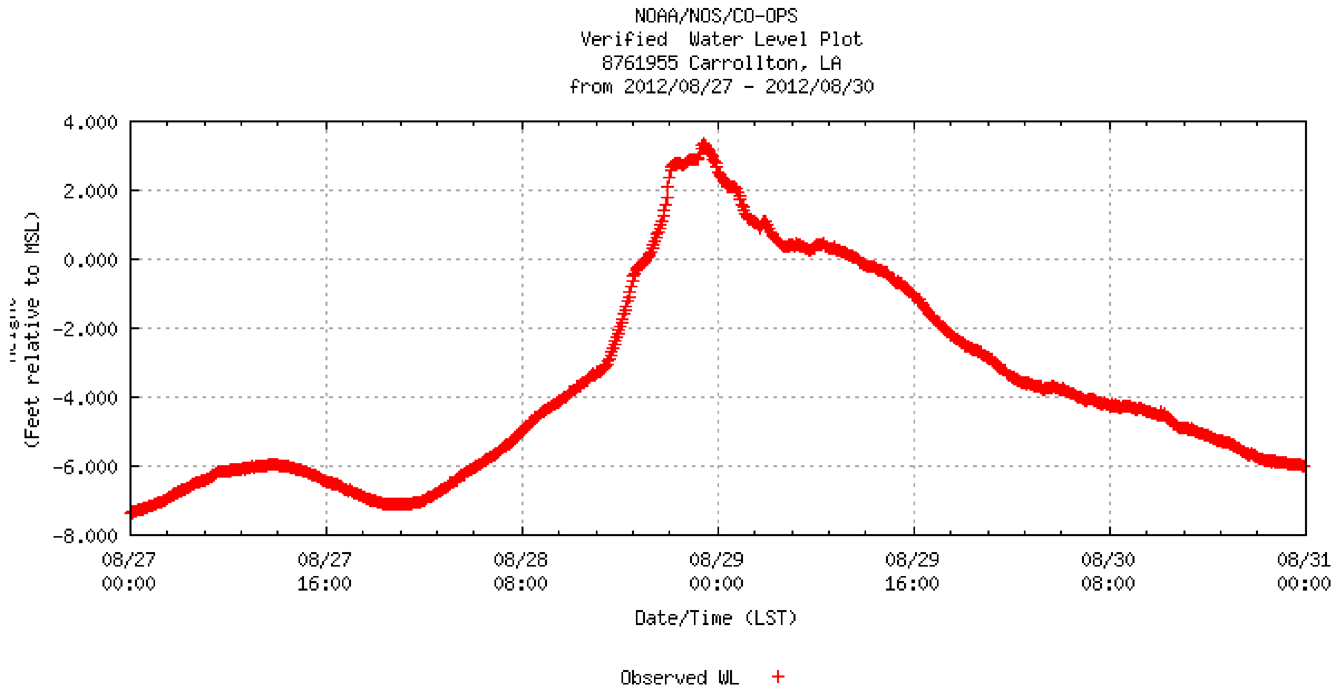


Fig.6. Storm surge at CARL1 during Isaac.

## 3. MISSISSIPPI RIVER FLOW REVERSAL

The phenomenon of flow reversal of the Mississippi River can best be seen in Figs. 7 and 8 based on U.S. Geological Survey (USGS) measurements at Belle Chase located just downstream from New Orleans, Louisiana. Fig.7 illustrates the occurrence of negative velocities in the afternoon on 28 Aug 2012 which lasted until the next morning, indicating clearly the phenomenon of river flow reversal. The river flow returned to its normal condition about two days later. Fig. 8 shows the river stage at Belle Chase, where the water level increased from approximately 8 to 18 ft in one day.

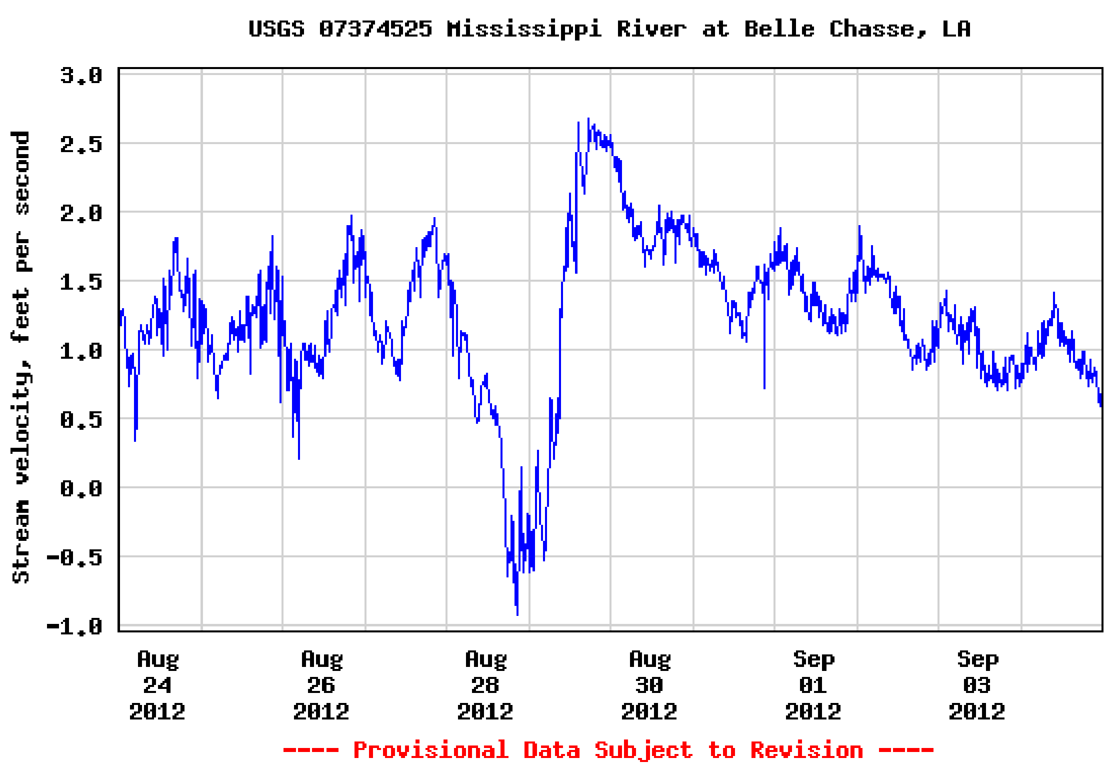


Fig.7. USGS measurements of river velocity at Belle Chase, LA during Isaac.

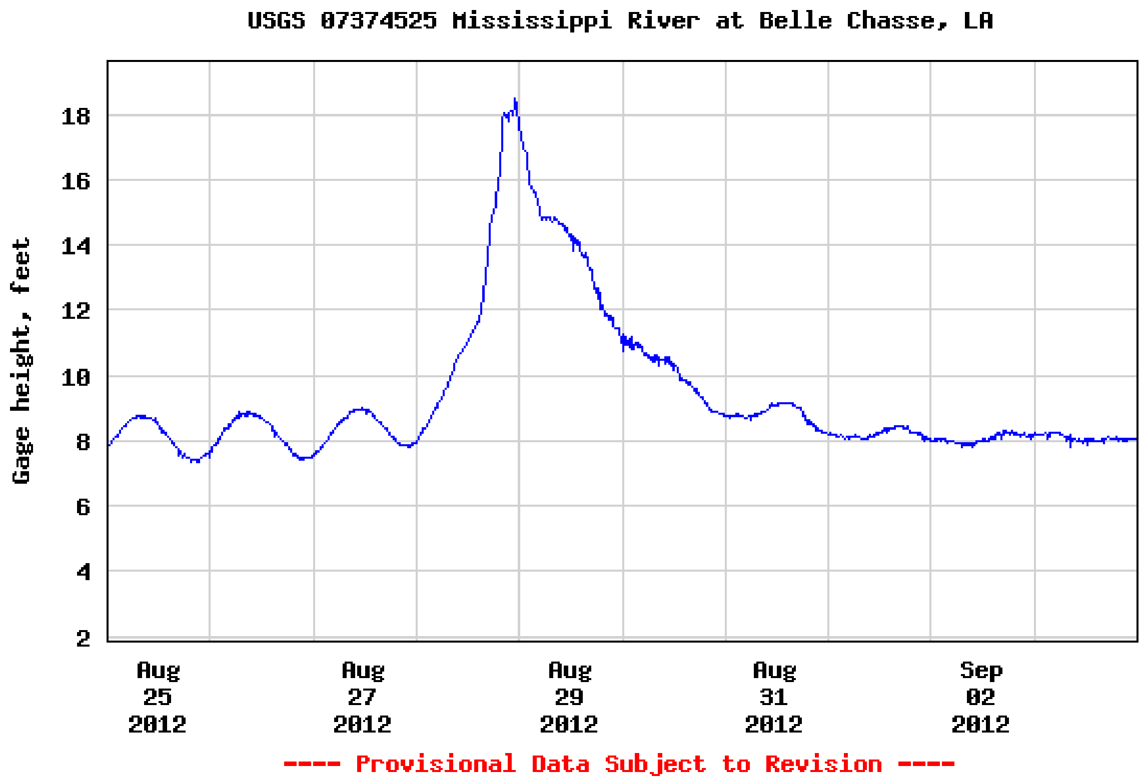


Fig.8. River stage at Belle Chase, LA, during Isaac based on USGS measurements.

More evidence of the Mississippi River flow reversal is provided in Figs. 9 and 10 for Donaldsonville and Baton Rouge, LA, respectively. These measurements were made by the U. S. Army Corps of Engineers (USACE). Note that these two stations are located at 173.6 and 228.4 river miles upstream from the river mouth, respectively. Figs.9 and 10 indicate that the net one-day increases in water elevation were 7.72 and 8.30 ft, respectively. Since the increase at Baton Rouge is higher than that at Donaldsonville, we can say that the Mississippi flow reversal can propagate all the way to Baton Rouge at a distance of over 200 river miles. Therefore, this flow reversal can cause navigational hazards in riverine traffic for ocean-going vessels and numerous barges along the Mississippi River.

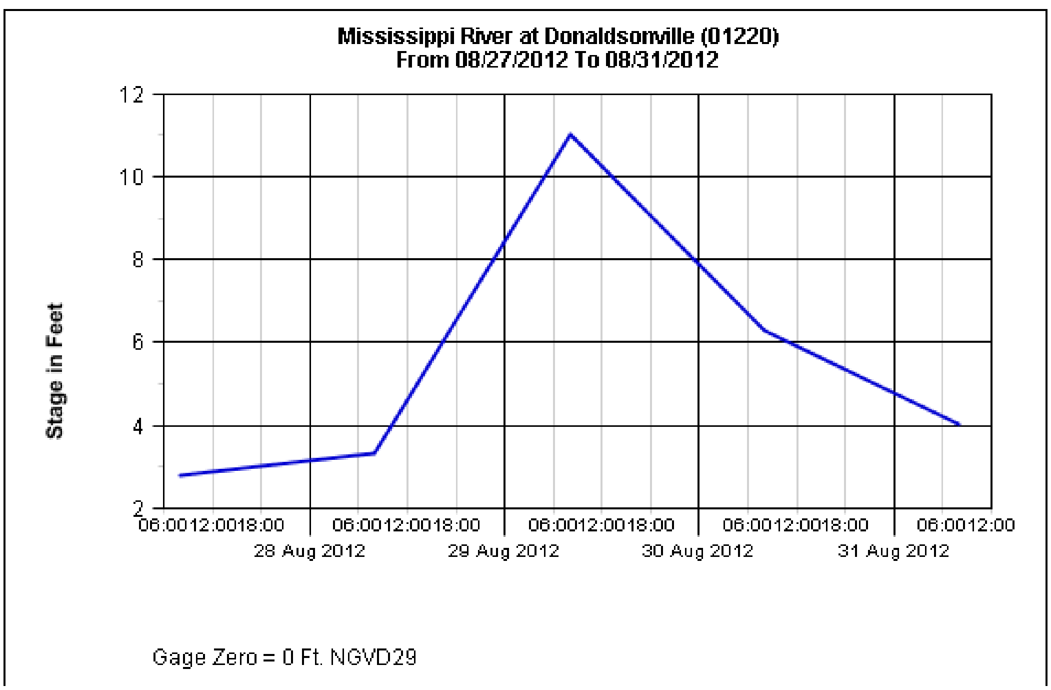


Fig.9. USACE measurements of the Mississippi River stage at Donaldsonville, LA during Isaac. Note that this station is located at 173.6 river miles upstream from the river mouth.

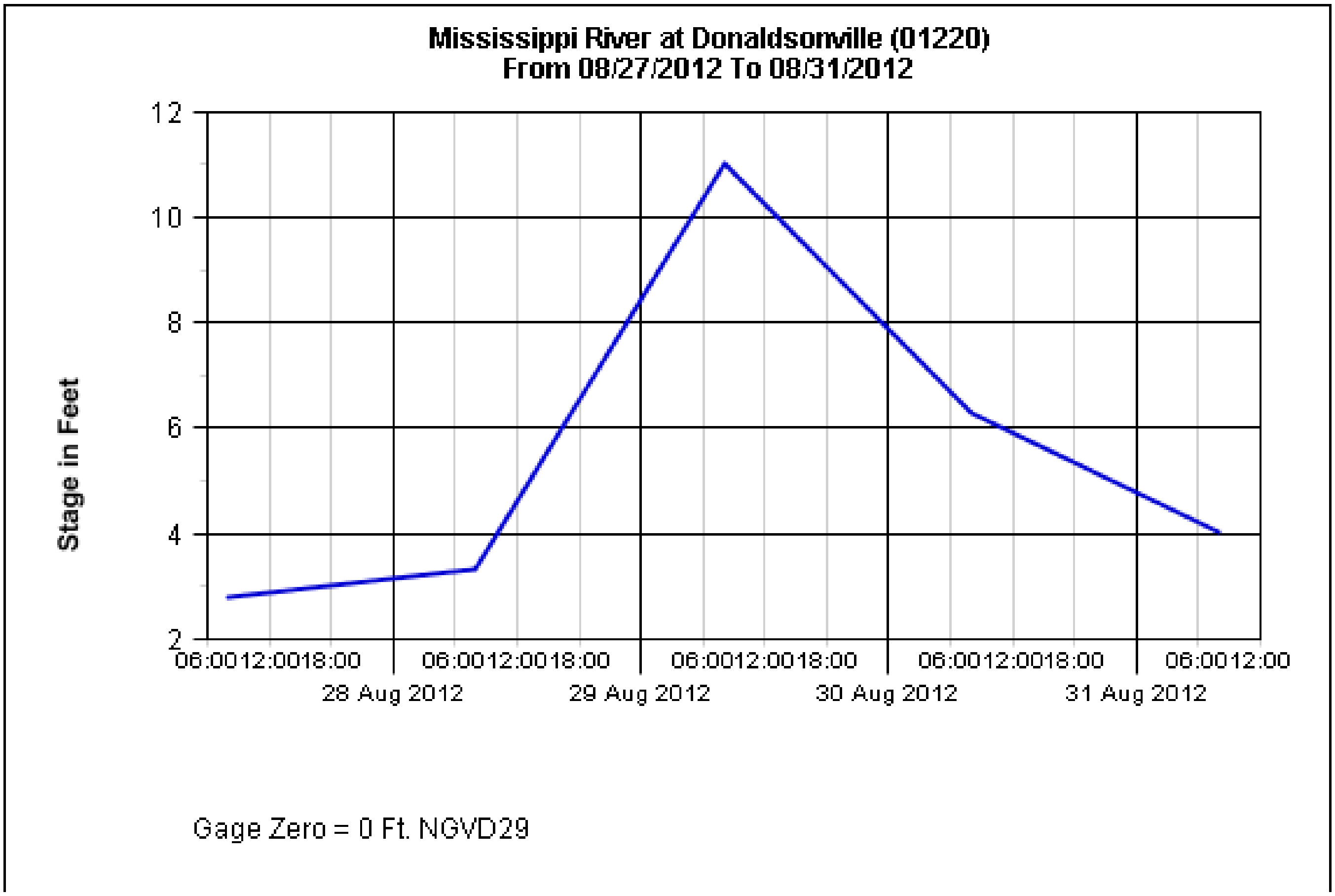


Fig.10. USACE measurements of the Mississippi River stage at Baton Rouge, LA during Isaac. Note that the station is located at 228.4 river miles upstream from the river mouth.

**4. A PHYSICAL EXPLANATION**

According to the storm track of Hurricane Isaac, the Mississippi River Delta area was located just on the right-hand side of the track so that both wind stress forcing and the inverse barometric effect must be taken into account. According to Hsu (2004), we have

$$S = K (1013-P) \quad (1)$$

where S is the storm surge in feet, K is a coefficient, and P is the atmospheric pressure in mb.

Equation (1) is verified in Fig. 11 so that

$$S = 0.14 (1013-P) \quad (2)$$
$$R^2 = 0.98 \quad (3)$$
$$R = 0.99 \quad (4)$$

where R is the correlation coefficient and $R^2$ is the coefficient of determination. Since $R^2$ is 0.98, indicating that 98 % of the storm surge in the Mississippi Delta area can be explained by the combination of both wind-stress forcing and inverse barometric effects. Therefore, Equation (2) is recommended for operational use.

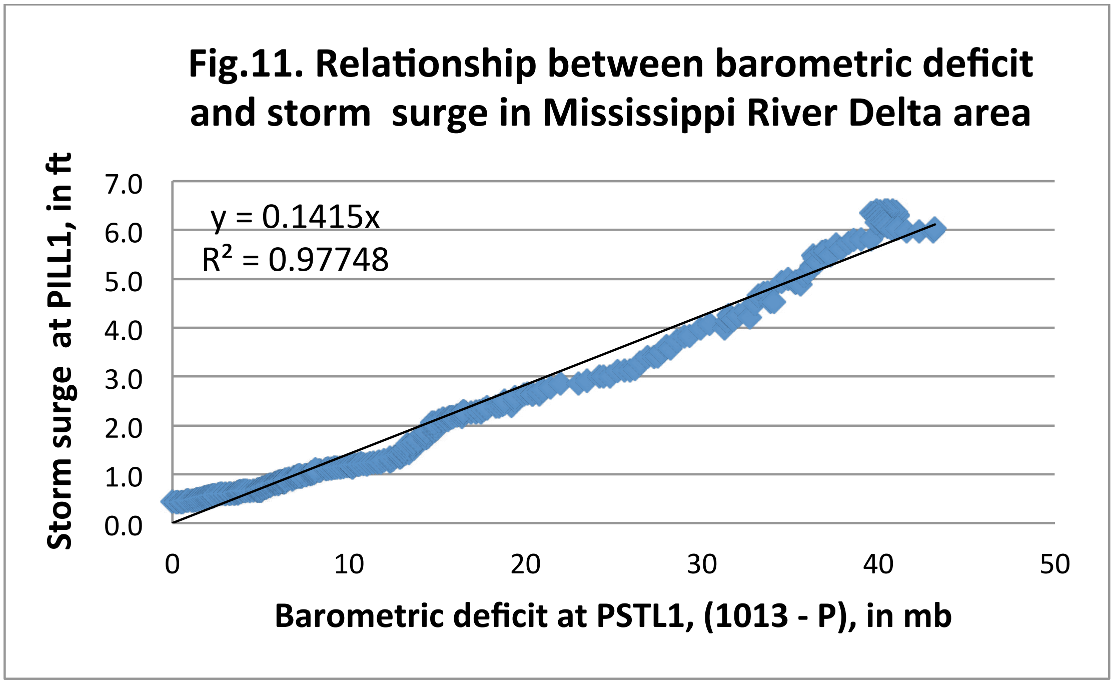


Fig.11. A verification of Equation (1).

**5. CONCLUSIONS**

During the passage of Hurricane Isaac in 2012 the Mississippi River Experienced flow reversal. This phenomenon is clearly demonstrated based on three independent and yet complimentary datasets as measured by USGS, USACE, and NOS. In order to explain this flow reversal physically, a formula is provided and verified. Since 98% of the storm surge in the Mississippi River Delta can be explained by the combination of both wind stress forcing and inverse barometric effects, Equation (2) is recommended for operational use.


## Acknowledgements:

Many thanks go to U.S. Geological Survey, U.S. Army Corps of Engineers, National Ocean Service, and National Data Buoy Center.


## References:


Berg, R., 2013:Tropical Cyclone Report, Hurricane Isaac. (see www.nhc.noaa.gov).

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, 28, pp25-31. ( see www.nwas.org).


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# SHIPWRECK: TRITONICA Sank 50 Years Ago

By Skip Gillham


**ROONAGH HEAD is shown at Sault Ste. Marie in a photo by Tom Manse, courtesy of Roger LeLievre.**

**TRITONICA is shown in June 1963, a month before being lost, in a photo by John Low, courtesy of Rene Beauchamp.**

The deep sea bulk carrier TRITONICA and the ROONAGH HEAD had been seen on radar at a distance of 7 and a half miles. Most of the evening of July 19-20, 1963, the visibility had been good on the St. Lawrence east of Quebec City, but a fog bank descended on the river near Ile D'Orleans and the two ships lost visual contact.

In the early hours of July 20, the TRITONICA emerged from the fog finding that the two ships were only a half mile apart. The latter vessel tried to veer out of the path of the outbound cargo ship but the bow of ROONAGH HEAD struck the inbound ore carrier a fatal blow.

Both ships were relatively new and had been working in Canadian and American waters, from time to time. TRITONICA had been built at Sunderland, England, and was completed in October 1956. The 527 foot, 11 inch long by 70 foot, 10 inch wide bulk carrier could carry 19,495 tons of cargo and initially served Dingwall Shipping under the flag of Great Britain.

With the opening of the St. Lawrence Seaway in 1959, the ship made three trips into the Great Lakes and was featured at Duluth in one of the many postcards printed to coincide with the opening of the long anticipated Seaway.

ROONAGH HEAD was eleven years old and had been built at Belfast, Northern Ireland, for the Ulster Steamship Co. It was completed on March 20, 1952, and began Great Lakes trading once the Seaway opened the freshwater lakes to vessels of this size. The 455 foot long by 60 foot wide cargo carrier could handle 9,211 tons deadweight and averaged three to four annual inland voyages beginning in 1959.

During the 1963 season, TRITONICA was being operated by Snowberry Co. Ltd. and registered in Bermuda for service on behalf of Canada Steamship Lines. It was chartered to the latter to carry ilmenite ore from Havre St. Pierre, on the north shore of the St. Lawrence, to the port of Sorel, Quebec, on the south shore east of Montreal. It had worked well on this route until the collision.

The ore laden TRITONICA sank quickly and there were only 17 survivors. Most of the 33 casualties were asleep in their bunks and had no chance to escape before their ship went down. The wreck landed on the bottom of the navigation channel and salvage efforts failed. In the fall of 1964, the hull was dynamited by Foundation Maritime and a trench was dug alongside the remains so that they would slide into deeper water.

ROONAGH HEAD remained afloat despite a huge gash in the bow. It was repaired and returned to service maintaining regular Great Lakes trading for several more years. The ship was finally sold to Spanish shipbreakers and arrived at the port of Castellon on September 14, 1971. Work on dismantling the hull got underway in October and the ship was broken up by Industrial y Comerical de Levante S.A.

An inquiry into the cause of the tragedy found both ships guilty of excessive speed for the conditions and at equal fault.

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# Mean Circulation Highlights and Climate Anomalies

## January through April 2013

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

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

### January-February 2013

January 500-hPa heights were above-average over the polar region, the Gulf of Alaska, the eastern conterminous United States, and the subtropical eastern North Atlantic. Below-average heights were observed over the central North Atlantic, southern Europe, and central Russia Figure 1. The sea-level pressure (SLP) pattern mirrors the 500-hPa pattern Figure 2.

Figure 1

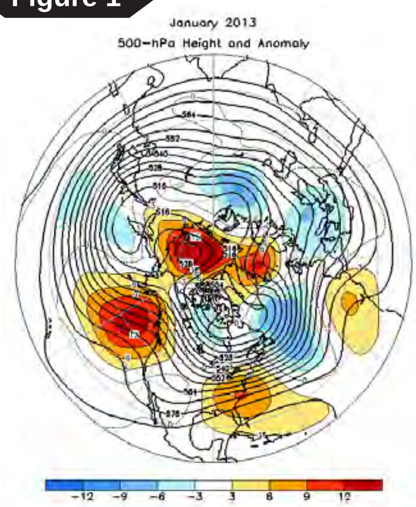
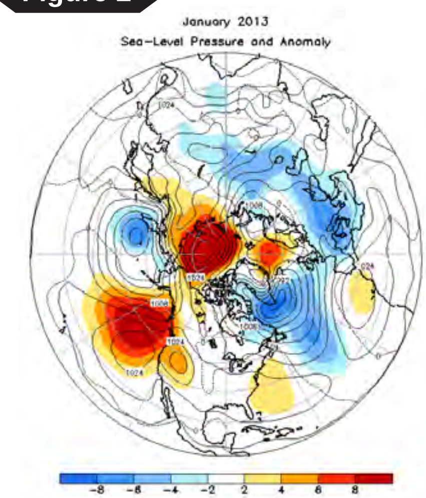



Figure 2




The 500-hPa circulation during February featured a general zonal wave-1 pattern at high latitudes and a zonal wave-3 pattern in the temperate latitudes. At high latitudes, above-average heights prevailed over the eastern North Atlantic and Greenland, and below-average heights prevailed over the North Pacific and Alaska. In the middle latitudes, above-average heights were observed over the central and eastern North Pacific, the eastern North Atlantic, and in the vicinity of the Caspian Sea, and below-average heights covered the eastern conterminous U.S., southern Europe, and Mongolia Figure 3. As was the case with January, the February SLP pattern largely mirrored its respective 500-hPa pattern, and also depicts an elongated, twin-lobed Aleutian Low Figure 4.

Figure 3

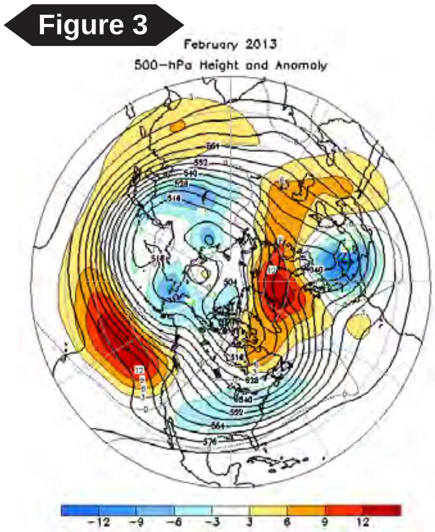
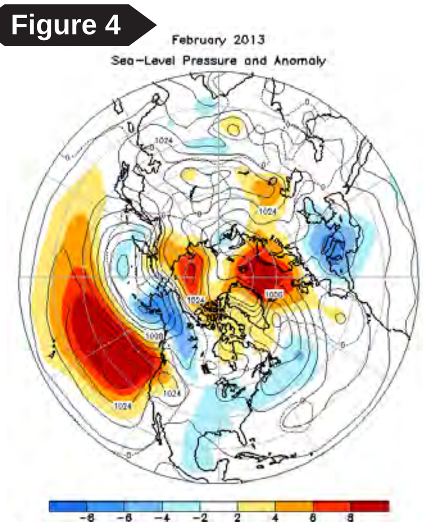



Figure 4




Wichita, KS and Portland, ME were two areas that received record-breaking heavy snowfall during this two-month period. Two major winter storms in less than a week brought a total of 53.3 cm of snow to Wichita, setting the all-time snowfall record for any month Reference 1. In New England, many snowfall records were shattered during a blizzard which affected the area on February 8-9. One such example is Portland, ME, which received 81.0 cm of snow, the most ever recorded there from a single snowstorm Reference 2.

## The Tropics

During January and February 2013, the sea surface temperatures (SSTs) remained colder-than-average across the eastern and east-central equatorial Pacific. The latest monthly Nino index for the Nino 3.4 region was -0.4C. Consistent with these conditions, the depth of the oceanic thermocline (measured by the depth of the 20C isotherm) remained below-average across the eastern and east-central equatorial Pacific, where corresponding sub-surface temperatures ranged from 1-5C below-average.

Equatorial low-level easterly trade winds remained near-average across the equatorial Pacific (January) and above-average across the west-central equatorial Pacific (February). Enhanced convection was observed across Indonesia and the western equatorial Pacific (January), and over the northern Indian Ocean and the western equatorial Pacific (February). Collectively, these oceanic and atmospheric anomalies reflect ENSO-neutral conditions.

## March-April 2013

The 500-hPa circulation pattern during March 2013 featured below-average heights from the eastern contiguous U.S. eastward across the North Atlantic and Europe, and much of Russia. Above-average heights were noted in the polar region and Greenland, along with several extensive east-west oriented patterns of height anomalies in the mid-latitudes Figure 5. The sea-level pressure and anomaly map (Figure 6) shows a pattern that resembles the 500-hPa circulation pattern fairly closely.

The month of April was characterized by above-average heights over the northern and eastern Pacific Ocean, the western North Atlantic, and southern Russia Figure 7. Below-average heights were observed over the western and central North Pacific Ocean, Canada, and over the vicinity of Iceland and Scandinavia. The SLP and anomaly field (Figure 8) largely mirrored the middle tropospheric flow pattern.

**Figure 5**

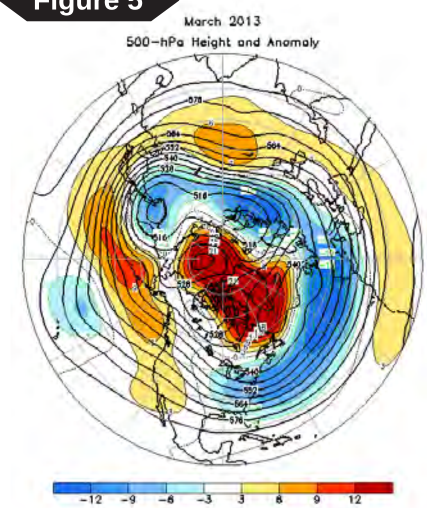



**Figure 6**

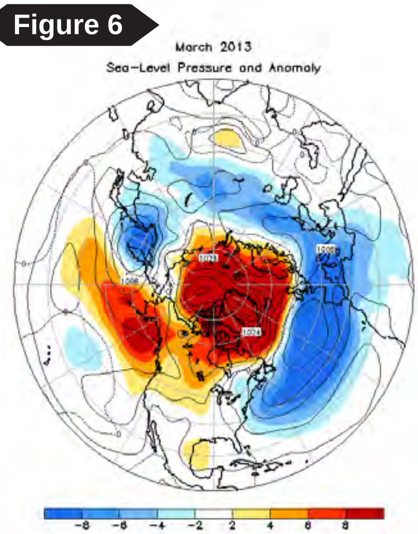



**Figure 7**

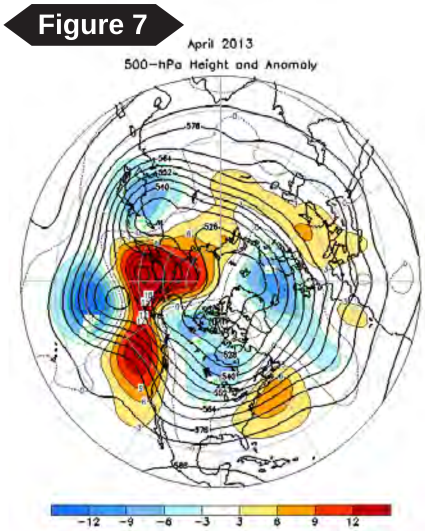
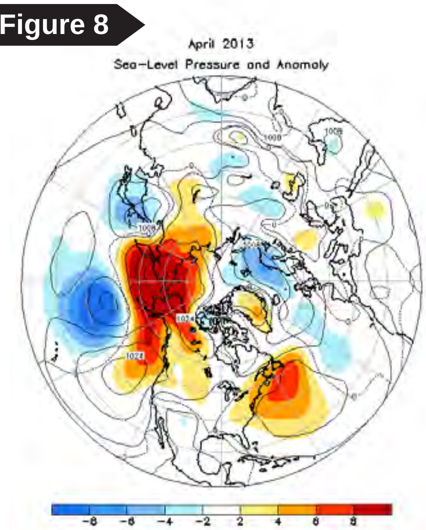



**Figure 8**



According to the National Climatic Data Center (NCDC) in Asheville, NC, the this was the coolest April for the contiguous U.S. since 1997 Reference 3. Unusually cold surface temperatures during March and April across the north-central contiguous U.S. resulted in significant agricultural impacts across the region. Frozen soils across the Midwest and western Great Lakes region ranged from several inches to several feet in depth, causing substantial delays in corn and soybean planting. The core of this unusually cold air was observed in North Dakota, where average temperatures in both March and April ranged as much as 5.6C - 6.7C below average Reference 4. Between April 13-15, a major late-season snowstorm brought record amounts of snow to North Dakota. The National Weather Service Office in Bismarck recorded 45.0 cm of snow from this event, breaking several daily and monthly snowfall records for this area Reference 5.

## The Tropics

ENSO-neutral conditions persisted through March and April 2013. Sea surface temperatures (SSTs) remained near-average across most of the equatorial Pacific. The latest monthly Nino indices for the Nino 3.4 region were -0.2C (March) and -0.1C (April), and the depth of the 20C isotherm (oceanic thermocline) remained near-average across the central and east-central equatorial Pacific. Equatorial low-level easterly trade winds were near-average across the equatorial Pacific (March) and slightly above-average over the western equatorial Pacific (April). Enhanced convection was observed over the western equatorial Pacific in both March and April, with enhanced convection also noted across Indonesia in April.

## References

http://www.crh.noaa.gov/ict/scripts/viewstory.php?STORY_NUMBER=2013022821
http://www.erh.noaa.gov/gyx/EventSummaries/Blizzard2013_1.php
http://www.ncdc.noaa.gov/sotc/service/global/extremes/201304.gif
http://www.cpc.ncep.noaa.gov/products/tanal/temp_analyses.php
http://www.crh.noaa.gov/news/display_cmsarchive.php?wfo=bis

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.

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

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# Tropical Atlantic and Tropical East Pacific Areas

## January through April 2013

*Jessica Schauer and Marshall Huffman*
*Tropical Analysis and Forecast Branch,*
*National Hurricane Center, Miami, Florida*
*NOAA National Centers for Environmental Prediction*

On 4 March 2013, the National Hurricane Center's (NHC) Tropical Analysis and Forecast Branch (TAFB) adopted a new format for their High Seas Forecasts. The old format described only areas where forecast conditions were expected to meet or exceed gale, storm, or hurricane force warning criteria in the Warnings section of the text while advisory conditions with winds from 20-30 kts and seas of 8 ft or above occurring outside the warning area, but associated with the same region or meteorological feature, were described in the synopsis section. This parsing of the conditions made it difficult for users to keep track of the entire forecast for a particular region or meteorological feature. The new format places all advisory and warning conditions associated with an area or meteorological feature with winds meeting or exceeding warning criteria, either at the current time or during the 48 hour forecast period, in the warnings section. This is consistent with the format of the *High Seas* forecasts issued by the Ocean Prediction Center. Examples of the old and new formats can be seen in ***Figure 1*** below.

**Old Format**

```
.WARNINGS.

...GALE WARNING...
.24 HOUR FORECAST WITHIN 30 NM EITHER SIDE OF LINE 14N94.5W TO
14N95.5W...INCLUDING THE GULF OF TEHUANTEPEC...N TO NE WINDS 30
TO 35 KT. SEAS 9 TO 14 FT. ELSEWHERE N OF 13N BETWEEN 93W AND
97W N TO NE WINDS 20 TO 30 KT. SEAS TO 11 FT.
.36 HOUR FORECAST WINDS LESS THAN GALE FORCE.

.SYNOPSIS AND FORECAST.

.12 HOUR FORECAST GULF OF TEHUANTEPEC...N WINDS 20 TO 25 KT.
SEAS LESS THAN 8 FT.
.18 HOUR FORECAST WITHIN 30 NM EITHER SIDE OF LINE 14N94.5W TO
14N95.5W...INCLUDING THE GULF OF TEHUANTEPEC...N TO NE WINDS 20
TO 30 KT. SEAS TO 10 FT.
.36 HOUR FORECAST WITHIN AREA BOUNDED BY 16N94.5W TO 12.5N93W TO
11N98W TO 16N94.5W N TO NE WINDS 20 TO 30 KT. SEAS TO 11 FT.
.42 HOUR FORECAST WITHIN AREA BOUNDED BY 15N95W TO 11N94W TO
10N100W TO 15N95W WINDS 20 KT OR LESS. SEAS TO 9 FT IN MIXED NE
AND SW SWELL.
.48 HOUR FORECAST WITHIN 180 NM OF 11N99W WINDS 20 KT OR LESS.
SEAS TO 8 FT IN MIXED NE AND SW SWELL.
```

**New Format**

```
.WARNINGS.

...GALE WARNING...
.12 HOUR FORECAST GULF OF TEHUANTEPEC...N WINDS 20 TO 25 KT.
SEAS LESS THAN 8 FT.
.18 HOUR FORECAST WITHIN 30 NM EITHER SIDE OF LINE 14N94.5W TO
14N95.5W...INCLUDING THE GULF OF TEHUANTEPEC...N TO NE WINDS 20
TO 30 KT. SEAS TO 10 FT.
.24 HOUR FORECAST WITHIN 30 NM EITHER SIDE OF LINE 14N94.5W TO
14N95.5W...INCLUDING THE GULF OF TEHUANTEPEC...N TO NE WINDS 30
TO 35 KT. SEAS 9 TO 14 FT. ELSEWHERE N OF 13N BETWEEN 93W AND
97W N TO NE WINDS 20 TO 30 KT. SEAS TO 11 FT.
.36 HOUR FORECAST WITHIN AREA BOUNDED BY 16N94.5W TO 12.5N93W TO
11N98W TO 16N94.5W N TO NE WINDS 20 TO 30 KT. SEAS TO 11 FT.
.42 HOUR FORECAST WITHIN AREA BOUNDED BY 15N95W TO 11N94W TO
10N100W TO 15N95W WINDS 20 KT OR LESS. SEAS TO 9 FT IN MIXED NE
AND SW SWELL.
.48 HOUR FORECAST WITHIN 180 NM OF 11N99W WINDS 20 KT OR LESS.
SEAS TO 8 FT IN MIXED NE AND SW SWELL.
```

***Figure 1.*** Examples of the old (left) and new (right) TAFB High Seas Forecast format for describing regions or meteorological features with conditions that meet warning criteria sometime within the 48 hour forecast period.

Another significant change in TAFB products has recently been implemented for non-tropical cyclone warnings. The criteria for gale, storm, and hurricane force wind warnings in marine products now include frequent gusts that meet the warning threshold. This change is consistent with National Weather Service Instruction 10-311 Section 2.3.5 "Headlines". This directive states that "in situations where winds gusts [are] frequently above advisory/warning thresholds, forecasters should use discretion in issuing advisories or warnings, as appropriate, to alert users and partners to hazardous marine conditions. Gusts occurring on a time-scale greater than two hours are considered frequent. Gusts should not be forecast unless they are expected to be at least 10 kts greater than the sustained wind."

## Tropical North Atlantic Ocean including the Caribbean Sea and the Gulf of Mexico

The TAFB Atlantic High Seas area of responsibility (AOR) extends from 7°N to 31°N west of 35°W, including the Caribbean Sea and Gulf of Mexico. Twenty five gale warnings were issued for this area in from January through April 2013; no storm or hurricane force wind warnings were issued. The number of warnings was up from the January through April five-year average of 23.6 warnings. The slightly higher number of warnings may have been due to the above-mentioned change in warning criteria to include frequent gusts above gale force. The Gulf of Mexico saw one more warnings while the Caribbean saw two more warnings than the 5-year average for their respective basins.

### GULF OF MEXICO GALE WARNINGS

**Table 1.** Non-tropical cyclone warnings issued for the Gulf of Mexico between 01 January 2013 and 30 April 2013.

| Onset | Region | Peak Wind Speed | Duration | Forcing |
|---|---|---|---|---|
| 1200 UTC 03 Jan | SW Gulf of Mexico | 35 kts | 24 hr | Cold Front |
| 1800 UTC 05 Jan | W Central Gulf of Mexico | 35 kts | 6 hr | Cold Front |
| 1200 UTC 16 Jan | Northern Gulf of Mexico | 40 kts | 42 hr | Cold Front |
| 1200 UTC 30 Jan | Western Gulf of Mexico | 40 kts | 24 hr | Cold Front |
| 0000 UTC 26 Feb | Western Gulf of Mexico | 35 kts | 6 hr | Cold Front |
| 0000 UTC 6 Mar | Western Gulf of Mexico | 35 kts | 6 hr | Cold Front |
| 0600 UTC 11 Mar | Western Gulf of Mexico | 35 kts | 18 hr | Cold Front |
| 1800 UTC 24 Mar | Western Gulf of Mexico | 35 kts | 6 hr | Cold Front |
| 0600 UTC 19 Apr | Western Gulf of Mexico | 35 kts | 24 hr | Cold Front |

***Table 1*** details the warnings issued in the Gulf of Mexico from 01 January through 30 April 2013. The first gale of 2013 in the Gulf of Mexico persisted for 24 hours in the southwest portion of the Gulf. Strong high pressure built slowly from the north behind a cold front that stalled from Tampa Bay to the Bay of Campeche as seen in ***Figure 2***. The pressure gradient between the ridge extending southward from the high over the U.S. southern plains into coastal northeast Mexico and the frontal boundary generated gale-force winds in the southwestern Gulf. The **Bonn Express** (ZCEG4) saw seas of 5 m (15 ft) and confirmed the gale force winds in the warning area when it reported 35 kts north-northwest winds near 19.0°N 95.5°W at 0600 UTC 4 January.

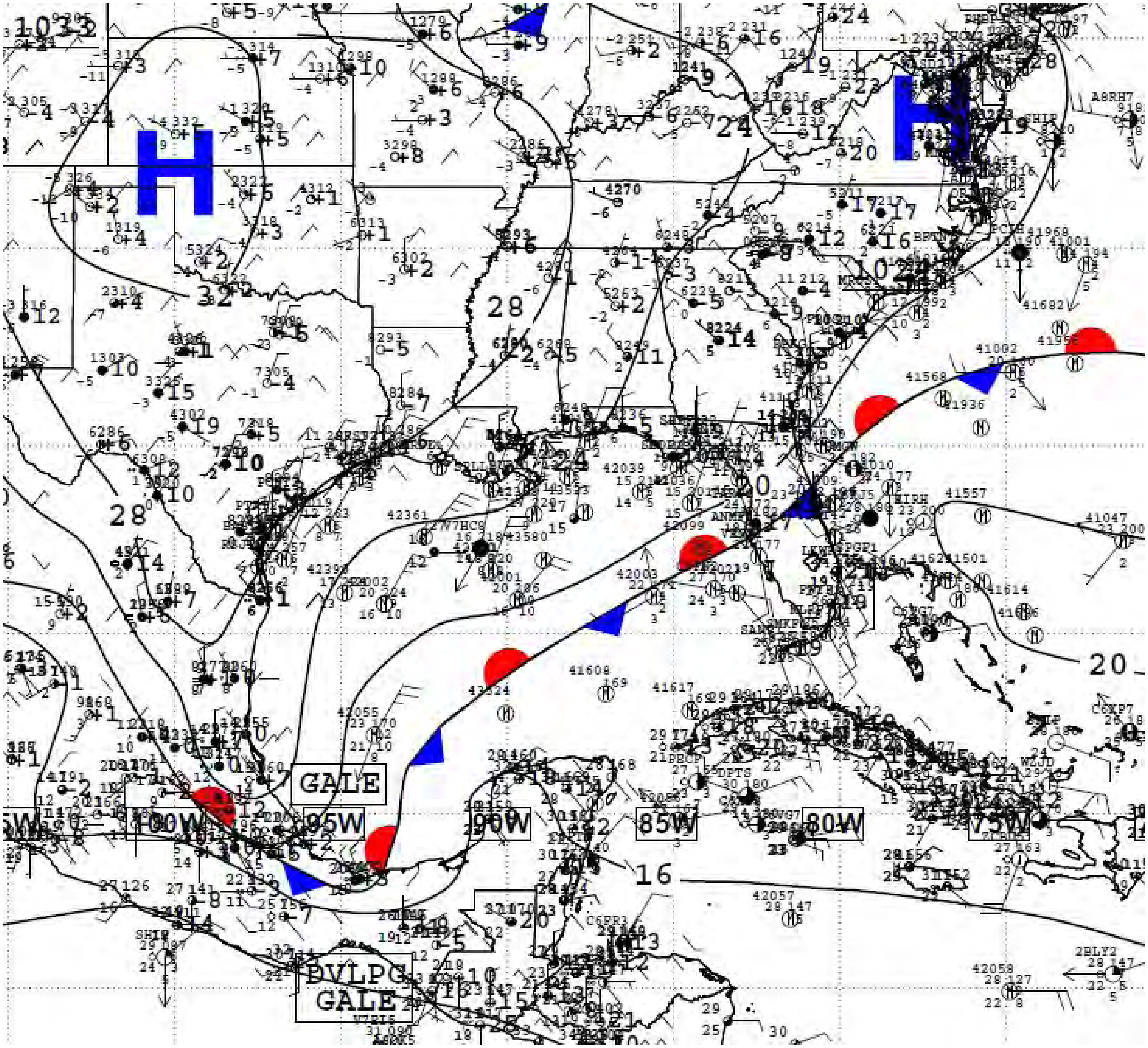


***Figure 2.*** National Weather Service Unified Surface Analysis (USA) valid 1800 UTC 03 January 2013.

The second gale warning event of 2013 was short lived, lasting from 1800 UTC 5 January to 0000 UTC 6 January. An **unknown ship** (WDG275) tracking through the warning area at 1800 UTC 5 January reported 36-kts north-northeast winds near 27.6°N 94.9°W and 3 m (10 ft) seas. This event was triggered by a secondary surge of cold dry air moving equator ward through the western Gulf of Mexico behind the front that had triggered the gale that began on 3 January.

The longest gale warning period in the Gulf of Mexico persisted for 42 hours and began at 1200 UTC 16 January. A sharp upper trough slowly moved through the U.S. southern plains and sent a strong cold front through the western Gulf. Post-frontal northwest winds to 40 kts were initially noted over the western Gulf south of 25°N. The container ship **CSAV Rungue** (A8QL5) reported 41 kts north-northwest winds near 22.4°N 97.4°W at 1200

UTC 16 January and 3 m (10 ft) seas. The associated upper trough became a cut off low over the lower Mississippi Valley on 17 January. This unusual pattern spurred strong winds at the surface over the northeastern Gulf. By 1200 UTC 17 January, sustained 30 kts winds with frequent gusts above gale force were noted behind the front over the northeastern Gulf north of 28°N. These conditions initiated the first gale warning of 2013 that included warnings for frequent gusts. The **Tyndall Air Force Base Tower C** (SGOF1) and the **Mars Mississippi Canyon** (42363) fixed drilling platform, both with an observing height over 35 m (115 ft), noted 35 kts winds in the northeastern Gulf between 1700 UTC and 2300 UTC on 17 January. ***Figure 3*** shows the 1506 UTC MetOp Advanced SCATerometer (ASCAT) pass from 17 January. Note the blue barbs indicating 35-40 kts winds in the northeastern Gulf that reached the surface. Warnings were discontinued in the Gulf by 0600 UTC 18 January as the upper low weakened and lifted northeastward.

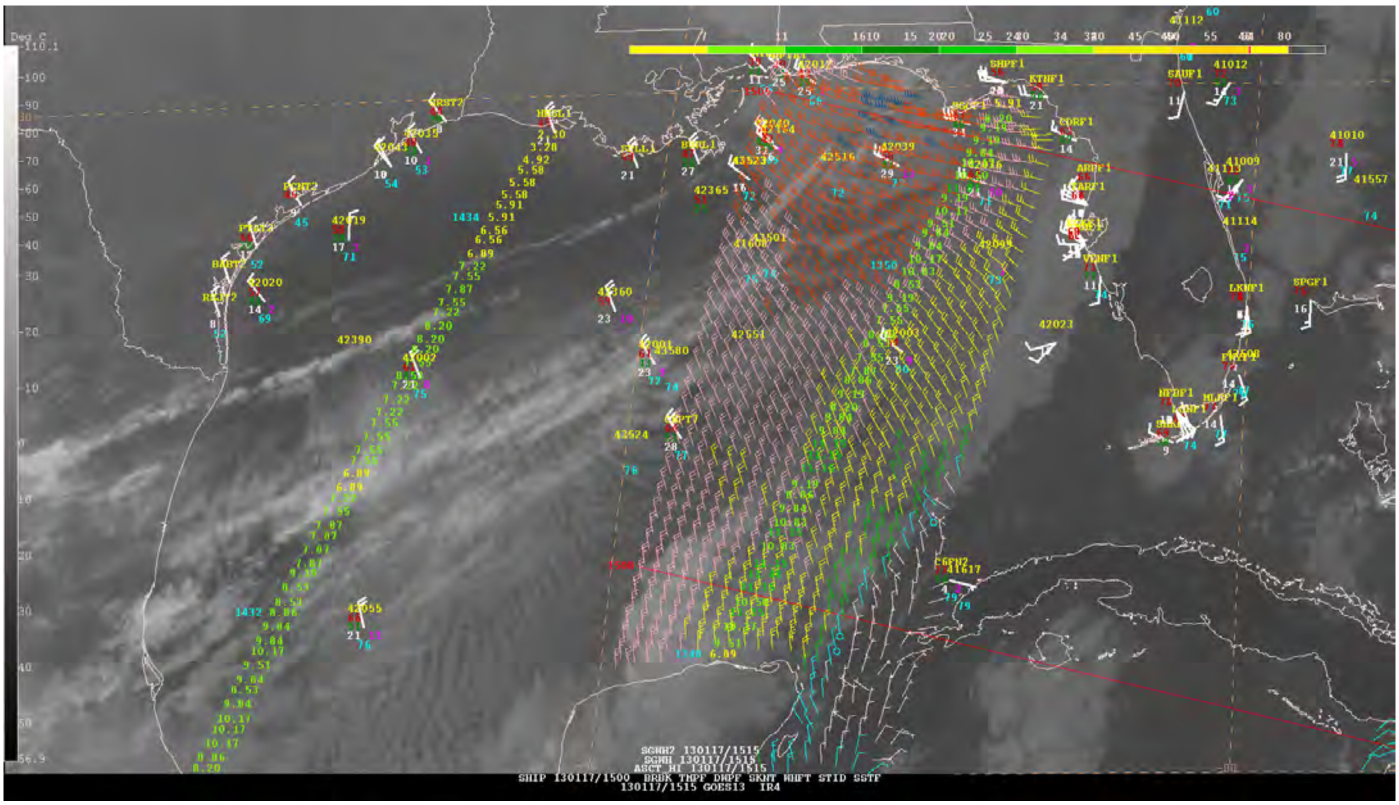

***Figure 3.*** The National Oceanic and Atmospheric Administration's (NOAA) Geostationary Operational Environmental Satellite East (GOES-E) infrared imagery overlaid with ship and buoy observations, altimeter passes from the National Aeronautics and Space Administration's (NASA) Jason-1 and Jason-2 as well as a scatterometer pass from the MetOp Advanced SCATerometer (ASCAT) valid around 1500 UTC 17 January.

Four gale warning events in the Gulf of Mexico in late January through mid-April were confined to the western Gulf behind strong but progressive cold fronts. All of these events persisted for less than 24 hours. Ships **Bernardo Quintana** (C6KJ5) and **Eagle Sydney** (3FUU) confirmed gale conditions on 30 January in the western Gulf.

The last gale warning issued in the Gulf of Mexico for the January through April 2013 period persisted for 24 hours. This late-season gale began on 19 April at 0000 UTC as a deep-layered trough passed through the U.S. southern plains on 18 April and sent a cold front at the surface off the Texas coast just before 0000 UTC 19 April. This front was reinforced by a secondary shortwave system that moved along the northern Gulf coastal plain into the mean trough aloft on 19 April. This shortwave allowed the surface cold front to also be reinforced and extended the period of gale force winds. ***Figure 4*** shows the conditions on 19 April. Note the gale force winds along the Mexican coast depicted by the blue barbs on the 1644 UTC ASCAT pass. Several ships saw gale force winds on 19 April, including the **Eagle Beaumont** (S6JO) near 29.2°N 94.4°W at 0900 UTC, the **Deepwater Champion** (YJVM9) near 26.9°N 94.7°W at 1100 UTC, and the **Disney Magic** (C6PT7) near 25.7°N 90.1°W at 1700 UTC. Seas to 5 m (16 ft) were noted by the Jason-1 pass in ***Figure 4***. The mean upper trough wrapped up into an upper low northeast of the area allowing ridging to build over the Gulf by 20 April when gale force winds diminished.

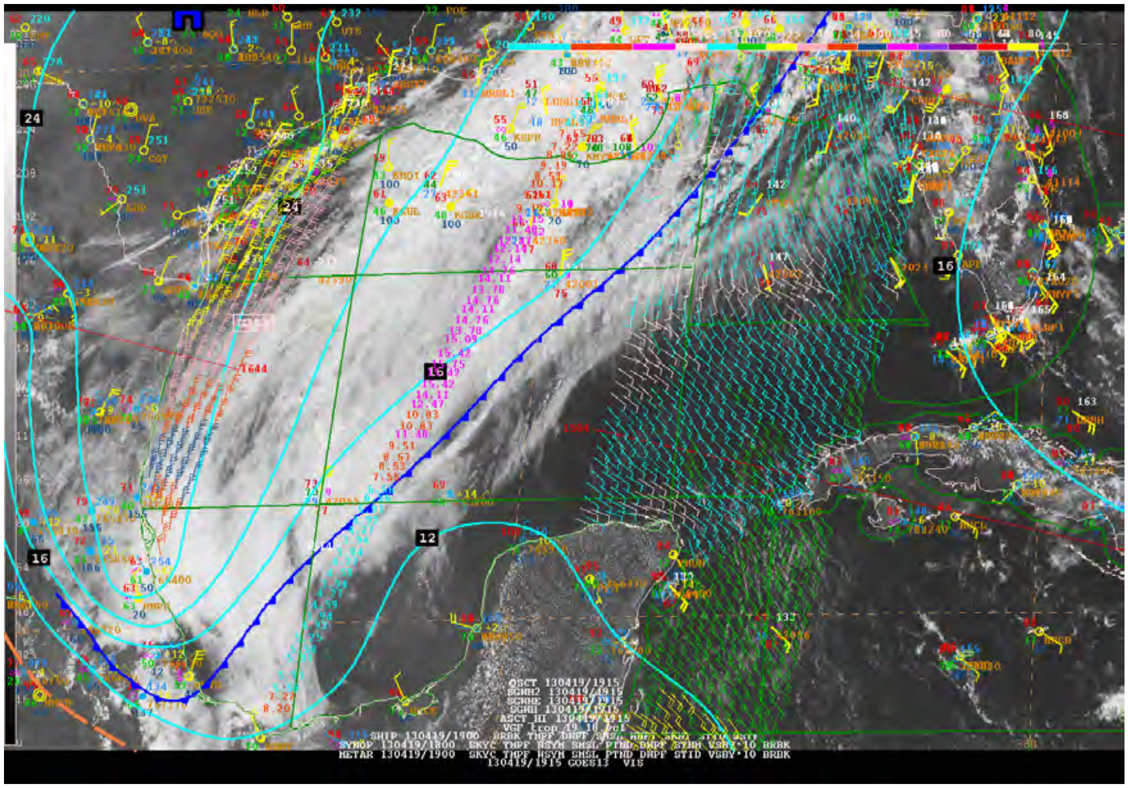

***Figure 4.*** GOES-E infrared imagery from 1915 UTC 19 April overlaid with the 1800 UTC National Weather Service (NWS) Unified Surface Analysis (USA), ASCAT passes from approximately 1500 UTC and 1645 UTC, and a Jason-1 pass from around 1915 UTC.

## ATLANTIC OCEAN GALE WARNINGS

***Table 2.*** Non-tropical cyclone warnings issued for the Atlantic Ocean between 01 January 2013 and 30 April 2013.

| Onset | Region | Peak Wind Speed | Duration | Forcing |
|---|---|---|---|---|
| 1200 UTC 11 Jan | NE Atlantic Forecast Waters | 40 kts | 114 hr | Low Pressure |
| 0000 UTC 18 Jan | NW Atlantic Forecast Waters | 35 kts | 18 hr | Cold Front |
| 1800 UTC 31 Jan | NE Atlantic Forecast Waters | 35 kts | 54 hr | Low Pressure |
| 0000 UTC 17 Feb | NW Atlantic Forecast Waters | 35 kts | 24 hr | Cold Front |
| 1200 UTC 22 Feb | N Cntrl Atlc Forecast Waters | 35 kts | 42 hr | Cold Front |
| 0000 UTC 3 Mar | NE Atlantic Forecast Waters | 40 kts | 30 hr | Cold Front |
| 1800 UTC 4 Mar | N Cntrl Atlc Forecast Waters | 35 kts | 30 hr | Cold Front |
| 1200 UTC 6 Mar | NW Atlantic Forecast Waters | 40 kts | 48 hr | Cold Front |
| 0000 UTC 9 Mar | N Cntrl Atlc Forecast Waters | 40 kts | 36 hr | Cold Front |
| 1800 UTC 24 Apr | NE Atlantic Forecast Waters | 40 kts | 18 hr | Cold Front |

***Table 2*** describes the 10 non-tropical cyclone warnings issued for the Atlantic Ocean from 07°N-31°N west of 35°W between 01 January 2013 and 30 April 2013. The longest gale warning within the TAFB AOR during this period occurred over the far northeast Atlantic waters. This nearly 5-day warning period began on 11 January at 1200 UTC. The impetus for the warning was a persistent, deep layered low center parked just north of the forecast area.

***Figure 5*** shows conditions at the beginning of the warning period. Note the cold air cumulus clouds coinciding with the gale force winds (blue wind vectors). Northwest swell built significant wave heights as high as 10 m (33 ft) over the forecast area during the warning period. The tanker **Ronald N** (A8PQ3) reported 40 kts northwest winds near 29.9°N 44.9°W on 15 January at 0600 UTC, confirming the gale conditions.

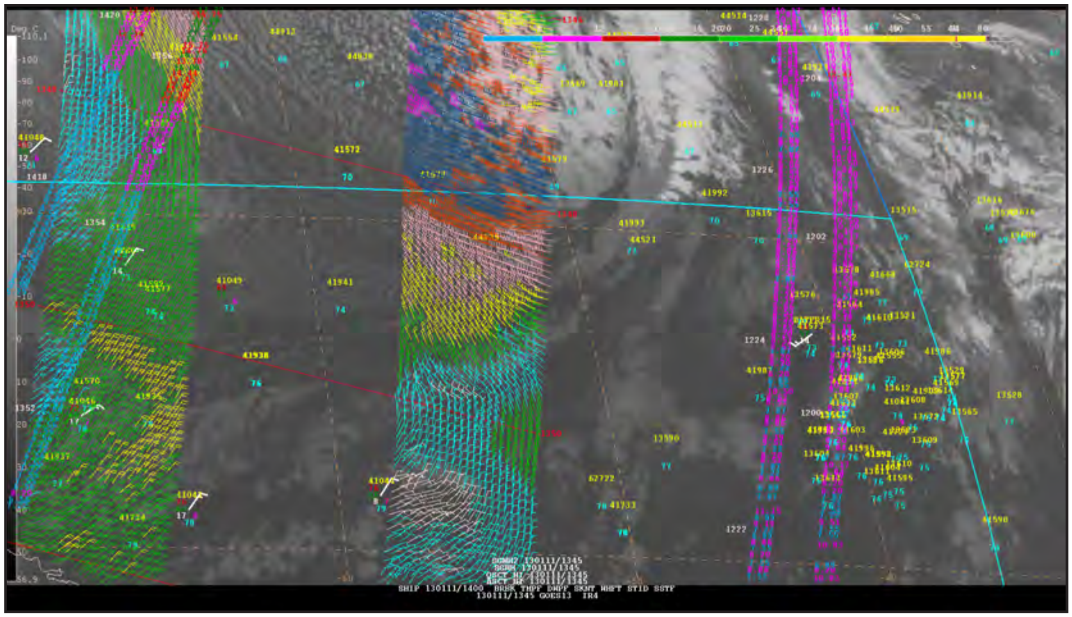

***Figure 5.*** GOES-E infrared imagery from 1345 UTC 11 January overlaid with ship and buoy observations from 1400 UTC, an ASCAT pass from 1548 UTC, and a Jason-1 and Jason-2 passes from around 1200 UTC and 1400 UTC. The light blue lines mark the TAFB AOR south of 31N and west of 35W.

The meteorological conditions associated with the gale lasting from 1800 UTC 31 January through 0000 UTC 3 February were similar in nature to the first warning period and were the result of a deep-layered low that developed within the TAFB AOR. ***Figure 6*** shows the surface analysis from 1800 UTC 1 February. This pattern changed little during the warning period. Notice the tight pressure gradient between the associated surface low near 25°N40°W and the 1034 hPa high pressure system centered to the north-northeast. This gradient resulted in gale force winds, primarily north of the low, which persisted for over two days.

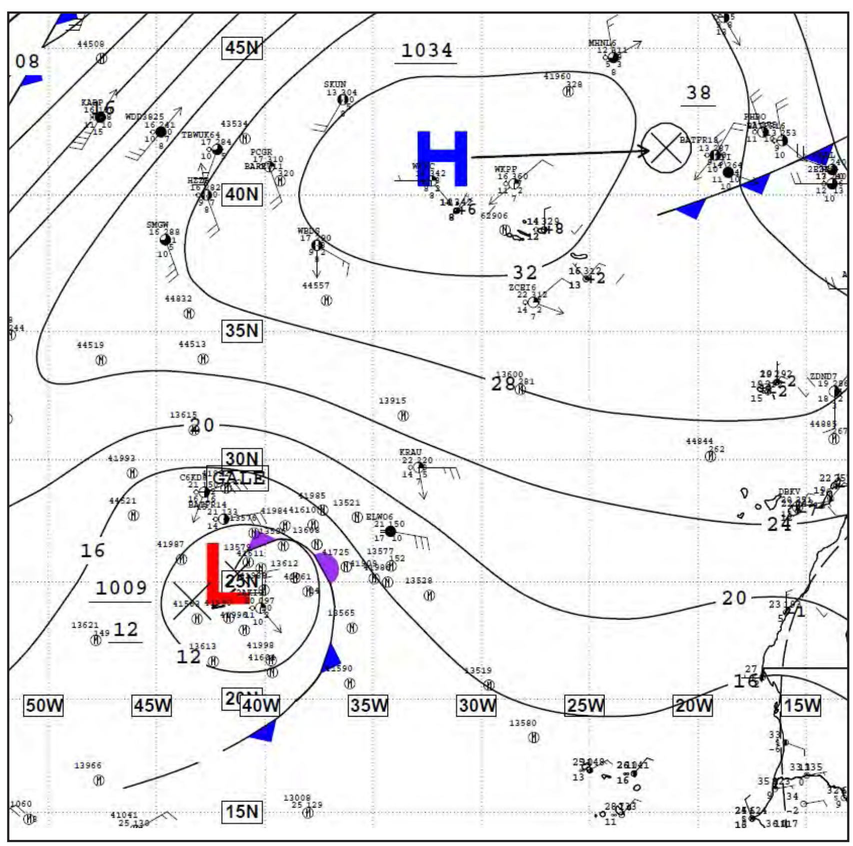


***Figure 6.*** National Weather Service (NWS) Unified Surface Analysis (USA) valid 1800 UTC 1 February 2013.

The remaining two gale events that impacted the northeastern portion of the TAFB AOR were shorter lived. These events began at 0000 UTC 3 March and 1800 UTC 24 April, respectively. Both events saw winds to 40 kts and seas over 6.5 m (20 ft). ***Figure 7*** shows the analysis of significant wave heights valid 0000 UTC 4 March. Note the large northwest swell over the northeastern portion of the forecast area.

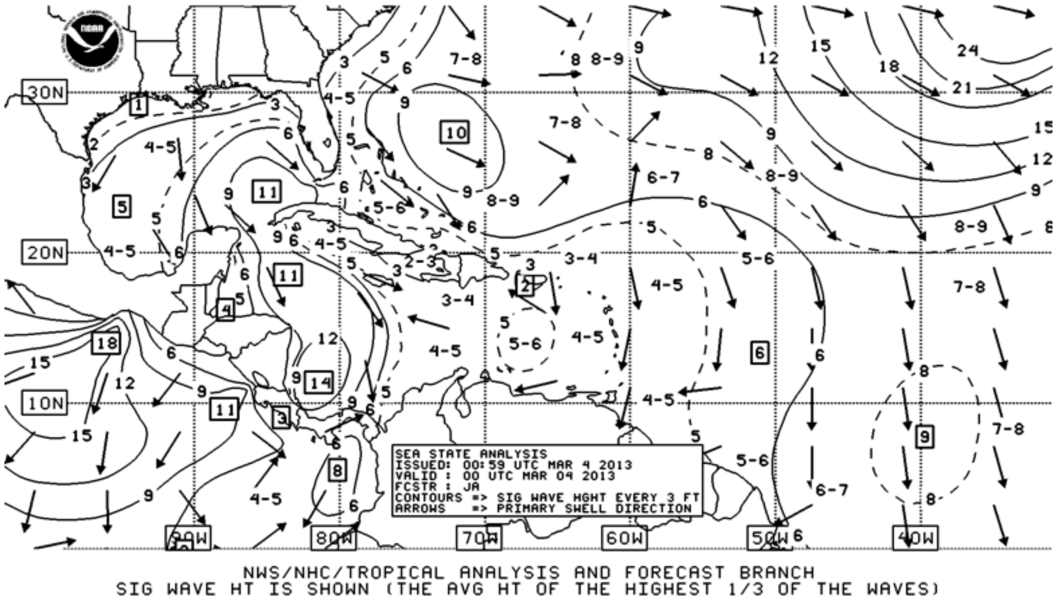


***Figure 7.*** TAFB significant wave height analysis valid 0000 UTC 4 March 2013.

Three cold fronts moving off the Florida coast triggered gale force winds in the offshore waters during the January-April 2013 period. The first of these events began on 18 January at 0000 UTC when a cold front that generated gale-force winds to the northeastern Gulf of Mexico made its way eastward into the Atlantic.

***Figure 8*** shows the surface analysis from 0000 UTC 18 January when gale warnings were active both in the Gulf of Mexico and off the northeast Florida coast. Ships **Monarch of the Seas** (C6FZ9), **Horizon Producer** (WJBJ), **MSC Ilona** (DARU), and **Houston** (KCDK) all reported minimal gale conditions within the Atlantic warning area during the 18 hour gale event period and confirmed seas of at least 4 m (13 ft).

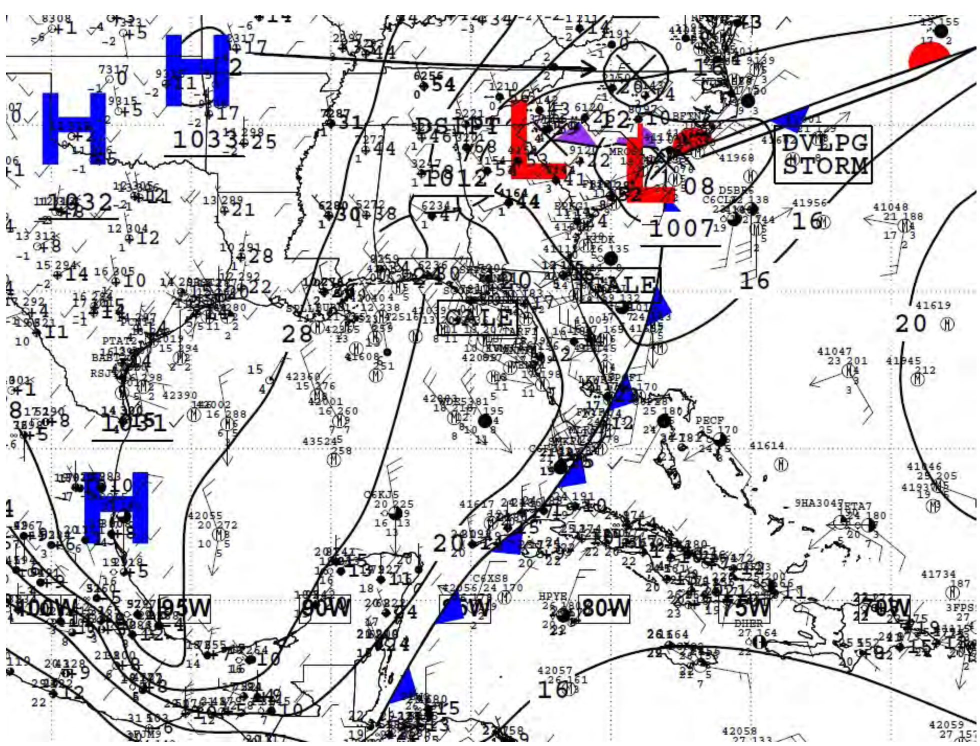


***Figure 8.*** National Weather Service (NWS) Unified Surface Analysis (USA) valid 0000 UTC 18 January 2013.

The next gale event in the northwest portion of the TAFB AOR began on 17 February at 0000 UTC and lasted for one day. This minimal gale event impacted waters north of the Bahamas off the Florida coast. ***Figure 9*** shows an ASCAT pass from 0200 UTC on 17 February. Note the brown wind vectors which correspond to 35-40 kts winds. The upper level support for this front pulled northward on 18 February, diminishing the surface winds over the TAFB AOR.

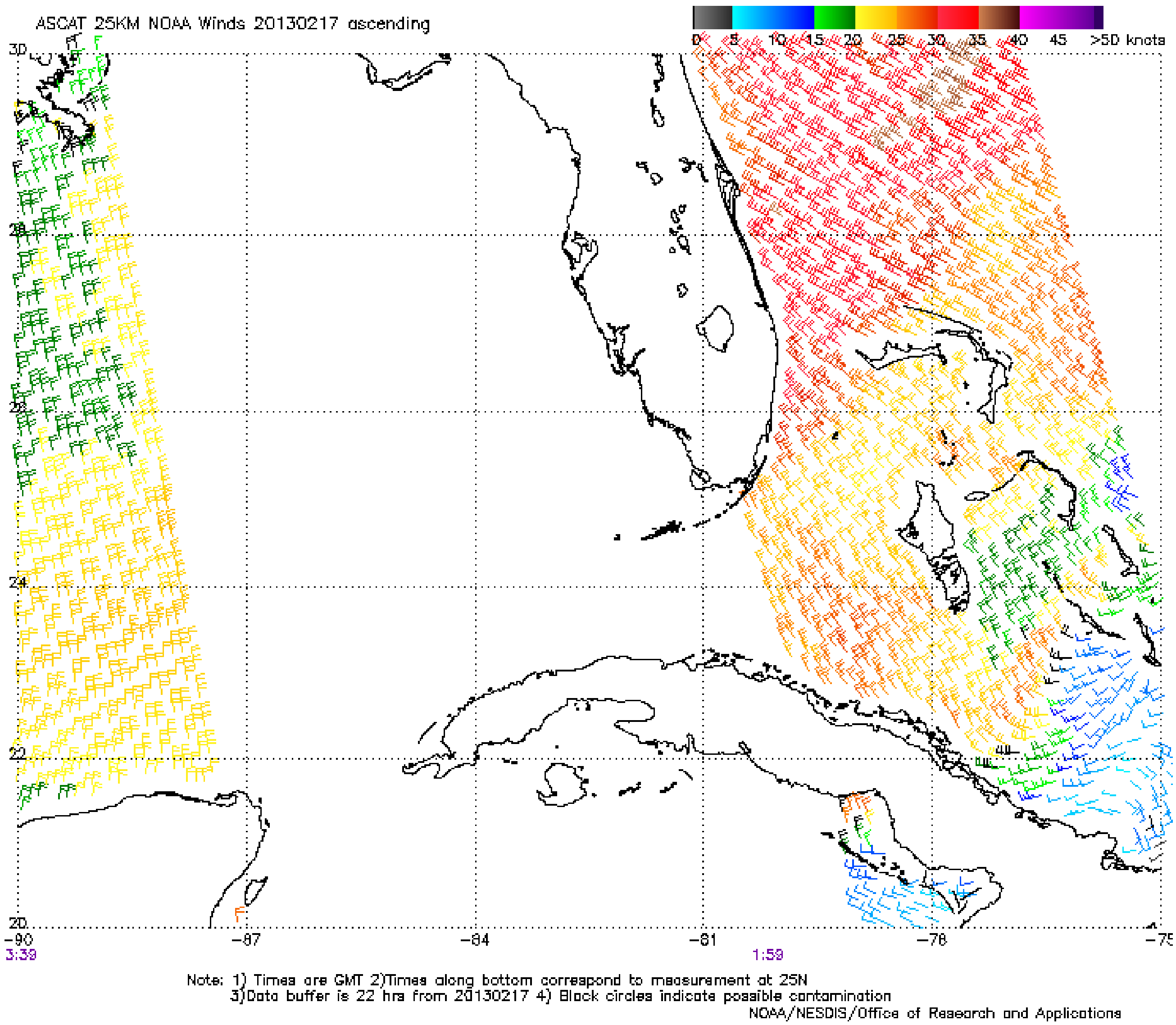


***Figure 9.*** ASCAT passes from 0159 UTC and 0339 UTC on 17 February 2013. Image courtesy of the National Environmental Satellite, Data, and Information Service's Center for Satellite Applications and Research (NESDIS/STAR).

The third cold front to bring gales in the northwest portion of the Atlantic forecast waters moved off the Florida coast just before 1200 UTC 6 March. Gale-force winds were noted both east and west of the front with winds reaching 40 kts behind the front north of 28°N around 0000 UTC 7 March. The gale warning persisted for two days. Ships **Carnival Pride** (H3VU), **London Highway** (3EIF9), and **Royal Klipper** (PCIH) confirmed the gale conditions noted in TAFB warnings. The **Carnival Pride** (H3VU) reported seas as high as 4 m (13 ft).

Ridging over far western Atlantic waters forced deep-layered troughs southeastward through the central portion of the TAFB AOR on three occasions during the first four months of 2013. These events all saw a cold front dip southward into north-central waters and shift eastward. On these occasions, a secondary cold front also moved in behind the initial boundary and reinforced it. Gale warning events began at 1200 UTC 22 February and 1800 UTC 4 March, respectively. Both of these events lasted less than two days. ***Figure 10*** shows the surface analysis at 1200 UTC 22 February, the beginning of the first event. The third event began at 0000 UTC 9 March and persisted for 36 hours. While there were no ship reports in the warning area during the first two gale events, the third event impacted several ships at sea. The **Kaan Kalkavan** (TCTX2) made several reports in the 35-40 kts range as it traversed from along 29°N-30°N between 59.2°W and 64.9°W on 9 March from 0000-1900 UTC. Ships **Columbine Maersk** (OUHC2) and **Ablemarle Island** (C6LU3) saw minimal gale-force winds on 09 March while container ship **Cap Henri** (A8VE3) saw 4 m (13 ft) seas and confirmed gale winds near 29.1°N 63.2°W at 0600 UTC 11 March.

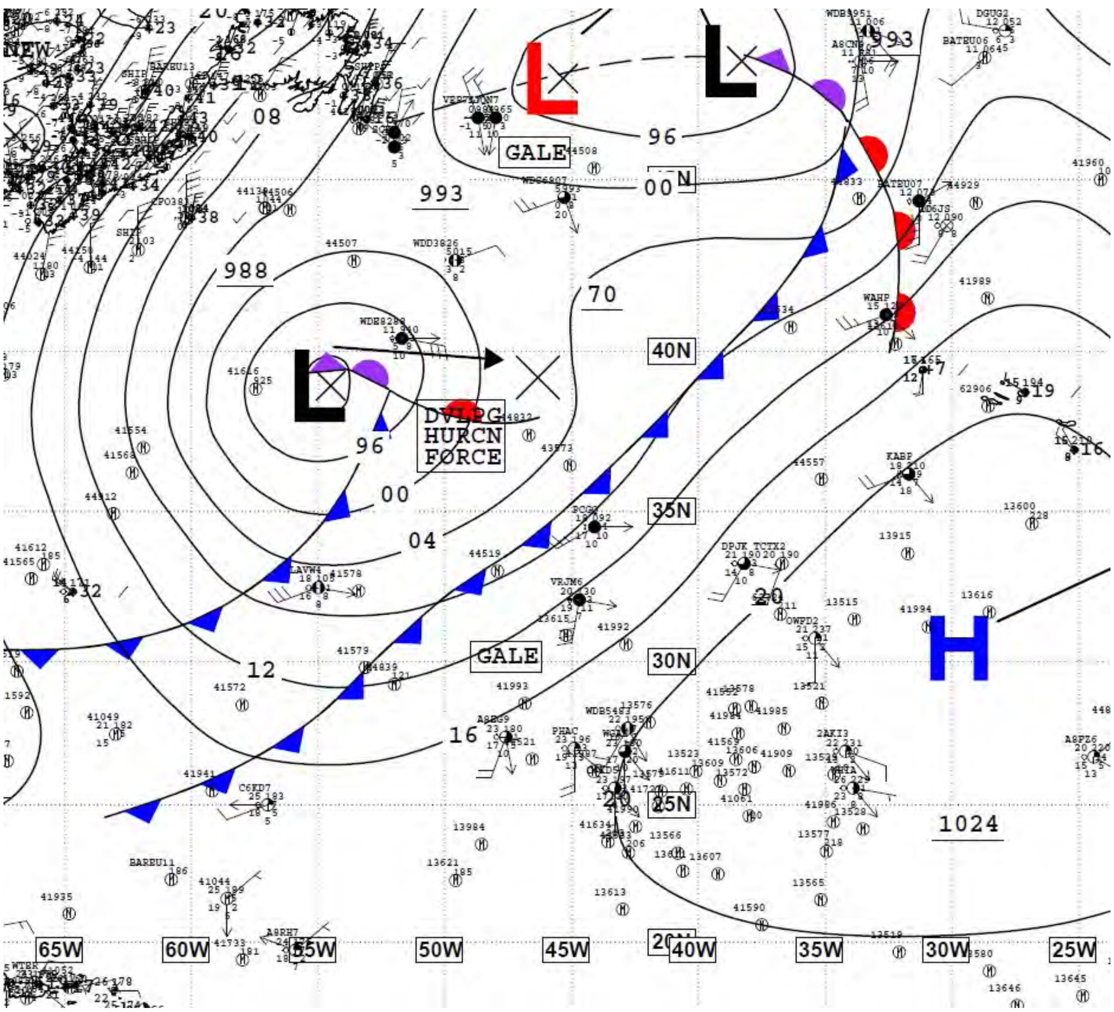


***Figure 10.*** National Weather Service (NWS) Unified Surface Analysis (USA) valid 1200 UTC 22 February 2013.

## CARIBBEAN GALE WARNINGS

***Table 3.*** Non-tropical cyclone warnings issued for the Atlantic Ocean between 01 January 2013 and 30 April 2013.

| Onset | Region | Peak Wind Speed | Duration | Forcing |
|---|---|---|---|---|
| 0600 UTC 5 Jan | Coast of Colombia | 35 kts | 18 hr | Pressure Gradient |
| 1800 UTC 8 Jan | Coast of Colombia | 35 kts | 72 hr | Pressure Gradient |
| 0600 UTC 20 Jan | Coast of Colombia | 35 kts | 24 hr | Pressure Gradient |
| 0600 UTC 30 Jan | Coast of Colombia | 35 kts | 12 hr | Pressure Gradient |
| 1200 UTC 22 Feb | Coast of Colombia | 35 kts | 18 hr | Pressure Gradient |
| 0000 UTC 3 Mar | NW Caribbean | 40 kts | 30 hr | Cold Front |

***Table 3*** describes the six non-tropical cyclone warnings issued for the Caribbean Sea between 01 January 2013 and 30 April 2013. Five of these six events were triggered by a strong pressure gradient between climatologically lower pressure over Colombia and strong subtropical high pressure to the north. All of these events featured minimal gale force winds. The longest such event lasted three days beginning 1800 UTC 8 January under a stagnant surface pattern. ***Figure 11*** shows conditions just before this gale event began. Note the large area of near gale-force winds (red vectors) along the coast of Colombia and 25-30 kts winds elsewhere (pink vectors) seen by the 1456 UTC ASCAT pass. Persistent strong trade winds had already built seas to 3.5 m (14 ft) according to the Jason-1 and Jason-2 passes to the west of the ASCAT swath. The tanker **British Harmony** (MHMZ8) provided eight reports of gale-force winds as it traveled along the coast of Colombia from 0000 UTC 9 January through 1700 UTC 10 January and encountered seas as high as 4 m (13 ft). The cruise ships **Amsterdam** (PBAD) and **Zuiderdam** (PBIG) also provided reports of gale winds during this event. The other gale events occurred under a more progressive atmospheric pattern to the north which limited the gale period to a day or less.

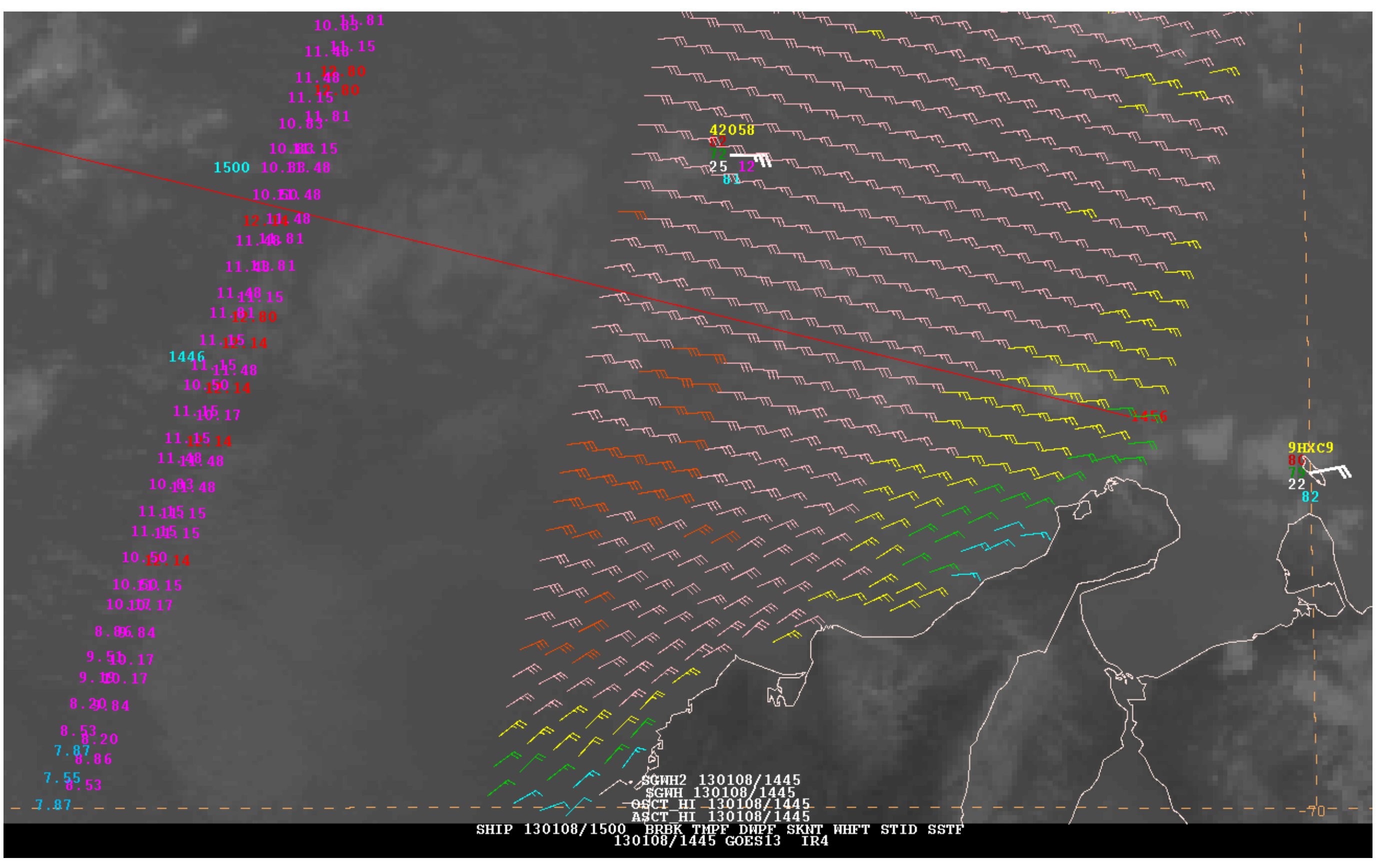


***Figure 11.*** GOES-E infrared imagery from 1445 UTC 8 January overlaid with ship and buoy observations from 1500 UTC, an ASCAT pass from 1456 UTC, and a Jason-1 and Jason-2 passes from around 1500 UTC.

The final gale in the Caribbean during the January through April 2013 period was initiated by a strong cold front moving through the western Caribbean. Gale force winds began at 0000 UTC 3 March in the northwest Caribbean and quickly shifted southward along the coast of Nicaragua, reaching 10°N by 0600 UTC 3 March. Winds reached 40 kts at that time according to the **Island Princess** (ZCDG4) which provided four reports of 35-40 kts winds in the gale area between 0300 UTC and 0800 UTC on 3 March. The gale lasted here until 0600 UTC on 4 March. The cold front that initiated this gale was also associated with gale-force winds in the Atlantic that began at 1800 UTC 4 March. ***Figure 12*** shows the TAFB "Graphicast" valid from 0000 UTC 4 March to 0000 UTC 5 March. This graphical snapshot of the significant marine weather shows both the gale warning behind the front over the Atlantic and the diminishing gale conditions in the southwest Caribbean in addition to the large northwest swells associated with an earlier gale warning over the northeast waters. "Graphicasts" for both the TAFB Atlantic and Eastern Pacific AORs can be found on the NHC web page at: http://www.nhc.noaa.gov/marine/graphicast.php

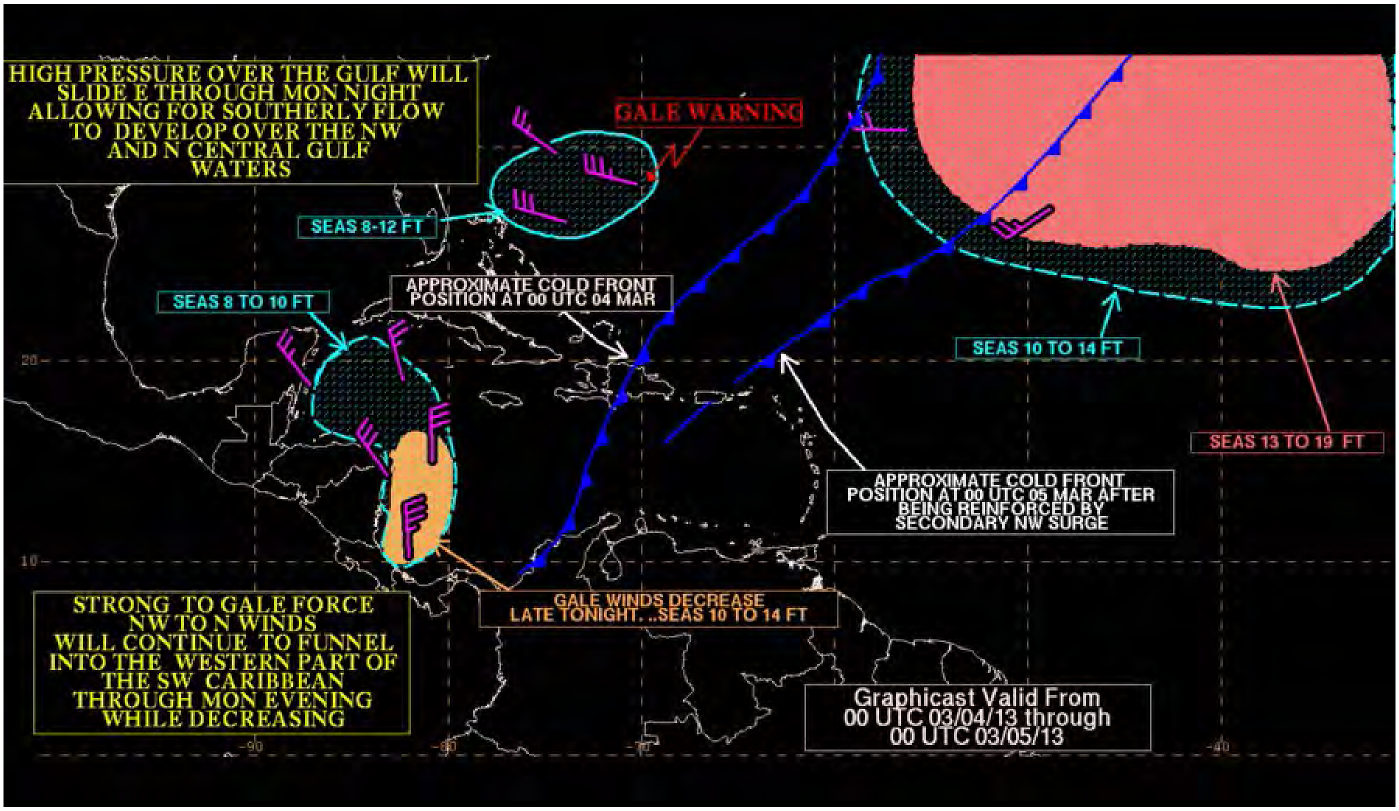


***Figure 12.*** The TAFB Atlantic Graphicast valid from 0000 UTC 4 March to 0000 UTC 5 March 2013.

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

All but four of the eastern North Pacific non-tropical cyclone warning events observed from 01 January 2013 to 30 April 2013 found between 30N and the equator east of 140W were in the Gulf of Tehuantepec, driven by mid-latitude cold frontal passages through the narrow Isthmus of Tehuantepec. There were ten (10) occurrences of gale force winds in the Gulf of Tehuantepec, with four of those events producing winds of storm force. All fourteen (14) events are cataloged in ***Table 4***.

**Table 4.** Non-tropical cyclone warnings issued for the subtropical and tropical eastern North Pacific between 01 January 2013 and 30 April 2013.

| Onset | Region | Peak Wind Speed | Gale/Storm Duration |
|---|---|---|---|
| 0600 UTC 04 Jan | Gulf of Tehuantepec | 40 kts | 96 hr |
| 0000 UTC 17 Jan | Gulf of Tehuantepec | 50 kts | 210 hr / 66 hr |
| 0000 UTC 23 Jan | High Seas - Low Pressure | 35 kts | 06 hr |
| 0600 UTC 31 Jan | Gulf of Tehuantepec | 40 kts | 96 hr |
| 1800 UTC 16 Feb | Gulf of Tehuantepec | 50 kts | 42 hr / 12 hr |
| 0600 UTC 18 Feb | Gulf of Papagayo | 35 kts | 06 hr |
| 1800 UTC 24 Feb | Gulf of California | 35 kts | 36 hr |
| 0600 UTC 01 Mar | Gulf of Tehuantepec | 50 kts | 84 hr / 24 hr |
| 1200 UTC 04 Mar | Gulf of Papagayo | 35 kts | 06 hr |
| 1200 UTC 06 Mar | Gulf of Tehuantepec | 40 kts | 30 hr |
| 0600 UTC 12 Mar | Gulf of Tehuantepec | 50 kts | 102 hr / 12 hr |
| 0000 UTC 26 Mar | Gulf of Tehuantepec | 45 kts | 66 hr |
| 1800 UTC 05 Apr | Gulf of Tehuantepec | 35 kts | 24 hr |
| 0600 UTC 20 Apr | Gulf of Tehuantepec | 35 kts | 12 hr |

The first significant and long duration non-tropical cyclone warning event of the period began at 0000 UTC 17 January in the Gulf of Tehuantepec. This storm force event was associated with a surface cold front that moved across the Gulf of Mexico and was followed by a strong high pressure ridge that built in across portions of northern Mexico and along the eastern Mexican Coast southward to the Chivela Pass. ***Figure 13*** shows the 0356 UTC MetOp Advanced SCATterometer (ASCAT) pass from 18 January and ***Figure 14*** shows a later 1629 UTC ASCAT pass from 18 January. Note the purple barbs in each figure indicate winds up to 50 kts in the Gulf of Tehuantepec and winds below storm force but above gale force fanning to the southwest.

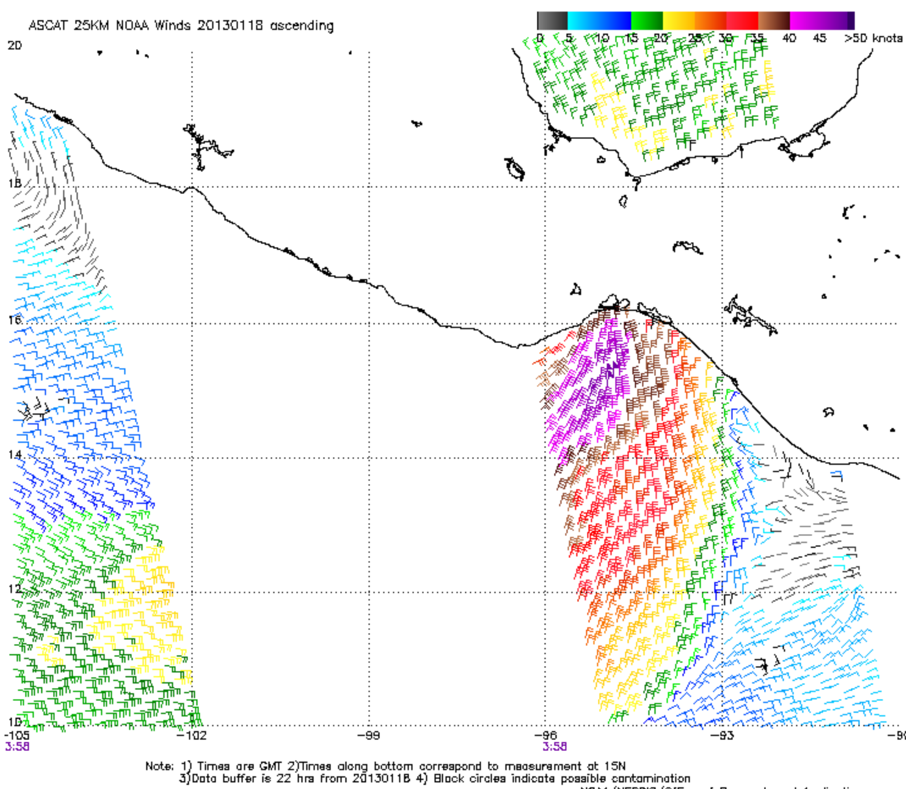


***Figure 13.*** Ocean vector wind retrievals from an ASCAT pass on 0356 UTC 18 January 2013. Note the large swath of winds above gale force originating from the Gulf of Tehuantepec region and area of winds up to 50 kts indicated by the purple barbs. Image courtesy of NESDIS/STAR.

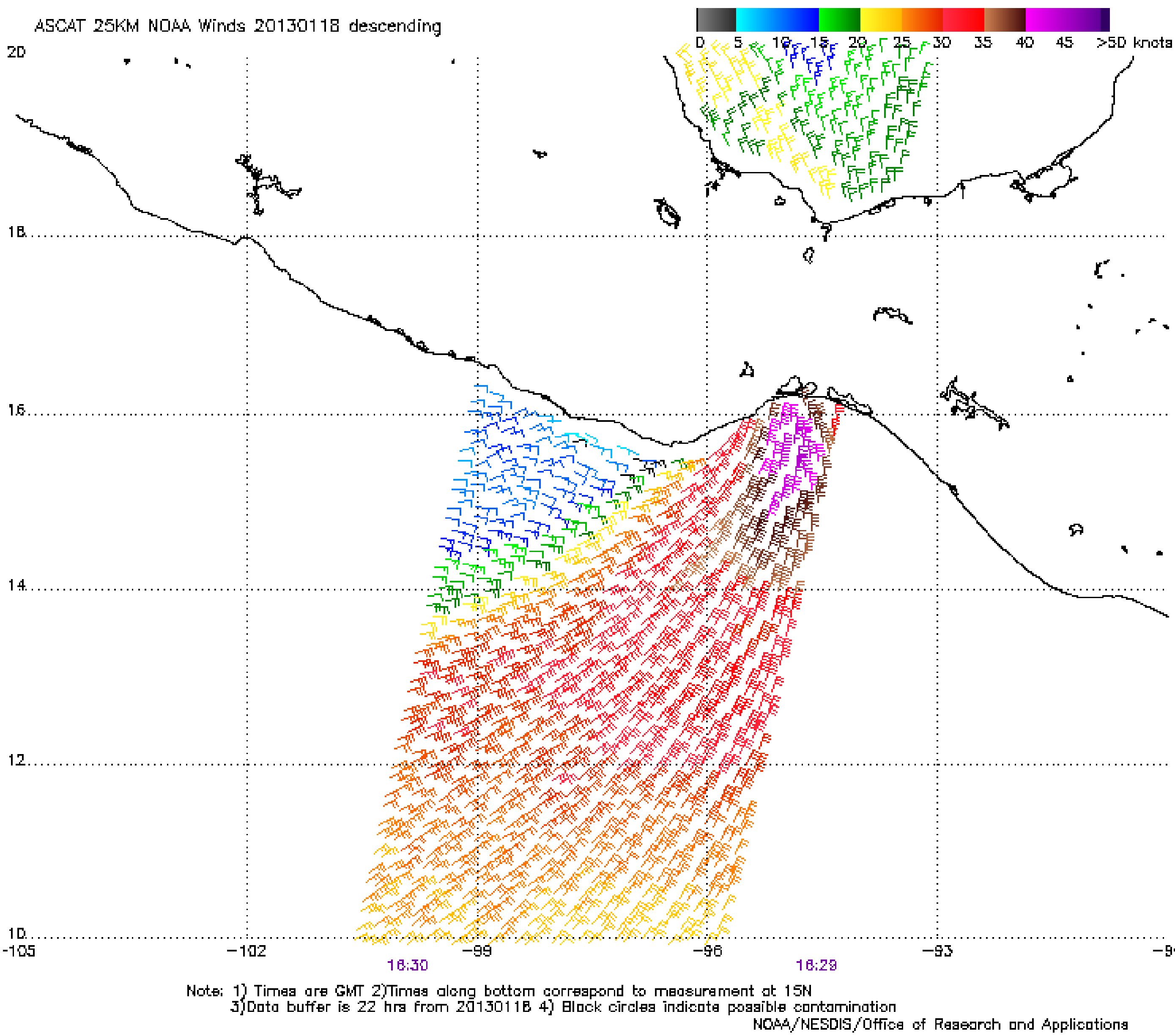


***Figure 14.*** Ocean vector wind retrievals from an ASCAT pass on 1629 UTC 18 January 2013. Note the large swath of winds above gale force originating from the Gulf of Tehuantepec region and area of winds up to 50 kts indicated by the purple barbs. Image courtesy of NESDIS/STAR.

The event began with winds of gale force for the duration of 12 hours before the onset of storm force winds. Once storm-force conditions were forecast to begin at 0000 UTC 17 January, the following four ships reported near storm and storm-force conditions: the ***Clan Tribute*** (ELXU2), which reported 41 kts at 0600 UTC 17 January with maximum seas of 8.5 m (28 ft), the ***Nyk Rosa*** (3FJM9) which reported 47 kts at 1200 UTC 18 January, the ***Hanjin Philadelphia*** (A8CN8), which reported 49 kts at 0600 UTC 18 January with maximum seas of 7.2 m (24 ft), and the ***Ever Delight*** (3FCB8), which reported 40 kts at 1800 UTC 18 January with maximum seas of 10.8 m (35 ft). Furthermore, nearing the end of the storm-force conditions for the event, one ship, the ***Island Princess*** (ZCDG4) reported 50 kts at 1100 UTC 19 January with maximum seas of 4.2 m (14 ft). In summary, this particular gale force event lasted 210 total hours with 66 hours of storm force winds during the peak of the wind surge through the Isthmus of Tehuantepec.

Another relatively long lasting gale-force wind event for the Gulf of Tehuantepec began 01 March at 0600 UTC and persisted until 1800 UTC on 04 March. Another cold front had progressed through the western Gulf of Mexico and introduced northerly flow through the Chivela Pass with a strong surface ridge building in its wake across portions of eastern Mexico and western Gulf of Mexico. Before the onset of storm force conditions at 1800 UTC 02 March, the ship ***British Harmony*** (MHMZ8) reported 39 kts at 0500 UTC 02 March. Storm force conditions were forecast to begin at 1800 UTC 02 March and ***Figure 15*** shows confirmation of these conditions on the ocean vector wind retrievals from the MetOp Advanced SCATterometer (ASCAT) satellite around 1250 UTC 03 March thereafter forecast to last until 1800 UTC 03 March. Another ship, the ***Ever Diadem*** (9V7955) located to the northeast of the storm force conditions near 15°N 95°W reported 37 kts at 1800 UTC 02 March with maximum seas to 4.2 m (14 ft) and 42 kts at 0000 UTC 03 March near 15°N 96°W with maximum seas to 2.8 m (9 ft).

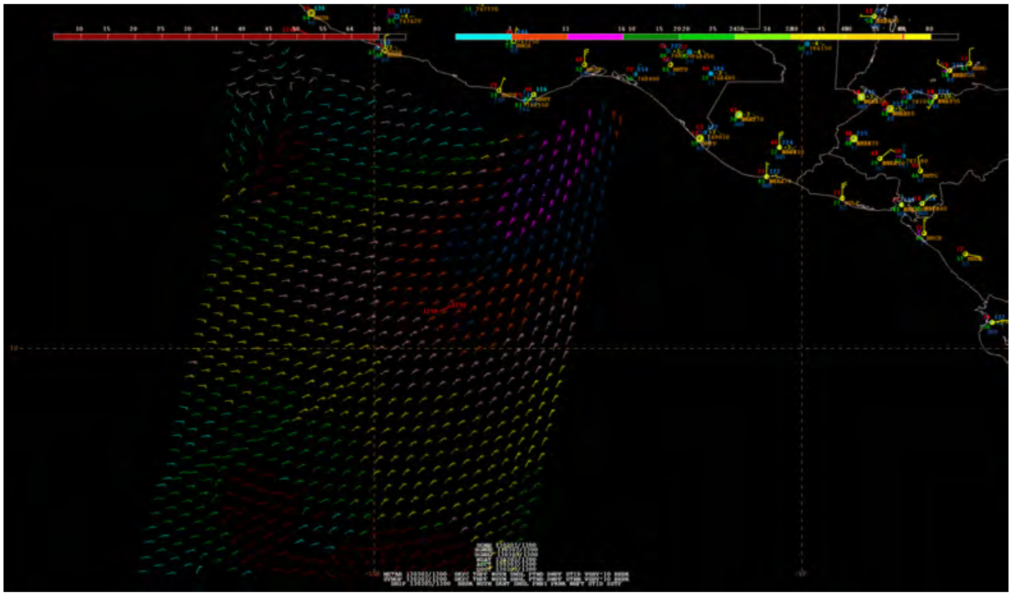

***Figure 15.*** Scatterometer pass from the MetOp SCATometer (ASCAT) valid around 1250 UTC 03 March showing a small area of 50 kts barbs southwest of the Gulf of Tehuantepec.

Finally, as the storm force conditions waned and gale force conditions remained along with elevated significant wave heights, ***Figure 16*** shows the next available scatterometer pass around 1620 UTC 03 March overlaid with an altimeter pass from the National Aeronautics and Space Administration's (NASA) Jason-1 and Jason-2. Winds remained at gale force until the conclusion of the event at 1800 UTC 04 March and seas remained at a maximum of 20 ft to the southwest of where the strongest swath of wind was observed a few hours prior to the altimeter pass.

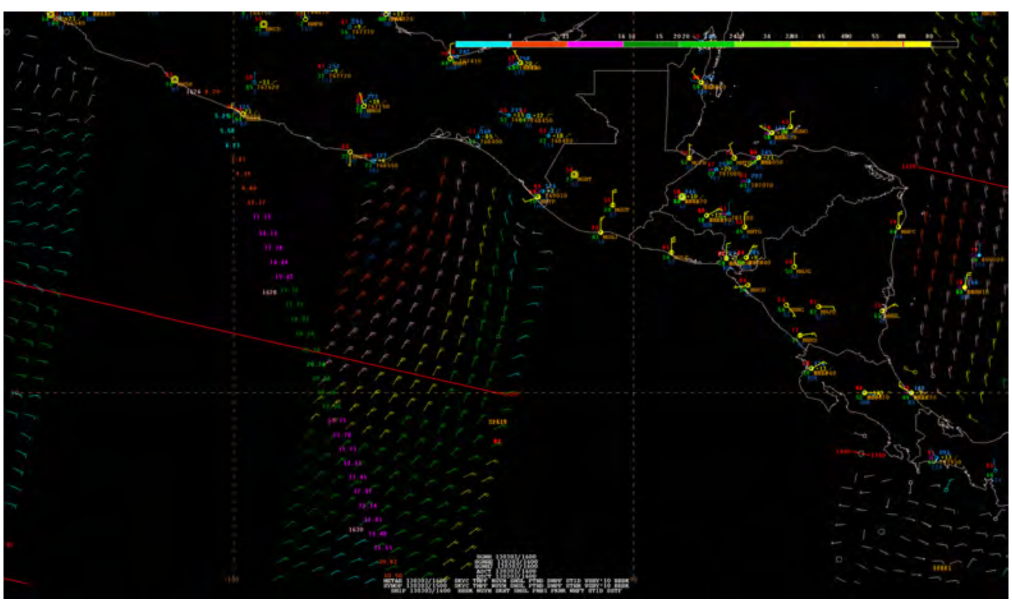

***Figure 16.*** Scatterometer pass from the MetOp SCATometer (ASCAT) valid around 1620 UTC 03 March showing the area of storm force winds had decreased to gale force, but that significant wave heights remained high as noted by a 1628 UTC 03 March altimeter pass from the National Aeronautics and Space Administration's (NASA) Jason-1 and Jason-2.

Outside of gap wind driven events…***Figure 17*** shows an area of low pressure centered over the western portion of the forecast area that was responsible for a short-lived gale event on 23 January from 0000 UTC – 0600 UTC. This 1006 hPa low was centered near 22°N 132°W at 0000 UTC. This was the peak intensity for the low while over the TAFB Area of Responsibility (AOR). The position of the low is significantly farther south than the climatological norm. The pressure gradient between the low and a 1024 hPa subtropical high to its northwest forced north to northeast winds to gale force over far northwestern forecast waters to the northwest of the low center. The **Carnival Splendor** (3EUS) reported 36 kts winds just west of the TAFB AOR near 24.7°N 142.8°W at 0000 UTC 23 January. The low began to weaken by 0600 UTC, and the gale force winds diminished. A 0910 UTC 23 January scatterometer pass from the India Space Research Organization (ISRO)/ Space Applications Center (SAC) Oceansat-2 satellite confirmed that winds had dropped just below gale force.

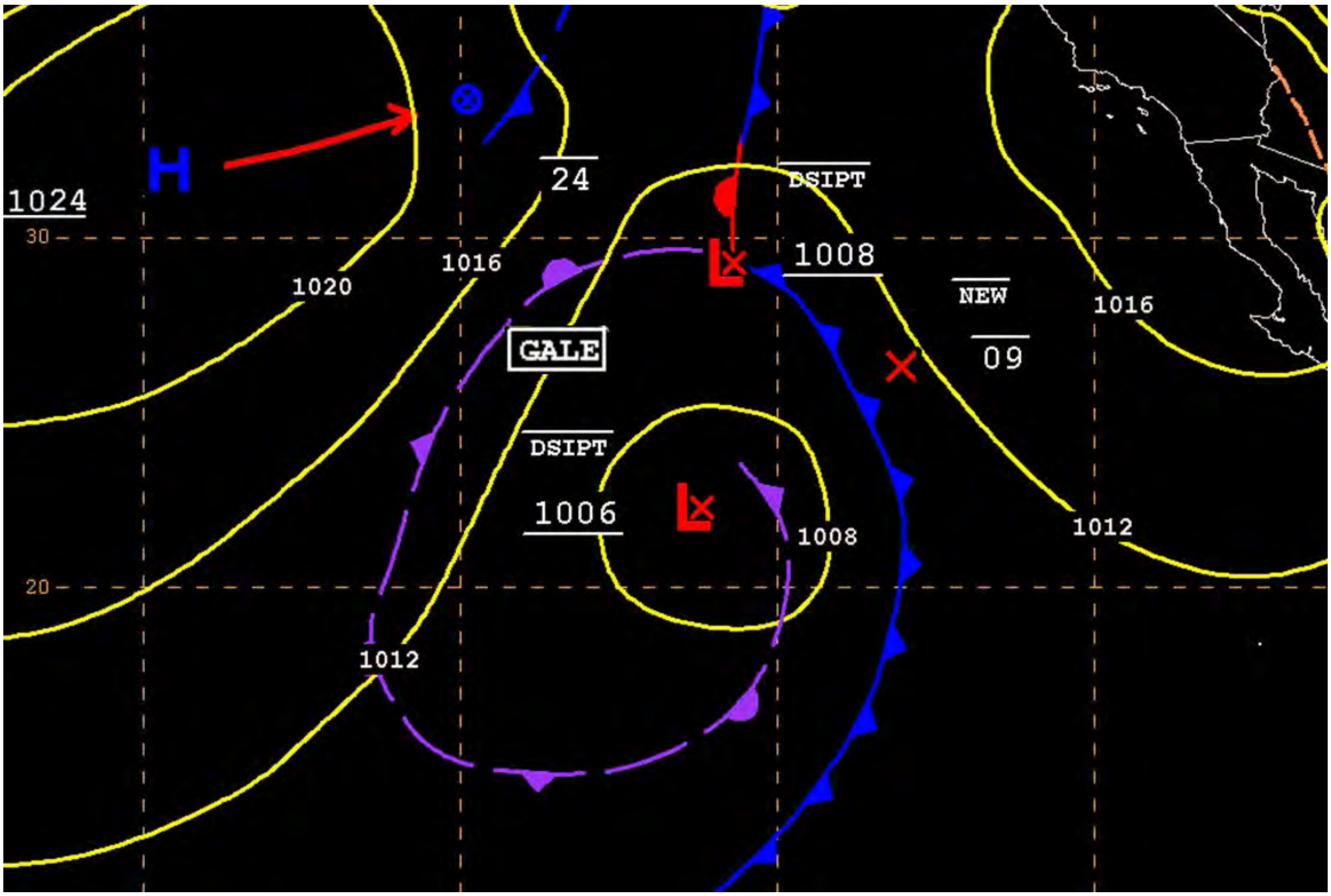


***Figure 17.*** National Weather Service Unified Surface Analysis (USA) valid 0000 UTC 23 January 2013.

Lastly, the only gale force wind event of the January through April period of 2013 in the Gulf of California began on 24 February at 1800 UTC and persisted until 0600 UTC on 26 February. During this time, a strong cold front associated with a deep layer low passing through the Southwestern United States into the Southern Plains moved into the Gulf of California. 1030-1035 hPa high pressure became established over the Northern Rocky Mountains behind the front. Cohen and Cangialosi (2010) noted that this pattern is typical of gale wind events in the Gulf of California. Just before the onset of gale winds, the 1756 UTC ASCAT pass captured an area of near gale force north-northwest winds north of 30°N in the Gulf of California as seen in ***Figure 18***. The gale force winds gradually made their way southward through the Gulf of California as the cold front pushed southeastward. The gale warning area stretched from 23°N to 27°N just before diminishing below gale force at 0600 UTC 26 February.

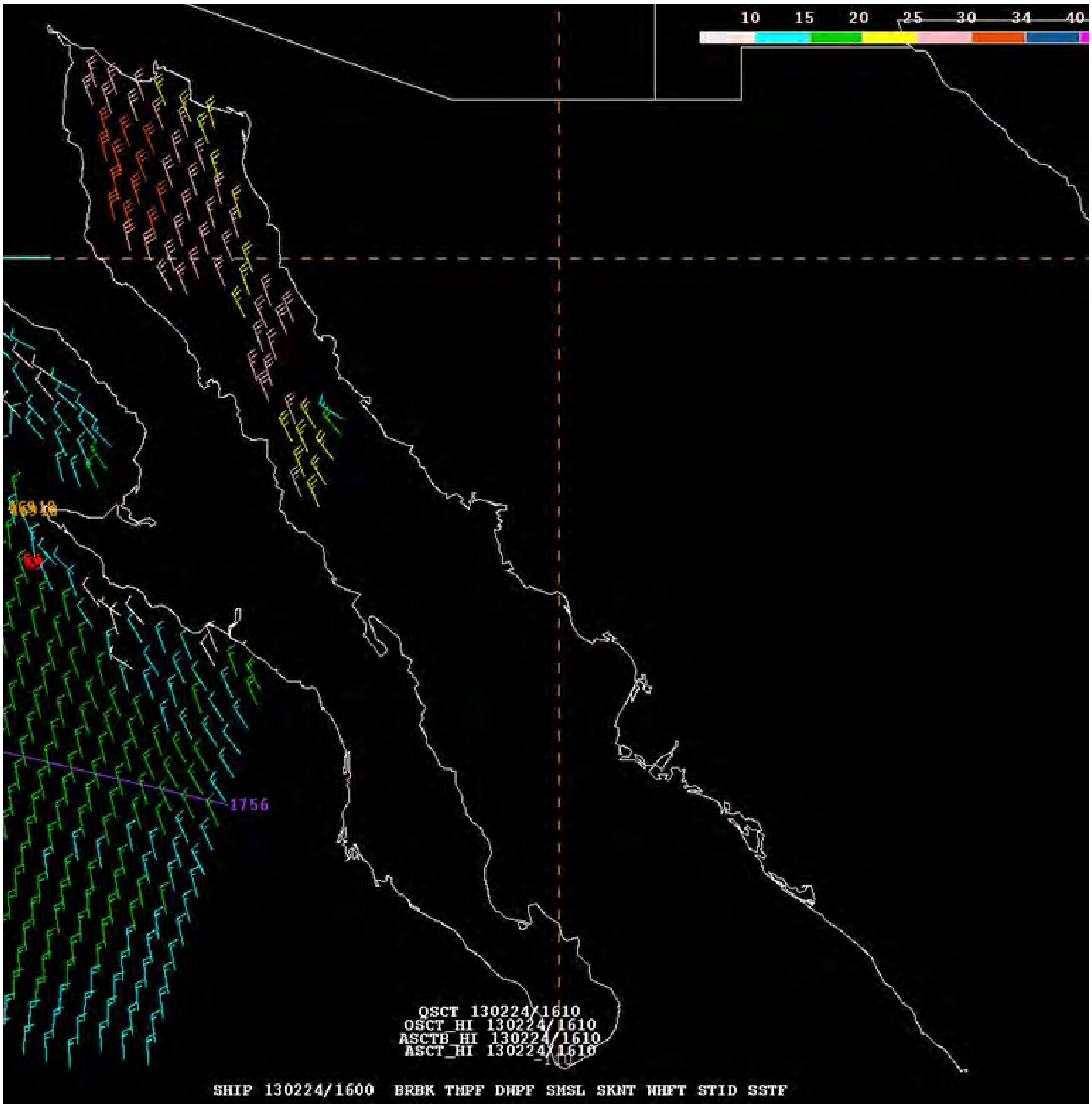


***Figure 18.*** An ASCAT pass over the northern Gulf of California at 1756 UTC 24 February 2013.

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# Marine Weather Review – North Atlantic Area

## November 2012 to February 2013

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## Introduction

The pattern over the North Atlantic during this late fall and winter heavy weather period was generally progressive through January with developing cyclones tracking northeast from near or off the U.S. coast toward the area near or east of Greenland where they either weakened or progressed east or northeast and weakened east of Iceland. This period produced seven intense lows with central pressures at or below 950 hPa, with most occurring from mid December through January, including a 930 hPa superstorm over the north central waters in late January. The pattern over the North Atlantic became more blocked in February favoring more rapid initial development of cyclones closer to the U.S. east coast. There was only one cyclone developing hurricane force winds over the southeastern waters near Spain and Portugal, and another moved from the subtropics into the south central waters where it briefly developed hurricane force winds in early December. There was no tropical activity during the four month period.

## Significant Events of the Period

**Southwestern Atlantic (Coastal) Storm, November 6-8:** A small but potent coastal storm developed off the U.S. mid-Atlantic coast in early November as depicted in Figure 1. It developed hurricane force winds briefly on the 7th with its compact circulation and a relatively modest central pressure of 988 hPa. The scatterometer image in Figure 2 (from OSCAT, an Indian scatterometer), reveals winds to 65 kts north of a well defined center off the New Jersey coast. The central pressure dropped to as low as 984 hPa the following evening before the cyclone began to weaken. The **YM Tianjin** (DDDI2, 40N 68.5W) reported northeast winds of 58 kts and 8.5 m seas (28ft) at 1500 UTC on the 7th. The **Duncan Island** (C6JS, 40N 69W) encountered northeast winds of 52 kts three hours later. Buoy 44008 (40.5N 69.2W) reported northeast winds 43 kts with gusts to 56 kts and 8.0 m(26ft) seas at 2200 UTC on the 7th, and highest seas 9.0m (30ft) one hour later. The cyclone weakened to a gale over Georges Bank the following day before spawning a new center on a front over Nova Scotia later that day, with the new center absorbing the old low near Newfoundland late on the 9th.

**North Atlantic Storm, November 10-12:** The secondary low over Nova Scotia noted above explosively deepened while passing north of Newfoundland late on November 9. The central pressure fell 43 hPa in the twenty-four hour period ending at 1200 UTC on the 10th. The cyclone developed a lowest central pressure of 952 hPa in the Labrador Sea six hours later. An ASCAT pass from 1324 UTC on the 10th revealed east winds to 60 kts north of a front as it approached Greenland. OPC analyzed the cyclone as a hurricane force low as it drifted northeast over the following thirty-six hours and formed a new center east of Greenland on the 11th. The complex system then slowly weakened while drifting northeast and passed north of Iceland late on the 13th. The **Novaya Zemlya** (UFNZ) reported southwest winds of 50 kts near 54N 30W at 0600 UTC on the 12th.

**North Atlantic Storm, November 29-December 2:** Slightly more intense than the November 10-12 event, this cyclone's initial development is shown in Figure 3, and its rate of intensification and coverage of hurricane force winds were even greater than was the case with the earlier event.

The cyclone originated as a low pressure wave near the southeast U.S. coast early on the 27th, with the central pressure falling 47 hPa as the complex low south of Newfoundland consolidated during the following twenty-four hours, a drop of almost 2 hPa per hour. The lowest central pressure was 950 hPa in the Labrador Sea on the morning of the 30th. The ASCAT image in Figure 4 reveals winds to 65 kts north of an apparent front and winds to 55 kts on the west and south sides. The **Sea-Land Champion** (WKAU, 46N 54W) reported southwest winds of 50 kts and 5.0 m seas (16ft) 0000 UTC on the 30th. The platform Hibernia (VEP717, 46.7N 48.7W) reported southwest winds of 79 kts at its height of 139m at 0300 UTC on the 30th while **Terra Nova FPSO** (VCXF, 46.4N 48.4W) encountered southwest winds of 60 kts three hours prior. The cyclone drifted north toward Greenland through December 1 with its top winds lowering to storm force, and then turned east along 60N and weakened to a gale south of Iceland by the 3rd. Dissipation followed late on the 4th as the low moved over the British Isles.

**North Atlantic Storm, December 3-4:** The second part of Figure 3 shows a weak low near 20N 50W not associated with any front. The low drifted northeast over the next two days and developed gale force winds as it approached 31N, OPC's southern boundary. More rapid development occurred north of 31N as the low merged with a front while accelerating north. The cyclone developed a lowest central pressure of 984 hPa near 41N 38W at 0600 UTC on the 4th, when it briefly developed hurricane force winds. An OSCAT high resolution pass from 0238 UTC on the 4th showed a small area of winds approaching hurricane force in the west semicircle. The cyclone subsequently weakened over the central North Atlantic late on the 4th and the 5th, before turning southeast and dissipating near Portugal on the 7th.

**North Atlantic Storm, December 12-16:** After originating on a front over New England late on December 10, a developing cyclone passed northeast across the Atlantic provinces of Canada with the main development occurring northeast of Newfoundland. The central pressure fell 32 hPa in the twenty-four hour period ending at 0600 UTC December 13. The cyclone developed a lowest central pressure of 947 hPa near 54N 35W at 1800 UTC on the 13th and then briefly developed hurricane force winds later that day. ASCAT imagery from 2243 UTC on the 13th revealed northeast winds 50 to 60 kts near the southern tip of Greenland, likely meaning actual winds reached hurricane force with this system due to low bias of ASCAT's retrieved winds. The cyclone then moved east and weakened while developing new centers near and north of Great Britain by the 16th, with the primary low center dissipating in the North Sea by the 18th.

**Northeastern Atlantic Storm, December 27-30:** Another cyclone with a central pressure below 950 hPa developed from the merging of four lows over the north central waters over a forty-eight hour period to form a main center with 947 hPa central pressure and a second center southwest of Iceland as shown in Figure 5. The strongest winds were with the second center with winds to 70 kts in the Denmark Strait and 50 kts south of the center as depicted in ASCAT imagery (Figure 6). At 2200 UTC on the 28th the buoy 62105 (55.1N 13.2) reported southwest winds of 45 kts, and seas 12.8m (42ft) one hour later. The two centers then passed east of Iceland as gale force lows latte on the 30th.

**Coastal Storm, December 29-31 and North Atlantic Storm, January 1-3:** Figure 7 depicts the initial development of this system as a coastal storm. The central pressure of the low pressure wave over North Carolina dropped 39 hPa in the twenty-four hour period covered by Figure 7. The **YM Tianjin** (DDDI2) reported northwest winds of 60 kts and 8.5 m seas (28ft) near 43N 66W at 1600 UTC on the 30th. The **Maersk Driscoll** (A8IY3) encountered southwest winds of 40 kts and 10.7 m seas (35ft) near 45N 59W two hours later. Buoy 44150 (42.5N 64.0W) reported southwest winds of 47 kts with gusts to 64 kts and 7.0 m seas (23ft) at 1200 UTC on the 30th, and 8.0 m seas (26ft) five hours later. The cyclone briefly developed hurricane force winds near Nova Scotia on the 30th before moving into the Labrador Sea where it stalled on January 1 and formed a secondary center southeast of Greenland near 57N 40W early on the 1st. The second low briefly developed hurricane force winds on the morning of the 1st before weakening and passing between Greenland and Iceland early on the 3rd, while the main low center dissipated.

**North Atlantic Storms, January 2-5:** A low formed south of Newfoundland near 42N late on the 1st , developed storm force winds when passing near 46N 40W on the morning of the 2nd, and then hurricane force winds the next day when approaching Greenland. The **Maersk Patras** (MYSU5) near 49N 37W reported southeast winds of 61 kts and 8.5 m seas (28ft) at 0900 UTC on the 3rd. ASCAT imagery revealed north to northeast winds of 50 kts near the southeast Greenland coast on the 3rd. The cyclone developed a lowest central pressure of 960 hPa on the afternoon of the 3rd before stalling and becoming absorbed by another developing low coming from the south. The new storm developed a lowest central pressure of 954 hPa near 64N 35W late on the 4th before rapidly weakening near the Greenland coast the next day.

**North Atlantic Storm, January 5-7:** Low pressure formed south of Newfoundland near 41N early on the 5th and quickly developed into the hurricane force low seen in the first part of Figure 8, at the eastern edge with a 972 hPa center. Figure 9 is an ASCAT image which returned the strongest winds with this system, up to 65 kts on the south side. The cyclone developed a lowest central pressure of 969 hPa six hours later as it turned toward the north and its top winds weakened to storm force. The cyclone dissipated near the east coast of Greenland late on the 7th.

**North Atlantic Storm, January 7-10:** Originating as a low pressure wave on the New England coast early on the 6th (Figure 8), this low explosively deepened or "bombed" after passing south of Newfoundland. The central pressure dropped 47 hPa in the twenty-four hour period ending at 0600 UTC on the 8th with the cyclone developing into a hurricane force low six hours later (Figure 8). An ASCAT (METOP-B) image valid near this time returned winds around the center of 50 to 60 kts, similar to Figure 4 for the late November event and almost as strong. The **Zim Tarragona** (4XFA) reported northwest winds of 45 kts and 10.0 m seas (33ft) near 39N 40W well south of the center at 1800 UTC on the 8th. The cyclone then stalled and weakened near the southern tip of Greenland on the 9th and the 10th before dissipating on the 11th.

**Eastern North Atlantic Storm, January 18-20:** The hurricane force low in the first part of Figure 10 developed from a low pressure wave in the central waters near 43N 37W at 0000 UTC January 18 with the central pressure dropping 28 hPa in the twenty-four hour period ending at 0600 UTC on the 19th. This was a short lived hurricane force event with the low appearing at maximum intensity in Figure 10 with the low then crossing into the Mediterranean as a gale the next day, but it stood out among the other events of the period as the only one occurring in that part of the Atlantic and featuring several ship reports of winds 60 kts or greater, which are listed in Table 1.

**North Atlantic Storm, January 18-21:** A gale force low emerged off the coast near Cape Hatteras and moved north while gradually intensifying at first, and then rapidly deepening after passing south of the island of Newfoundland. Figure 10 depicts the final development of this system into the third deepest cyclone of the period, with a lowest central pressure of 943 hPa. The central pressure dropped 48 hPa in the twenty-four hour period ending at 1800 UTC on the 19th or on average 2 hPa per hour. The **CMA CGM Verlaine** (DASO) near 42N 37W reported southwest winds of 50 kts and 8.5 m seas

| OBSERVATION | POSITION | DATE/TIME (UTC) | WIND | SEA(m/f) |
|---|---|---|---|---|
| **Cap Gabriel** (A8MW8) | 44N 10W | 19/0600 | NE 65 | 11.5/38 |
| **Grey Fox** (V7LD4) | 42N 11W | 19/0800 | N 65 | |
| **Maersk Leticia** (VRJC9) | 40N 10W<br>40N 10W<br>41N 10W | 19/1000<br>19/1200<br>19/1800 | NW 75<br>NW 55<br>NW 45 | 8.0/26<br>8.5/28<br>9.0/30 |
| **Saga Sapphire** (9HOF8) | 41N 10W<br>42N 10W | 19/0700<br>19/1000 | SW 60<br>N 60 | <br>9.8/32 |
| TBWUK35 | 40N 11W | 19/1000 | W 50 | 8.0/26 |
| BATFR14 | 43N 15W | 18/2200 | N 60 | |

Table 1. Some notable ship observations taken during passage of the eastern North Atlantic storm of January 18-20, 2013.

(28ft) at 1200 UTC on the 19th. The ASCAT image in Figure 11 retrieved a swath of 65 to 70 kts winds on the south side of the low center which appears near the eastern edge of the image. The cyclone then turned toward the west along 60N later on the 20th and its top winds weakened to storm force by the 21st. The cyclone then dissipated in the northern Labrador Sea late on the 21st.

**Northwestern Atlantic Storms, January 21-24:** Low pressure moved from the lower St. Lawrence River to the Labrador Sea from late on the 20th to the 21st and became a storm force low by 0000 UTC on the 22nd before turning west on the 22nd. It spawned a secondary low near the southeast Greenland coast with hurricane force winds north of its front late on the 22nd. These lows became absorbed by a stronger developing cyclone moving from the mid-Atlantic coast of the U.S. to the eastern Labrador Sea from late on the 21st to the 23rd. The stronger low developed a lowest central pressure of 948 hPa as it approached southern Greenland on the evening of the 23rd. The central pressure fell 41 hPa in the twenty-four hour period ending at 1200 UTC January 23. The **Atlantic Cartier** (SCKB) reported south winds of 50 kts and 5.0 m seas (16ft) near 49N 27W at 1800 UTC on the 23rd. ASCAT imagery from 2241 UTC on the 23rd showed winds of 50 to 60 kts around the north, northwest and south sides of the cyclone and was similar to that of the late November event (Figure 4). The low then turned west into the Labrador Sea and weakened with Figure 12 showing the weakening system in the Labrador Sea.

**North Atlantic Storm, January 24-28:** The most powerful storm of the period originated as low pressure moving off the mid-Atlantic coast of the U.S. on the morning of January 24 and tracking northeast across the southern Grand Banks and out over the north-central waters. The central pressure fell 29 hPa in the first twenty-four hours and 54 hPa in the second twenty-four hour period after moving offshore. Figure 12 shows the cyclone at maximum intensity with a 930 hPa central pressure (27.46 inches) , the deepest of the period in both the Atlantic and the Pacific. The satellite image in Figure 14 shows the cyclone near maximum intensity with the cold topped clouds wrapping around a well defined center indicating considerable vertical extent of the system and broad frontal features. The ASCAT image in Figure 15 from close to the time of maximum intensity shows considerable dark red areas with winds 48 to 63 kts associated with the occluded front and especially in the cold air south of the portion of the front that wraps around the south side. The **Atlantic Cartier** (SCKB) near 42N 36W reported southwest winds of 60 kts at 1800 UTC on the 25th. The buoy 62095 (53.1N 15.9W) reported southwest winds of 42 kts and 11.5 m seas (38ft) at 0700 UTC on the 27th, followed by a report of 13.0 m seas (43ft) two hours later. Figure 13 shows the weakened cyclone as a storm force low south of Iceland at 0000 UTC on the 28th. Dissipation followed a day later.

**North Atlantic Storm, January 26-28:** The next significant development occurred as the 1005 hPa storm in Figure 12 intensified to become the 957 hPa hurricane force low in Figure 13, while another hurricane force low formed near Greenland. The central pressure of the stronger system fell 35 hPa in the twenty-four hour period ending at 1800 UTC January 27. ASCAT imagery at 1107 UTC on the 28th detected west winds to 60 kts on the south side of the stronger low and the next satellite pass near 1249 UTC on the 28th revealed northeast winds to 55 kts near the southern tip of Greenland. Buoy 62023 at 51.4N 7.8W reported southwest winds of 50 kts at 1200 UTC on the 28th. Buoy 62095 (53.1N 15.9W) reported southwest winds of 45 kts and 9.8 m seas (32ft) at 1300 UTC on the 28th, followed by a report of seas 13.7m (45ft) three hours later. The stronger low weakened as it passed northwest of the British Isles late on the 28th and dissipated near the Faroe Islands early on the 29th while the Greenland low drifted southwest and weakened into a trough.

**North Atlantic Storm, January 27-30:** A cyclone of similar intensity followed close behind the January 26-28 event, originating as a low pressure wave south of Newfoundland near 40N early on the 27th. Figure 13 shows the cyclone as a 995 hPa storm in the south-central waters heading northeast. The cyclone developed a lowest central pressure of 954 hPa and hurricane force winds near 59N 11W at 1800 UTC on the 29th. ASCAT imagery available from 1227 UTC on the 29th detected west to northwest winds 50 to 55 kts on the south side of the system. The buoy 62105 (55.0N 13.2W) reported southwest winds of 50 kts and 9.0 m seas (30ft) at 1400 UTC on the 29th, followed by a report of 11.3m (37ft) two hours later. The cyclone weakened the following day with its top winds lowering to storm force and moved inland over southern Norway late on the 30th.

**Northwestern Atlantic Storm, January 31-February 2:** Most of the initial intensification of this system was inland over eastern Canada with the center emerging in the southern Labrador Sea 0000 UTC February 1. The central pressure fell 30 hPa during the preceding twenty-four hours. The cyclone turned northward and developed a lowest central pressure of 940 hPa at 0000 UTC February 2 (Figure 16), making it the second most intense (in terms of central pressure) low of the four month period. **Terra Nova FPSO** (46.4N 48.4W) reported west winds of 64 kts (anometer height 53m) at 2100 UTC on the 2nd. Thebaud Platform near Sable Island reported south winds of 50 kts at 0000 UTC on the 1st. The cyclone moved northward through the Davis Strait late on the 2nd and on the 3rd with its winds weakening to gale force.

**North Atlantic Storm, February 2-5:** Figure 16 also depicts the development of the open low pressure wave south of Nova Scotia over a forty-eight hour period when it tracked northeast to Iceland. The deepening low developed hurricane force winds over the north-central waters by February 3 and the central pressure fell 41 hPa in the twenty-four hour period ending at 1800 UTC on the 3rd , when the cyclone developed a lowest central pressure of 952 hPa. The **Atlantic Compass** (SKUN) encountered south winds of 50 kts and 6.5 m seas (21ft) at 1800 UTC on the 2nd. Later, the buoy 64045 (59.1N 11.7W) reported west winds 43 kts and 16.0 m seas (53ft) at 0900 UTC on the 4th. An ASCAT image from 2218 UTC on the 3rd revealed a swath of west winds 50 to 70 kts south of Iceland. Winds weakened to storm force on the 4th as the system turned toward the southeast, and to gale force late on the 5th as the low moved through the southern North Sea and inland.

**Southwestern Atlantic (Coastal) Storm, February 8-10:** A developing low moved offshore from Cape Hatteras on the morning of February 8 and quickly developed hurricane force winds the following evening. The cyclone developed a lowest central pressure of 968 hPa at 1800 UTC on the 9th and could be considered a "bomb" as the central pressure fell 29 hPa in the twenty-four hour period ending at 0000 UTC on the 9th. Some selected surface observations taken during this event are listed in Table 2. The cyclone passed just south of the island of Newfoundland on the 10th and weakened, and then dissipated southeast of the island on the 11th.

**Coastal Storm of February 16-19:** The development of this cyclone over a twenty-four hour period is depicted in Figure 17, a period in which

| OBSERVATION | POSITION | DATE/TIME (UTC) | WIND | SEA(m/f) |
|---|---|---|---|---|
| **Atlantic Cartier** (SCKB) | 45N 48W | 09/1800 | E 55 | 14.0/46 |
| **Sea-Land Champion** (WKAU) | 41N 63W | 09/1800 | SW 50 | 15.5/51 |
| **Rio Madeira** (DUG2) | 37N 64W | 09/1200 | W 40 | 10.0/33 |
| | 37N 66W | 10/0000 | W 50 | |
| Thebaud Platform | 43.9N 60.2W | 09/1200 | NE 46 G53 | |
| **Mount Desert C/MAN** (MDRM1) | 44N 68W | 09/0800 | NE 64 G7<br>Peak gust 77 | |
| Buoy 44029 | 42.5N 70.6W | 09/1100 | N 43 G58 | |
| | | 09/0700 | Peak gust 64 | |
| | | 09/0600 | | 9.0/30 |
| Buoy 44024 | 42.3N 65.9W | 09/0800 | E 41 G51 | 9.0/30 |
| | | 09/0900 | Maximum | 9.5/31 |
| Buoy 44020 | 41.4N 70.3W | 09/0300 | NE 45 G56 | 3.5/11 |
| Buoy 44008 | 40.5N 69.2W | 09/0300 | | 9.0/30 |
| Buoy 44017 | 40.7N 72.0W | 09/0000 | N 43 G58 | 5.5/18 |
| | 09/0400 | | Maximum | 7.0/23 |

Table 2. Selected ship, buoy, C/MAN and platform observations taken during passage of the coastal storm of February 8-10, 2013..

the central pressure dropped 47 hPa, or almost 2 hPa per hour. It followed a track north of the previous system, passing across Nova Scotia and Newfoundland. This was the deepest low of the period in the southwestern and coastal waters. The **Maersk Ohio** (KABP) near 36.5N 68W reported west winds of 63 kts and 8.5 m seas (28ft) at 0200 UTC on the 18th, and 9.5 m seas five hours prior near 36.5N 70W. Buoy 44150 (42.5N 64.0W reported west winds 51 kts with gusts to 62 kts and 6.5 m seas (21ft) at 2200 UTC on the 17th, and highest seas 8.5m (28ft) three hours later. Buoy 44024 (42.3N 65.9W) reported northwest winds of 39 kts with gusts to 51 kts and 4.5 m seas at 2000 UTC on the 17th followed ten hours later by a report of 9.5m (31ft). Thebaud platform (CFO383, 43.9N 60.2W) reported southwest winds of 41 kts with gusts to 57 kts at 0300 UTC on the 18th and, three hours later, reported 11.0 m seas 36ft). ASCAT imagery from 0143 UTC on the 18th showed a swath of west to southwest winds 50 to 60 kts south of Nova Scotia. The cyclone subsequently weakened on the 18th while passing northeast across Newfoundland and became absorbed by a secondary low forming on a front to the north late on the 19th.

**North Atlantic Storms, February 22-27:** Two hurricane force lows formed in the waters south of Canada's Atlantic provinces in late February. The first developed quickly from a new low south of Nova Scotia near 41N on the night of the 21st and developed hurricane force winds with a 984 hPa center near 39N51W at 1800 UTC on the 22nd. It developed a lowest central pressure of 969 hPa southeast of the Grand Banks on the morning of the 23rd with its top winds lowering to storm force. Consecutive ASCAT passes twelve hours apart ending near 0000 UTC on the 24th revealed small areas of north to northwest winds of 55 kts southwest of the center. The cyclone weakened to a gale over the north central waters on the 24th and re formed to the north into a storm force low near Greenland on the 25th , before moving north through the Denmark Strait as a gale on the 26th. Selected ship reports taken in this event are listed in Table 3. A second cyclone originated near the southeast coast of the U.S. on the night of the 22nd and intensified as it moved northeast across the offshore waters, developing storm force winds while passing just east of Georges Bank 0000 UTC on the 25th and developing a lowest central pressure of 976 hPa near 40N 62W six hours later. Intensification was rapid, with the central pressure dropping 25 hPa in the preceding twenty-four hour period. Hurricane force winds lasted into the afternoon of the 25th. An ASCAT image offering partial coverage showed winds to 55 kts south of the center and a small area of northeast winds of 55 kts on the north side. The cyclone subsequently tracked east until early on the 26th before turning north and stalling over the Grand Banks as a gale on the 27th and 28th. Dissipation followed late on the 28th.

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3. Bancroft, George, Marine Weather Review-North Pacific Area, *Mariners Weather Log, Vol. 57, Number13, April 2013.*
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| OBSERVATION | POSITION | DATE/TIME (UTC) | WIND | SEA(m/f) |
|---|---|---|---|---|
| **Washington Express** (WDD3826) | 45N 41W | 23/1100 | NE 50 | 5.8/19 |
| **Zim Tarragona** (4XFA) | 36N 58W | 22/1800 | NW 50 | 11.3/37 |
| **Unique Guardian** (VRJM6) | 32N 47W | 22/2200 | SW 50 | 6.0/20 |
| **Maersk Missouri** | 43N 46W | 23/1800 | N 50 | |
| **E. R. Boston** (A8UU3) | 38N 43W | 24/0000 | NW 50 | |
| **Philadelphia Express** (WDC6736) | 45N 44W | 24/0300 | NW 55 | 14.9/49 |

Table 3. Selected ship observations taken during passage of the first of two North Atlantic storms during February 22-27, 2013..

# Marine Weather Review – North Pacific Area

November 2012 to February 2013

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## Introduction

The weather pattern over the North Pacific featured a main track of cyclones from southwest to northeast from near or south of Japan to the northeastern Pacific or Gulf of Alaska, with a few turning north in the Bering Sea or even to the west of the Kamchatka Peninsula when the pattern became more blocked. December and February were the most active months in terms of number of lows producing hurricane force winds, with December having been found in the past to be most active in a study based on QuikSCAT winds (VonAhn and Sienkiewicz, 2005). In contrast to the North Atlantic, only three very intense lows developed with central pressures below 950 hPa, with one of these, at the beginning of November, reported on in the preceding issue of MWL. Another, occurring in mid-January, stood out with a pressure as low as 932 hPa and the strongest satellite detected winds. No tropical cyclones developed or moved into OPC's radiofacsimile chart area during the four month period, although such activity is not unusual especially early in the period.

## Significant Events of the Period

**North Pacific Storm, November 2-4:** Originating southeast of Japan on October 30, this cyclone gradually intensified while moving east into the south-central waters where it developed storm force winds. More rapid intensification followed as the system turned northeast toward the eastern Gulf of Alaska (Figure 1). The second part of Figure 1 shows the cyclone at maximum intensity making it the second deepest of the period in the northeastern Pacific. The **Alaskan Frontier** (WDB7815) reported west winds of 60 kts and 7.5 m seas (25 ft) near 54N 139W at 2200 UTC November 4. The **British Pride** (ZQTP2) encountered west winds of 55 kts near 35N 154W at 1600 UTC on the 3rd. The buoy 46004 (50.9N 136.1W) reported southwest winds of 52 kts with gusts to 70 kts and 8.0 m seas (26 ft) at 1600 UTC on the 4th, and seas 12.5m (41 ft) three hours later. Buoy 46208 (52.5N 132.7W) reported southwest winds of 43 kts with gusts to 58 kts and 9.0 m seas (30 ft) at 2000 UTC on the 4th, followed three hours later by a report of 13.0 m seas (43 ft). ASCAT imagery in Figure 2 reveals a swath of west winds 50 to 60 kts on the south side of the cyclone. With a low bias of ASCAT that increases with wind speed, is is likely that hurricane force winds were occurring. The cyclone subsequently weakened and moved inland over Southeast Alaska late on the 4th.

**North Pacific/ Bering Sea Storm, November 11-14:** A new low formed off Japan near 34N 152E at 1800 UTC November 9 and moved to the central Aleutian Islands with a lowest central pressure of 956 hPa late on the 12th accompanied by hurricane force winds. An ASCAT pass from 2252 UTC on the 12th detected a swath of west winds on the south side similar in appearance to Figure 2 except 50 to 55 kts. The **Cosco Vancouver** (A8EO8) near 52N 178E reported northeast winds of 45 kts. The **Adrian Maersk** (OXLD2) encountered northwest winds 35 kts but with seas 13.4 m (44 ft) near 53N 169E at 0000 UTC on the 14th. Buoy 46071(51.1N 179.1E) reported northwest winds of 45 kts with gusts to 56 kts and 8.0 m seas (26 ft) at 1100 UTC on the 13th , and six hours later reported 9.0 m seas (30 ft). Buoy 46072 (51.7N 172.2W) reported seas as high as 11.0 ms at 1700 UTC on the 13th. The cyclone subsequently moved into the southeast Bering Sea late on the 13th and winds dropped to gale force the next day. The system re-formed in the Gulf of Alaska early on the 15th and made a cyclonic loop there through the 18th before moving southeast and dissipating off Vancouver Island on the 20th.

**Northeastern Pacific Storm, November 21-23:** A cyclone formed on a front in the central North Pacific late on November 19 and moved northeast, developing a lowest central pressure of 957 hPa near 52N 144W and hurricane force winds at 1800 UTC on the 22nd. The central pressure fell 25 hPa during the preceding twenty-four hours. This was the deepest low of the period in the northeast Pacific. The **Hanjin Geneva** (DHZQ) near 53N 131W reported southeast winds of 65 kts and 9.5 m seas (31 ft) at 0000 UTC on the 23rd. The **Kodiak** (KQXZ) near 58N 145W encountered east winds of 50 kts six hours later. Buoy 46184 (53.9N 138.9W) reported southeast winds 41 kts with gusts to 54 kts and 8.5 m seas (28 ft) at 0000 UTC on the 23rd, followed by a report of 11.0 m (36 ft) one hour later. Buoy 46183 (53.6N 131.1W) reported southeast winds 51 kts with gusts to 62 kts and 8.0 m seas (26 ft) at 2000 UTC on the 22nd. The cyclone then weakened and moved inland over Southeast Alaska on the night of the 23rd.

**North Pacific Storm, December 3-8:** A weak low passing 350 nm south of Japan on December 2 gradually intensified as it moved out over the south-central waters during the next three days and then developed hurricane force winds as it turned toward the north near 170W (Figure 3). The cyclone developed a lowest central pressure of 949 hPa near 49N 170W by 1200 UTC on the 8th, and was the third deepest cyclone of the November to February period. The **Ballyhoo** (WDD6249) reported northeast winds of 65 kts and 4.5 m seas (15 ft) near 52N 173W at 0600 UTC on the 8th. The **Antwerpen Express (**DGAF) near 48N 174W encountered north winds of 70 kts and 8.0 m seas (26 ft) three hours later. The cyclone then weakened as it moved into the southeast Bering Sea with its winds diminishing to gale force early on the 9th, and then below gale force as it moved inland over Alaska early the next day.

**Sea of Japan Storm, December 5-6:** Low pressure rapidly intensified while moving northeast across the Sea of Japan on December 5, developing hurricane force winds with its compact circulation and 986 hPa center while approaching northern Japan (Figure 3). Figure 4 is an ASCAT image reveals the compact circulation with winds 50 to 60 kts around the south and southwest sides. A vessel reporting with the SHIP callsign encountered southeast winds of 50 kts near 45N 148E at 1200 UTC on the 6th. The cyclone was short lived, as it moved into the southern Sea of Okhotsk and weakened on the 7 before becoming absorbed by another storm moving across Japan late on the 7th (second part of Figure 3).

**Northwest Pacific and Bering Sea Storm, December 10-12:** A new low formed just east of Japan late on December 8 and moved to 53N 169E forty-eight hours later where it developed a lowest central pressure of 962 hPa and hurricane force winds. An ASCAT (METOP-B) pass valid at 0953 UTC on the 11th returned an area of northeast winds of 50 kts north of the low center in the western Bering Sea. The **World Spirit** (ELWG7) reported south winds of 58 kts and 6.5 m seas (21 ft) near 53N 172E at 0600 UTC on the 11th, and then seas of 10.7 m (35 ft) near that location six hours later. The **APL India** (A8JX7) near 48N 170E encountered southwest winds of 50 kts at 1800 UTC on the 10th. Buoy 46035 (57.1N 177.8W) reported south winds of 37 kts with gusts to 45 kts at 1800 UTC on the 12th, and highest seas 9.5 m (31 ft) one hour later. The cyclone then passed north of the western and then the central Aleutians on the 12th with its winds weakening to gale force late on the 12th. Dissipation followed early on the 14th over southwestern Alaska.

**North Pacific Storm, December 16-20:** A complex area of low pressure near Japan on December 15 moved northeast and consolidated into a single storm force low off northern Japan early on the 16th, temporarily weakened to a gale passing just south of the central and eastern Aleutians on the 17th and then re-intensified in the western Gulf of Alaska to a storm force low on the night of the 17th. The cyclone developed a lowest central pressure of 968 hPa and hurricane force winds near 55N 144W at 0600 UTC on the 19th. An ASCAT (METOP-B) image valid about one hour later revealed west to northwest winds to 60 kts on the south side and was similar to Figure 2 for the November 2-4 event. Buoy 46185 (52.4N 129.8W) reported southeast winds of 39 kts with gusts to 56 kts and 6.5 m seas (21 ft) at 0800 UTC on the 19th, and seas 7.5 m (25 ft) one hour later. Buoy 46246 (50.0N 145.1) reported seas as high as 14.0 m (47 ft) at 1800 UTC on the 19th. The cyclone subsequently turned toward the southeast and gradually weakened the following two days with its winds weakening to gale force late on the 20th. It was then absorbed by a stronger low passing to the east off the U.S. Pacific Northwest states on the 22nd.

**North Pacific Storms, December 21-January 1:** In the most active period five hurricane force lows developed in close succession in late December. The first formed on a front near 36N 169E 1200 UTC December 21 and developed a lowest central pressure of 985 hPa thirty hours later at 45N 179E (Figure 5). A METOP-B ASCAT pass valid 2137UTC on the 22nd showed a swath of west to northwest winds of 50 to 55 kts southwest of the low, and an image from the other ASCAT instrument (METOP-A) about an hour later revealed east winds to 55 kts on the north side. The cyclone began a weakening trend as it turned toward the east late on the 22nd, and dissipated near 150W on the morning of the 24th. A second development, in the western North Pacific, is depicted in Figure 5 and originated as a wave of low pressure south of Japan on the 21st. The central pressure fell 31 hPa in the twenty-four hour period ending at1200 UTC on the 23rd. The cyclone developed a lowest central pressure of 956 hPa near 52N 160E at 0000 UTC on the 24th. The ASCAT (METOP-B) image in Figure 6 shows the system east of the northern Kurile Islands with winds 50 to 60 kts southwest, west and east of the center. The **Northwest Shearwater** (ZCAO7) reported northwest winds of 50 kts near 33N 139E at 1200 UTC on the 22nd. The **Cosco Vancouver** (A8EO8) near 52N 175E encountered southeast winds of 50 kts and 10.4 m seas (34 ft) at 0600 UTC on the 24th. The cyclone subsequently drifted northeast over the far western Bering Sea and weakened over the next several days with its winds diminishing to gale force on the 24th. The third development occurred as a low east of Japan (second part of Figure 5) moved northeast and subsequent development is depicted in Figure 7. The cyclone developed a lowest central pressure of 958 hPa near 50N 165W twelve hours later. Hurricane force winds with this system occurred from early on the 25th until the morning of the 26th. The ASCAT (METOP-B) image in Figure 8 shows winds 50 to 60 kts on the south and southwest sides of the cyclone. The **APL Holland** (9VKQ2) encountered south winds of 40 kts and 9.0 m seas (30 ft) near 37N 178W at 0600 UTC on the 25th, and 11.3 m seas (37 ft) near 37N 175W six hours later. The cyclone moved into the Gulf of Alaska on the 27th and weakened, then dissipated early on the 28th. A fourth hurricane force low developed farther east and is depicted in Figure 9. It is shown at maximum intensity in the second part of Figure 9. An ASCAT (METOP-B) image at 2051 UTC on the 29th revealed a swath of west to southwest winds 50 to 55 kts on the south and southeast sides of the cyclone's center. The **MSC Altair** A8YN2 (33N 172W) reported west winds of 50 kts at 2200 UTC on the 28th. The **Guardsman** (WBN5978) encountered south winds of 50 kts and 8.8 m seas (29 ft) near 56N 153W at 0000 UTC on the 31st. Buoy 46001 (56.3N 148.2W) reported south winds of 35 kts and 11.0 m seas (36 ft) at 1800 UTC on the 30th. The cyclone subsequently turned more toward the northeast and weakened in the southeast Bering Sea late on the 30th and moved inland over southwest Alaska on the 31st. As this was happening a fifth hurricane force low formed south of Kodiak Island near 51N at 1800 UTC on the 31st with a 960 hPa central pressure, coming from south of the eastern Aleutians (second part of Figure 9). It passed near Kodiak Island early on January 1 and weakened inland over southwest Alaska later that day. The **Alex Haley** (NZPO) near 57N 152W reported east winds 55 kts at 0000 UTC January 1, and six hours later 10.0 m seas (33 ft) at 57N 153W. Simultaneous with this development, a sixth intense system formed in the far west near 51N 149E, briefly developing hurricane force winds with a 956 hPa central pressure at 1800 UTC on the 31st before turning east and weakening to a gale passing east of the Kamchatka Peninsula late on the 1st. The **Ever Dainty** (9V7951) near 41N 142E reported west winds of 55 kts and 4.3 m seas (14 ft) at 0000 UTC on the 1st. The **Sea-Land Charger** (WDB9948) encountered southwest winds of 35 kts and 12.8 m seas (42 ft) twelve hours later.

**Central North Pacific Storm, January 10-12:** A new low formed east of Japan at 1800 UTC January 8 and moved east-northeast, briefly developing hurricane force winds near 41N 177W with a 980 hPa center at 0600 UTC on the 11th. The cyclone developed a lowest central pressure of 968 hPa as a storm force low while passing near 47N 172W twelve hours later. The **APL Korea** (WCX8883) near 46N 159W reported south winds of 40 kts and 6.7 m seas (22 ft) at 2200 UTC on the 11th. Winds dropped to gale force as the cyclone turned north into the Bering Sea by the 12th. It then passed north through the Bering Strait early on the 14th.

**Western North Pacific Superstorm, January 13-18:** The rapid development of a Western Pacific superstorm with a central pressure as low as 932 hPa (27.52 inches of mercury) over only a twenty-four hour period is shown in Figure 10. Its winds were already storm force when it passed south of Japan late on the 13th. The central pressure fell 49 hPa in the twenty-four hour period ending at 0000 UTC on the 15th , or on average about 2 hPa per hour. Figure 11 is a satellite image of the storm near maximum intensity revealing cold topped clouds in broad frontal features even wrapping around a well defined center. The cold cloud tops in this infrared image indicate this system is vertically well developed. The ASCAT (METOP-B) image in Figure 12 reveals widespread winds in the 50 to 75 kts range around the cyclone center. The 75 kts winds appear near the gap between passes indicating the image might miss some higher winds on the south side of the system. A Jason-2 satellite altimeter image in Figure 13 has a western pass cutting through the south side of the cyclone in which almost 42 ft (12.8 m) appears near 40N 165E. The cyclone moved northeast in the next twenty-four hours before turning north with gradual weakening, and maintained hurricane force winds from early on the 14th until early on the 17th. The center turned west along 51N on the 17th and 18th and moved into the Sea of Okhotsk as a gale before looping to the southwest and then east before becoming absorbed by the second of two late January hurricane force lows on the 23rd to be covered below. Some notable surface observations taken in this event are listed in Table 1.

**North Pacific Storms, January 21-26:** Two cyclones producing hurricane force winds occurred in close succession in late January. The first of these is shown at maximum intensity in the first part of Figure 14. It intensified by 28 hPa in a twenty-four hour period ending at 0000 UTC on January 22 after forming as a new low east of Japan near 33N 152E late on the 19th. ASCAT imagery from 0928 UTC on the 22nd detected winds of 50 to 60 kts in the west and south sides of the system. The **Monte Sarmiento** (DCLH2) reported west winds of 45 kts near 30N 167E at 1800 UTC on the 21st. Twelve hours later the **Sea-Land Charger** (WDB9948) encountered southwest winds of 40 kts and 10.7 m seas (37 ft). The cyclone then tracked east-northeast with gradual weakening, with winds lowering to gale force early on the 24th and remaining gale force as the system approached Vancouver Island late on the 25th. The development of the second cyclone from a 1000 hPa low near Japan over a forty-eight hour period is depicted in Figure 14. It developed a lowest central pressure of 965 hPa near 49N 171E at 1800 UTC on the 24th. An ASCAT (METOP-B) image from 2219 UTC on the 23rd revealed winds to 70 kts on the south side similar to the winds in Figure 16 for the February 21-24 event. The **A.P. Moller** (OVYQ2) near 48N 178E reported southwest winds of 45 kts and 8.5 m seas (28 ft) at 0000 UTC on the 25th. The cyclone passed near the western Aleutian Islands on the 25th and weakened, with its winds lowering to gale force as it drifted north over the western Bering Sea late on the 26th.

| OBSERVATION | POSITION | DATE/TIME (UTC) | WIND | SEA(m/f) |
|---|---|---|---|---|
| Maersk Kendal (MTDU5) | 33N 137E | 13/2100 | E 45 | |
| LNG Akwa Ibom (ZCDL9) | 34N 139E | 14/1100 | N 50 | |
| Ever Diadem (9V7955) | 30N 148E<br>30N 147E | 14/1200<br>14/1800 | S 50<br>W 50 | 6.5/21<br>6.5/21 |
| Westwood Rainier (C6SI3) | 52N 174E<br>52N 175E | 16/1200<br>17/0000 | E 55<br>SE 55 | |
| Hanjin Geneva (DHZQ) (DHZQ) | 53N 175W<br>53N 177W | 16/1800<br>17/0000 | SE 54<br>E 51 | 6.7/22<br>11.3/37 |
| Kuala Lumpur Express (DFNB2) | 49N 157E | 17/1800 | W 50 | |
| Buoy 46070 | 55.1N 175.3E | 17/0100 | Maximum | 11.0/36 |

Table 1. Selected ship and buoy observations taken during the passage of the western Pacific superstorm of January 13-18, 2013.

**North Pacific Storm, January 27-February 1:** This developing low moved east from near Japan on January 27 and developed into a hurricane force low in the central waters on the 29th. It developed a lowest central pressure of 972 hPa near 40N 177W at 0600 UTC on the 30th. An ASCAT image from 2241 UTC on the 29th showed a swath of 50 to 65 kts winds on the south side. The **APL Korea** (WCX8883) reported northwest winds of 50 kts and 10.0 m seas (33 ft) near 43N 151E at 1200 UTC on the 29th. The cyclone then tracked northeast and weakened, reaching the southern Gulf of Alaska February 1 and dissipating later that day.

**Eastern North Pacific Storm, February 7-9:** Low pressure originating south of Japan near 32N late on February 5 tracked east-northeast across the Pacific and rapidly intensified after passing 180W, becoming a hurricane force low with a 972 hPa central pressure near 43N 166W at 1200 UTC on the 8th. The central pressure fell 31 hPa in the twenty-four hour period ending at 1800 UTC on the 8th. The lowest central pressure was 961 hPa near 49N 160W twelve hours later, but the top winds were down to storm force by then. The **Cormorant Arrow** (C6IO9) near 42N 175E reported northwest winds of 40 kts and 10.4 m seas (34 ft) at 0000 UTC on the 8th. The **CSAV Barcelona** (9HCX7) near 54N 156W encountered southeast winds of 45 kts. The cyclone turned north into the western Gulf of Alaska as a gale on the 9th and then dissipated inland over south-central Alaska early on the 10th.

**North Pacific Storms, February 11-18:** Three hurricane force cyclones developed in close succession in mid February. The first followed a track east-northeast from southeast of Japan late on the 9th to the central waters late on the 12th where it briefly developed hurricane force winds with a 974 hPa center near 46N 177W and a lowest pressure 972 hPa six hours later. An ASCAT image offering partial coverage at 2108 UTC on the 12th showed west winds of 50 to 60 kts south of the center. The cyclone began weakening the next day and reached the eastern waters near 48N 144W on the 15th, where it dissipated. A second developing low originated south of Japan near 30N early on the 12th and moved northeast, developing hurricane force winds with a 981 hPa center near 39N 151E twenty-four hours later, with the central pressure dropping 33 hPa which is quite a fall for that low latitude. Hurricane force winds with this system continued through early on the 15th when the central pressure reached a low point of 964 hPa near 44N 171E 0600 UTC on the 15th. The cyclone subsequently weakened to a gale near the eastern Aleutians on the 16th and then dissipated in the Gulf of Alaska the next day. A third cyclone, mainly affecting the western waters, originated near Japan at 0600 UTC on the 15th and tracked northeast, developing into a 964 hPa hurricane force low near 43N 162E at 1200 UTC on the 16th. The central pressure fell 35 hPa in the preceding twenty-four hours. ASCAT imagery revealed winds 50 to 55 kts on the south and southwest sides in a pass from 1051 UTC on the 16th. Winds eased to storm force late that day but the lowest central pressure occurred later, at 1200 UTC on the 17th when the center passed near 50N 163E with a 956 hPa pressure. The **NYK Rumina** (9V7645) near 46N 166E reported east winds of 45 kts and 10.7 m seas (35 ft) at 1800 UTC on the 16th. The **Hatsu Excel** (VSXV3) near 53N 160E encountered north winds of 50 kts and 13.1 m seas (43 ft) at 0000 UTC on the 18th. The system then drifted northeast over the western Bering Sea as a gale on the 19th and 20th, stalled and then dissipated on the 22nd.

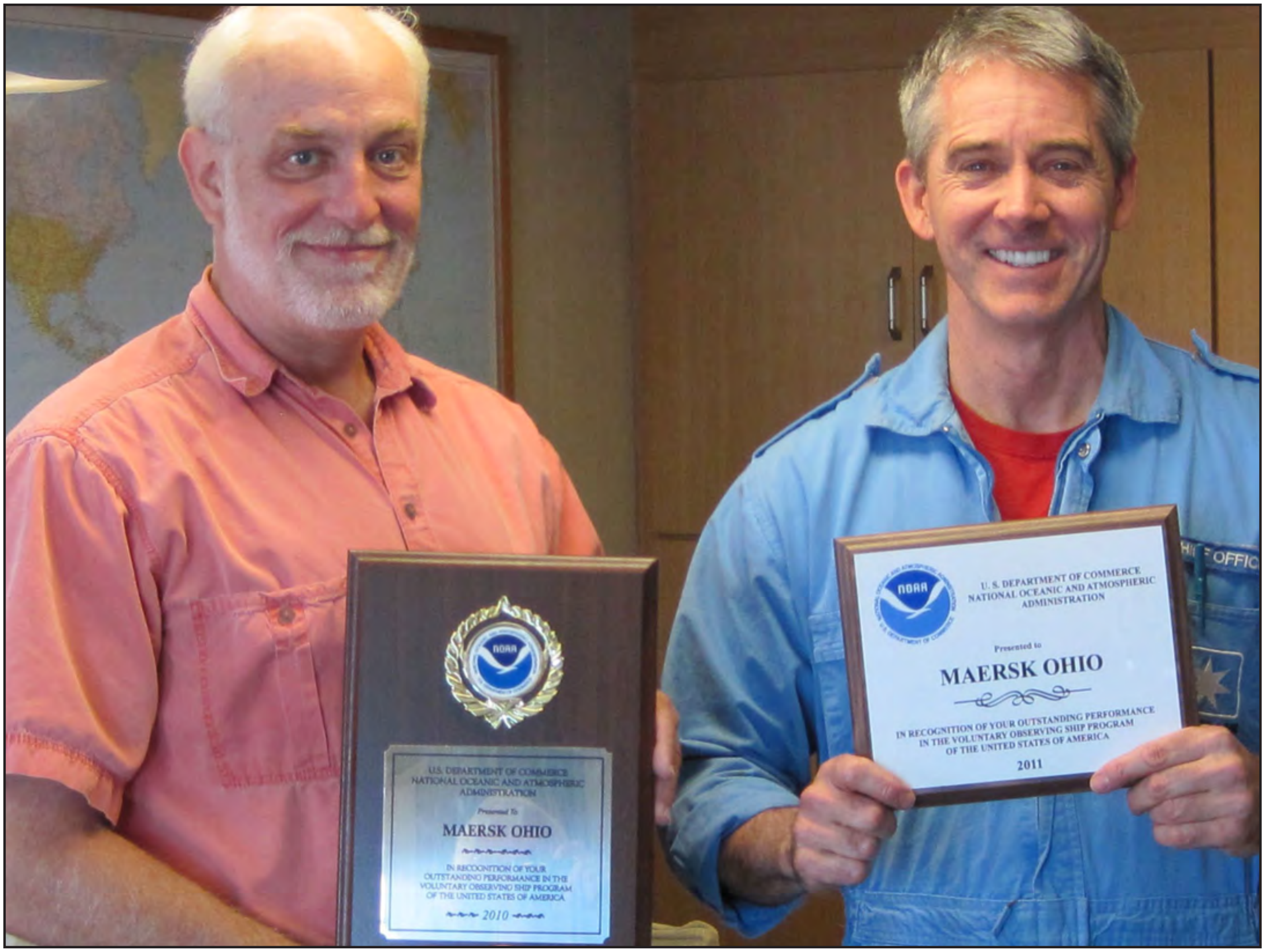
**Northwestern Pacific and Bering Sea Storm, February 17-19:** Low pressure formed on a front near 43N 170E at 1800 UTC February 17 and moved northeast, becoming a storm force low near the central Aleutian Islands twelve hours later. The cyclone briefly developed hurricane force winds early on the 18th in the southern Bering Sea when ASCAT imagery revealed east winds of 50 kts northeast of the center at 0831 UTC on the 18th with partial Bering Sea coverage. The central pressure dropped to as low as 958 hPa near 56N 179E 0000 UTC on the 19th but with winds down to storm force. KEY796 near 57N 170W reported east winds of 40 kts at1800 UTC on the 18th. Buoy 46070 (55.1N 175.3E) reported seas to 7.0 m (23 ft) at 0200 UTC on the 19th. The cyclone subsequently drifted northwest and dissipated in the northwest Bering Sea on the 20th.

**North Pacific Storm, February 18-20:** Low pressure originating near Japan late on February 17 moved northeast, developed a lowest central pressure of 972 hPa near 52N 169W 0600 UTC on the 20th and briefly produced hurricane force winds early on the 20th. ASCAT (METOP-B) imagery from 0844 UTC on the 20th revealed a swath of west to southwest winds 50 to as high as 65 kts on the south side of the low center. The **Grete Maersk** (OYCY2) reported southwest winds of 50 kts near 45N 168W at 0000 UTC ion the 20th, while the **APL Korea** (WCX8883) encountered west winds 40 kts and 8,5 m seas (28 ft). The **Zim Chicago** (A8SI9) near 52N 152W reported west winds of 50 kts twenty-four hours later. The cyclone then continued its northeastward motion and dissipated in the northeastern Gulf of Alaska the next day.

**North Pacific Storm, February 21-24:** Figure 15 shows the rapid development of this rather compact system from an open wave of low pressure near 37N 159E over a twenty-four hour period. The central pressure dropped 35 hPa during this period, and the central pressure then dropped another 10 hPa twelve hours later when the center passed near 52N 180W with a 961 hPa pressure. The ASCAT (METOP-B) image in Figure 16 returned a swath of west to northwest winds 50 to 70 kts on the south and southwest sides of a well defined center early on the 22nd. The **Zim Chicago** (A8SI9) encountered north winds of 50 kts near 55N 179W at 0600 UTC on the 23rd. Buoy 46075 (53.9N 160.8W) reported south winds of 35 kts at 0000 UTC on the 24th and highest seas 11.0 m (36 ft) one hour later. The cyclone subsequently moved along the eastern Aleutian chain and the Alaska Peninsula on the 23rd and dissipated east of Kodiak Island the next day.

**North Pacific Storm, February 23-27:** Low pressure moved east from northern Japan early on the 23rd ,became a storm force low the following night and then a hurricane force low 0000 UTC on the 25th near 41N 158E with a 981 hPa central pressure. ASCAT imagery from 1102 UTC on the 25th returned an area of west winds 50 to as high as 65 kts south of the low center, near the edge of a pass. Hurricane force winds continued until late on the 25th . The lowest central pressure of 971 hPa occurred as the low passed near 46N 168E at 1800 UTC on the 25th. The **Glen Canyon Bridge** (3EFD9) near 48N 167E reported north winds of 55 kts at 1800 UTC on the 25th , and later at 0500 UTC on the 26th encountered north winds of 50 kts and 8.2 m seas (27 ft) near 49N 171E. The cyclone subsequently weakened as it passed just south of the central and eastern Aleutians and then moved through the Gulf of Alaska. Dissipation followed late on March 2.

# VOS Program Awards




Captain Carl Hall and Chief Mate Chris Kavanaugh accept the 2010 and 2011 on behalf of Captain Mike Leveille and Chief Mate Chris McCloud and the fine officers and crew of MAERSK OHIO. They have performed in an exemplary manner for 4 consecutive years and are well on their way to a 5 year “Observing Excellence” pennant. Congratulations.

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# National Weather Service VOS Program New Recruits:

February 14 through June 30, 2013

| SHIP NAME | CALL SIGN |
|---|---|
| Alliance Fairfax | WLMQ |
| Amavisti | V2CR5 |
| APL Melbourne | A8SN4 |
| APL Shanghai | A8SN5 |
| Arthur Maersk | OXJH2 |
| Chemical Pioneer | KAFO |
| Columbine Maersk | OUHC2 |
| Dubai Express | VRBN8 |
| Ever Dynamic | 3FUB8 |
| Ever Racer | 3FJL4 |
| Ever Respect | 3FRZ4 |
| Ever Sigma | MKKZ7 |
| Green Point | WCY4148 |
| Horizon Consumer | WCHF |
| Kaministiqua | CFN4612 |

| SHIP NAME | CALL SIGN |
|---|---|
| Maersk Chicago | WMCS |
| Maersk Detroit | WMDK |
| Mahimahi | WHRN |
| Mette Maersk | OUJK2 |
| Michipicoten | CFG8060 |
| Norwegian Breakaway | C6ZJ3 |
| NYK Libra | HOJY |
| Ojibway | CFN4292 |
| Rudolf Schepers | V2DN6 |
| Saginaw | VF2560 |
| Silver Shadow | C6FN6 |
| Star Lima | LAPE7 |
| Tecumseh | CFN5905 |
| W. H. Blount | C6JT8 |

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**NOAA WEATHER RADIO NETWORK**
(1) 162.550 mHz
(2) 162.400 mHz
(3) 162.475 mHz
(4) 162.425 mHz
(5) 162.450 mHz
(6) 162.500 mHz
(7) 162.525 mHz

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

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

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

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