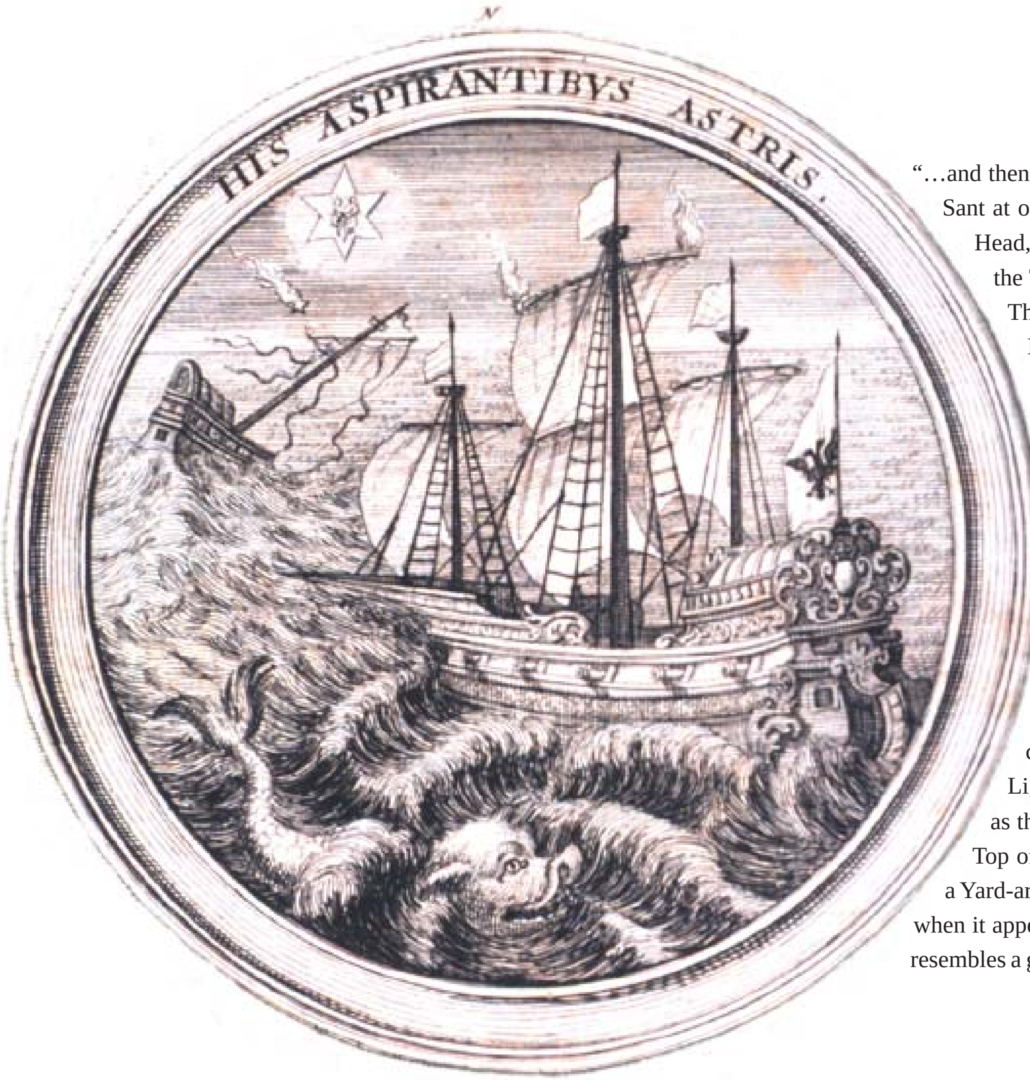
Mariners Weather Log

Vol. 46, No. 1 Spring/Summer 2002



"…and then we saw a Corpus Sant at our Main-top-mast Head, on the very Top of the Truck of the Spindle. This sight rejoiced our Men exceedingly, for the height of the Storm is commonly over when the Corpus Sant is seen aloft. But when they are seen lying on the Deck, it is generally accounted a bad Sign.

"A Corpus Sant is a certain small glittering Light. When it appears, as this did, on the very Top of the Main-mast or at a Yard-arm, it is like a Star. But when it appears on the Deck, it resembles a great Glow-worm…"

Additional Observations of a Seventeenth Century Seafarer: William Dampier

(see page 16)

Mariners Weather Log

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From the Editorial Supervisor

Welcome to Spring. The birds are singing, flowers are blooming, and the sun's warmth is re-energizing the earth. So I happen to look at the world from a northern hemispheric perspective - sorry to my friends in the South. It is just that I get all excited as the warm weather of spring returns. Of course, living in southern Mississippi, it only lasts a few weeks until the sweltering heat and humidity of the deep south returns. When you add the fire ants, the overabundance of mosquitoes, and the intense, springtime thunderstorms, you wonder why anyone would want to live here at all.

Actually, I believe that being out at sea is the best you can ask for in life. You get the warmth of the sun and the wind in your face to make you feel free and alive as you travel all around this beautiful orb that we call home.

As the seasons change, so does life. There will be good times as well as bad, and it is up to us as to how we read the clouds and weather our storms.

In this issue, we have changed our issue date to reflect the seasons. We also say farewell to one of our own, Jim Nelson, our Houston PMO, who has retired and found his snug harbor. We get a valuable history lesson about the **Edmund Fitzgerald** that can keep us safe in the future, and to reflect upon the past, the British Met Office donated an interesting article about the escapades and observations of a seventeenth century seafarer named William Dampier.

So, no matter on what bearing life has you traveling today, find a leeward shelter for awhile and enjoy our latest offering of the Mariners Weather Log. – **Luke**

Some Important Web Page Addresses

NOAA	http://www.noaa.gov
National Weather Service	http://www.nws.noaa.gov
National Data Buoy Center	http://www.ndbc.noaa.gov
AMVER Program	http://www.amver.com
VOS Program	http://www.vos.noaa.gov
SEAS Program	http://seas.nos.noaa.gov/seas/
Mariners Weather Log	http://www.nws.noaa.gov/om/mwl/mwl.htm
Marine Dissemination	http://www.nws.noaa.gov/om/marine/home.htm
U.S. Coast Guard Navigation Center	http://www.navcen.uscg.gov/marcomms/

See these Web pages for further links.

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Great Lakes Storm November 9-11,1998: Edmund Fitzgerald Remembered

Kirk Lombardy
Marine Forecaster
NWS, Cleveland, Ohio

The author wishes to express his respect toward the Captains and crews of the Great Lakes shipping industry. The issue of the great tragedy of the Edmund Fitzgerald would rather be kept solemn by many. The intent of this article is to show how the interaction between the National Weather Service and marine interests has progressed in the last 24 years.

On 10 November 1975, the most notorious Great Lakes shipping disaster occurred. The **SS Edmund Fitzgerald** sank and it's crew of 29 men perished in the deep waters of Lake Superior during an intense storm which had developed over the central United States and made a bee-line for the western Great Lakes.

Twenty-three years later, a case of deja vu settled in on the anniversary of the **SS Edmund Fitzgerald**. From 9 - 11 November 1998, a storm of equal proportions developed over the same area as the **Fitzgerald** storm and followed a similar path toward the western Great Lakes. However, this time there was an improved forecast, warning, and dissemination system in place.

Final Voyage of the SS Edmund Fitzgerald

On 9 November 1975, **Fitzgerald** began loading at Burlington Northern Railroad Dock No. 1, in Superior, WI. The ship's final voyage would carry taconite; destined for Detroit, MI (Figure 1).

Fitzgerald departed at full speed of approximately 14 Knots (16 mph). Two hours into the voyage, the ship arrived at a point near Two Harbors, MN. The **SS Arthur M. Anderson**, owned by the United States Steel Corp., bound for Gary, IN proceeded eastward on a similar course as **Fitzgerald**. The two ships were approximately 10 to 20 miles apart.

Routine weather reports, via radio, were made at 0600 UTC (0100 EST) and 1200 UTC (0700 EST) by the **Fitzgerald** on 10 November. At 1220 UTC (0720 EST), a normal radio report was made to the company office. The report indicated the estimated time of arrival was indefinite due to weather.

Fitzgerald headed northeast away from the recommended shipping lanes along the south shore of Lake Superior. (Strong northeast storm force winds caused extremely high waves at the end of the fetch on the south shore of the lake).

Fitzgerald's new course passed approximately half way between Isle Royal and the Keewanaw Peninsula. At this point, the ship turned eastward to parallel the northern shore of Lake Superior and then southeast-ward along the eastern shore. **Fitzgerald** reached a point approximately 11 miles Northwest of Michipicoten Island at 1800 UTC (1300 EST), 10 November. The ship passed to the West of Michipicoten West End Light. At this point, **Fitzgerald** changed course to pass north and east of Caribou Island on a southeast heading toward Whitefish Bay, MI.

The **SS Edmund Fitzgerald** sank near the International Boundary Line some time after 0015 UTC (1915 EST). Her final coordinates were 46°59.9'N, 85°06.6'W.

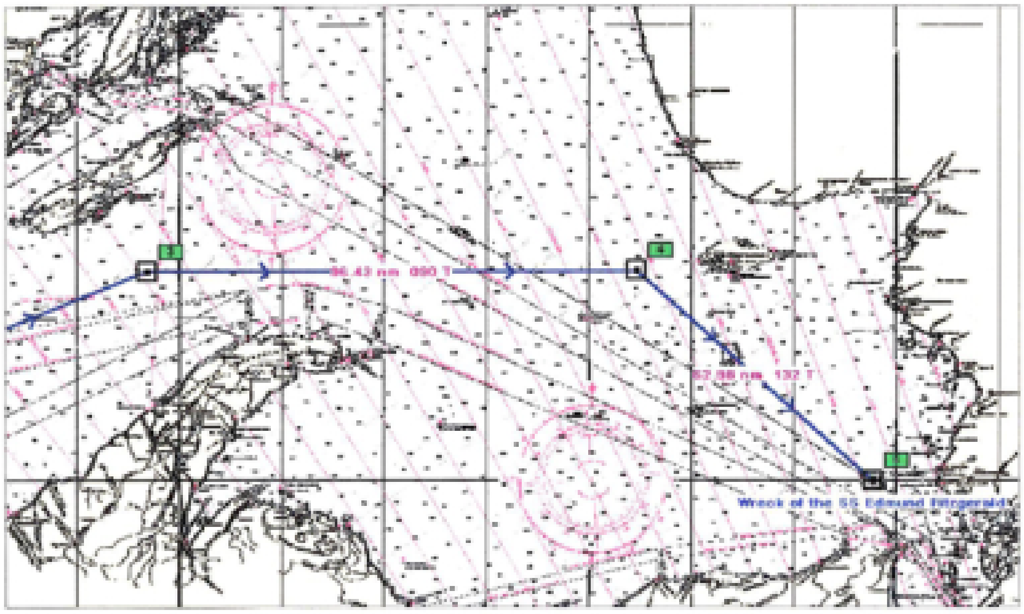

Figure 1. Actual track of the SS Edmund Fitzgerald and the location where the ship sunk in Lake Superior. The numbers in the boxes along the track represent approximate waypoints where the Fitzgerald changed course. Waypoint number 5 marks the location of the wreck.

SS Edmund Fitzgerald Encountered Weather

The storm of historical proportions developed over the Oklahoma Panhandle on 8 November, and by 1200 UTC (0700 EST), on 9 November, this strengthening storm was located over southern Kansas (Figure 2).
The track at this time was to the northeast with a minimum barometric pressure of 29.53" of Hg. On 9 November at 1200 UTC (0700 EST), National Weather Service (NWS) forecast maps for surface conditions out to 36-hours predicted that the storm would track in a northeast direction and pass just south of Lake Superior by 0000 UTC on 11 November (1900 EST 10 November).
The NWS made several revisions to the forecasts by gradually increasing the wind speed and wave heights.

Gale warnings were issued in early forecasts on 9 November for the eastern portions of Lake Superior. Successive forecasts indicated winds would increase from the east-northeast at 25 to 37 knots during the night of 9 November. Since the low was forecast to pass south of Lake Superior, winds were expected to gradually shift around to the north and then northwest.
Gale warnings were upgraded to storm warnings at 0700 UTC (0200 EST) on 10 November. Later forecast revisions called for winds to increase to 35 to 50 knots from the northeast and then diminish slightly to 28 to 38 Knots from the northwest on Tuesday, 11 November. Waves were forecast to build to 8 to 16 feet by Monday afternoon.

A cold front extended about 20 miles west of Caribou Island, Ontario and was moving at a speed of 20 to 25 knots toward the east. Earlier forecasts projected the low to pass just south of Lake Superior. The forecasters noticed the low would pass slightly further north over the eastern end of Lake Superior and forecasts had to be revised.

Based on the latest position and forecast track of the storm, the forecasters knew the wind speed was under forecast. A revision to the forecast was made at 2139 UTC (1639 EST) on 10 November. The wind was increased to 38 to 52 knots from

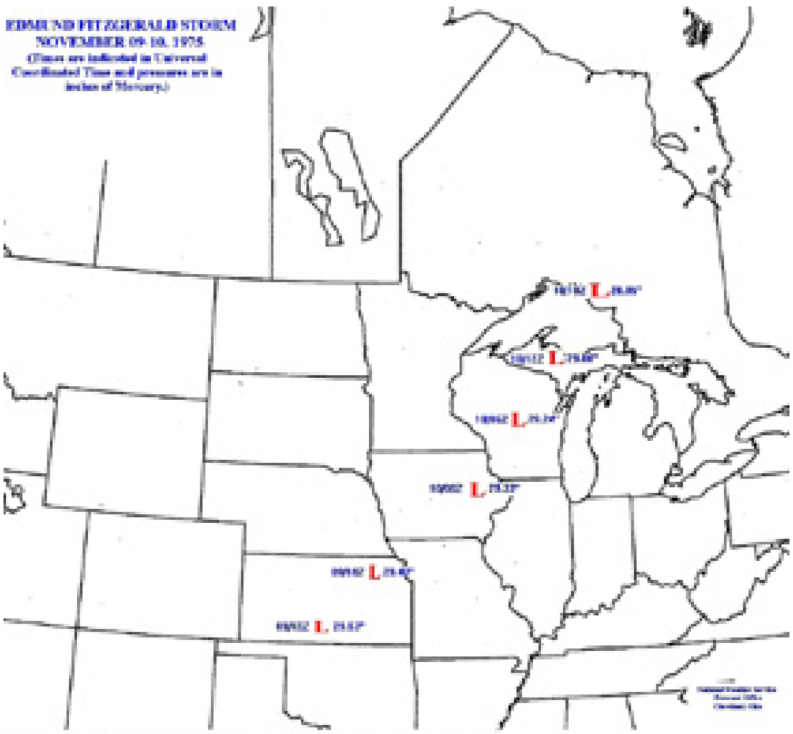

Figure 2. Storm track of the Edmund Fitzgerald Storm November 9-10, 1975.

the northwest. Gusts to 60 knots were also expected.

The early forecasts for this event indicated an increase in wind speed as the storm moved northeast. However, the forecasts considerably under estimated the strength of the storm and its motion.

Each forecast revision had stronger forecast winds than the previous forecast. This was likely a result of limited forecast guidance and a reaction, by the forecasters, to the deepening storm.

Another difficult situation the forecasters encountered was how to handle the changing wind directions and speeds as the low moved over the lake. The ultimate goal is to convey a clear and concise forecast. However, this storm did not prove to be easy to describe the forecast wind conditions.

Ships that were built in the 1970s were thought to be invincible and that they could handle rough seas. The improving technology allowed engineers to design larger ships. According to the Port Meteorological Officer stationed in Cleveland, Ohio, the larger and stronger ships gave crews a false sense of security. Crews and the shipping industry took the risk and battled the strong winds and rough seas the Great Lakes had to offer.

The combination of a complex forecast, the need to frequently update the forecasts, and the unknown risks encountered by the ship's crew contributed to the demise of the Edmund Fitzgerald.

The effects of the storm finally abated by 0600 UTC (0100 EST) on 11 November.

The final track of the storm was just north of the forecast track on 9 November. The storm moved from the northeast corner of Kansas on 9 November to east central Iowa, central Wisconsin on 10 November, Marquette, Michigan, west of Michipicoten Island on Lake Superior, White River, Ont., southern tip of James Bay, and finally to eastern Hudson Bay on 11 November. The lowest recorded pressure of the storm was 28.95" Hg.

The **SS Edmund Fitzgerald** encountered winds and seas that were forecast by the NWS. The following are some actual weather observations that were reported by the crew of the **Fitzgerald**: At 0600 UTC (0100 EST) on 10 November, the ship was about 20 miles due south of Isle Royal and reporting winds from the northeast at 52 knots and waves of 10 feet. Then, six hours later, **Fitzgerald** reported she was about 35 miles north of Copper Harbor, MI, and reported winds from the northeast at 35 knots and waves of 10 feet.

This was the final weather report sent by **Fitzgerald.**

The nearby vessel **SS Arthur M. Anderson** was in the vicinity of the **Fitzgerald** when the weather observations were reported. The **Anderson** substantiated **Fitzgerald's** weather observations at 0600 UTC (0100 EST) and 1200 UTC (0700 EST) on 10 November.

Further west (approximately 15 miles southwest of the **Anderson**), a Canadian motor vessel **Simcoe** reported winds from the west at 44 knots and waves 7 feet at 1800 UTC (1300 EST) on 10 November. An automated weather sensing unit at Stannard Rock was reporting winds from the west-northwest at 50 knots, gusting to 59 knots. At 0000 UTC on 11 November (1900 EST 10 November), Stannard Rock was reporting west-northwest winds at 40 knots, gusting to 65 knots.

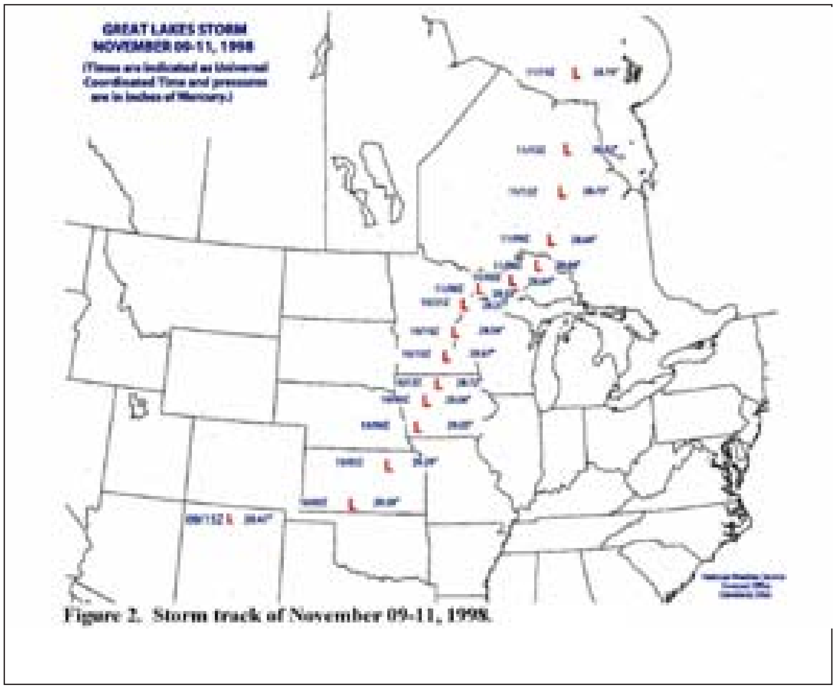

Figure 3 - The storm track of the Great Lakes Storm, November 9-11, 1998.

Great Lakes Storm - November 9-11, 1998

Storm Track and History

A major storm system developed over the Four Corners region of the United States on 8 November 1998 and moved rapidly east to the Oklahoma Panhandle (Figure 3). By 1500 UTC (1000 EST) on 9 November 1998, the storm had deepened to a central pressure of 29.47" Hg. Further deepening was expected to occur during the next 36 hours. The storm began to track northeast through Kansas, southeast Nebraska, central Iowa, southeast Minnesota, to northern Wisconsin where the central pressure dropped to 28.51" Hg at approximately 2100 UTC (1600 EST) on 10 November. This is the lowest recorded pressure of the storm and fell well below the minimum pressure of the **Edmund Fitzgerald** storm (28.95" Hg). Gale warnings were issued at 1500 UTC (1000 EST) on 9 November for Lake Superior. East-southeast winds to 30 knots were forecast for the early portions of Monday night but were forecast to increase to gale strength to 35 knots late at night. Waves were forecast to build to 6 to 8 feet overnight. Winds were expected to shift to east-northeast and increase to 45 knot gales on Tuesday while waves were forecast to continue to build to 8 to 12 feet during the day.

Storm warnings were issued at 2100 UTC (1600 EST) on 9 November for the eastern two thirds of Lake Superior as winds were forecast to reach storm force of 50 knots on Tuesday. Waves were forecast to continue to build to 7 to 12 feet Tuesday and to 12 to 20 feet Tuesday night. The highest waves were forecast for the eastern two thirds of Lake Superior.

Storm warnings were issued for the rest of Lake Superior by 0900 UTC (0400 AM EST). Storm force winds were forecast to increase to 60 knots from the west-northwest on Wednesday with waves of 12 to 20 feet across the lake.

The forecasts that were issued by the NWS were consistent throughout the entire event. No major changes in the forecast were made when a new forecast was issued.

Overall, the forecasts for Lake Superior were accurate and gave the Captains and crews nearly 40 hours of lead time to prepare for the arrival of the storm and to move their vessels to safe harbor. As previously mentioned, the highest wind speeds were not expected to occur on Lake Superior until Wednesday, 11 November. Observations from various reporting stations indicated sustained winds on the lake were above 50 knots with gusts over 60 knots. The highest recorded wave height was 15 feet on Lake Superior. Waves were likely higher in locations where reporting sites were not available; especially on the down wind end of the lake where the greatest fetch occurred. More about the observations on Lake Superior and the rest of the Great Lakes will be discussed later in the Wind and Wave Reports section of this report.

The final track of the storm was across extreme western Lake Superior to northern Lake Superior and then on to James Bay and the Hudson Bay by 1500 UTC (1000 EST) on 11 November 1998. The storm's central pressure maintained a steady state averaging about 28.70" Hg as it moved from Lake Superior to the Hudson Bay. This storm followed a similar track as the **Edmund Fitzgerald** storm. Seas and winds were higher and stronger respectively, as reported by ships and buoys in the more recent storm than the historical storm. This is likely the result of an increase in the number of buoys and reporting stations on the Great Lakes.

A commercial shipping company called the NWS Office in Cleveland, Ohio to report that the storm was being compared to the **Fitzgerald** storm. Captains of the large vessels heeded warnings and dropped anchors during the storm in safe harbor. They were not about to take any chances with the storm.

National Weather Service Statements and Bulletins

The National Weather Service Forecast Office in Cleveland, Ohio is responsible for issuing storm outlooks for the entire Great Lakes as part of the marine enhancement program.

NWS Cleveland issued a storm outlook for the entire Great Lakes at 0530 UTC (0030 EST) on 9 November 1998. The first Storm Bulletin was issued at 1730 UTC (1230 EST) on 10 November and bulletins continued through 2200 UTC (1700 EST) on 11 November when all Storm Warnings for the Great Lakes were downgraded to Gale Warnings. A total of 10 reports were issued at three hour intervals.

Wind and Wave Reports

The highest wind gust reported on all of the lakes was from a ship anchored about 4 miles off of Sandusky Breakwater on Lake Erie; which is on the south shore of the lake. At 2050 UTC (1550 EST), on 10 November, the ship reported a wind gust to 98 knots (113 mph) from the west-southwest and waves of five feet. The low wave height of 5 feet was due to lack of fetch across the water. The highest waves occur at the downwind end of the lake. The maximum sustained wind speeds and gusts that occurred on each of the lakes as reported by various stationary observational points are as follows:

Lake Superior - northwest at 52 knots with gusts to 63 knots;
Lake Michigan - southwest at 41 knots gusts to 54 knots;
Lake Huron - south at 23 knots with gusts to 51 knots;
Lake Erie - southwest at 25 knots with gusts to 64 knots; and
Lake Ontario - southeast at 49 knots with gusts to 64 knots.

The highest waves reported on each of the lakes were as follows:

Lake Superior - 15 feet
Lake Michigan - 20 feet
Lake Huron - 14 feet

Lake Erie - 20 feet
Lake Ontario - 13 feet

Higher waves likely occurred at locations without reporting sites.

Today, ship Captains and crews heed warnings issued by the National Weather Service to protect not only their lives but their expensive ships and cargo. Captains will drop the ship's anchor in sheltered areas such as behind islands and in navigable rivers for protection.

Storm Event Problems

Strong southwest winds forced shallow water away from Saginaw Bay and the basin on the west end of Lake Erie. This caused dangerously low water levels to occur and put vessels either in the basin or planning on navigating in the basin at risk. Tug boats that remained in the basin bottomed out due to low water levels.

Another vessel, the **Wolverine**, hit bottom at the Bay City Work Dock. The United States Coast Guard had to assist the vessel and no serious damage to the ship resulted.

Two duck hunters were reported missing on Saginaw Bay on Tuesday (10 November). The winds were so strong that the Coast Guard could not search for them until Wednesday morning. The duck hunters' boat ended up being caught on some rocks off of Sebewaing (Huron County). One of the duck hunters managed to walk to shore early Wednesday morning and the other duck hunter was lifted off the rocks by a Coast Guard helicopter later that morning. Both hunters were unharmed.

Thanks to improved forecasts, warnings, and dissemination, no lives were lost during this major Great Lakes Storm.

Improved National Weather Service Warning and Forecast Systems

The National Weather Service has made great strides over the last 20 years in the development of forecast and warning tools. Faster and more powerful computers allow forecasters to look at developing storms in great detail. This is a major step forward compared to the days of the **Fitzgerald**. Forecasters of the time relied on hand analyzed weather maps and crude, by today's standards, satellite and radar weather information. The hand analyzed charts consisted of a surface map taken from routine weather observations at airports across the United States and Canada. The upper air maps were plotted using upper air soundings from weather balloons launched twice-a-day at 0000 UTC and 1200 UTC. All of this information was fed into computers to generate weather forecast maps for the next few days.

The computer models of the '70s produced limited forecast data. Most forecasts were created by comparing the hand analyzed charts to the forecast maps. Wind speed and wave forecasts on the Great Lakes were difficult to make due to limited observation data. Frequently, the forecasts had to be updated based on ship and shore reports across the Great Lakes.

Communication systems of the '70s were limited to the technology of the time. Data transmission was very slow and forecasts had to be delivered from one place to another on paper rather than electronically. Ship to shore radios were the only means ship Captains had to receive the latest forecasts. The NWS used a Di-Fax system to receive weather forecast maps and noisy teletype machines to transmit and receive text data.

The NWS has undergone a major transformation over the last 10 years. A modernization plan was developed during the '80s to improve the warning and forecast systems in the NWS.

Next Generation Geostationary Operational Environmental Satellites (GOES - Next) have been launched during the '90s to improve coverage across North America. Satellites, already in place, were beyond their usable life and were in jeopardy of failing. The GOES satellites of the '90s allow forecasters to see rapid scan animation loops of clouds and moisture in great detail during significant storm events.

NWS Doppler radars have the ability to detect both precipitation and air movements inside of a storm and determine the wind direction and speed. This feature was not available with the radars of the '70s.

State-of-the-art computer systems called Advanced Weather Interactive Processing Systems (AWIPS) has been deployed in the NWS across the country. The AWIPS displays numerous data fields on two large computer monitors. The forecaster is able to overlay satellite data over surface weather observations while looking at Doppler radar data on the other monitor. The imagery can be animated and updated automatically. This is especially useful when looking at radar and satellite data. A third monitor is used to edit text documents, such as: marine forecasts, marine weather statements, or special marine warnings and storm warnings.

A network of buoys has also been deployed on the Great Lakes to report wind and wave conditions to the forecaster.

Computer generated weather forecast models have improved over the last 20 years and have replaced outdated models. The computer models provide detailed forecast parameters that display wind speed and direction, temperature, relative humidity, cloud levels, the location and forecast track of storm systems, and wave height forecasts. As computing power increases, smaller scale phenomena in the atmosphere such as lake effect precipitation and lake breezes are being simulated with greater precision.

A denser network of land surface weather observations from Automated Surface Observation Systems (ASOS) and marine weather observations such as buoys and ship reports, also aids in providing more data for detailed forecasts.

The result will be improved weather forecasts because small scale changes in the atmosphere will be detected earlier and with greater precision.

The NWS will continue to strive for improved forecast, warning, and dissemination systems to ensure the safety of marine interests. ⚓

Acknowledgments

My gratitude to Daron Boyce - former Senior Marine Forecaster and George Smith - Port Meteorological Officer, from the National Weather Service Office in Cleveland, Ohio for their expertise in the historical perspective of the events leading to the Edmund Fitzgerald incident.

My thanks also to Gary Carter - former Chief of Scientific Services Division at the National Weather Service Eastern Region Headquarters and Robert LaPlante - Science Operations Officer for the National Weather Service Office Cleveland, OH who contributed input, comments, and suggestions to this report.

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SHIPWRECK - George Stone

By Skip Gillham

The **George Stone** was a typical wooden Great Lakes freighter of the latter part of the 19th century. The 282-foot, 6-inch long bulk carrier was built by F.W. Wheeler & Co. and launched at West Bay City, MI on June 20, 1893.

The 1,841 gross ton vessel went to work in the Bradley fleet and hauled cargoes such as iron ore, coal and grain. It is shown in a photo (on right) from the collection of the Milwaukee Public Library.

George Stone was in a collision that sank the schooner **S.H. Kimball** on May 8, 1895. The **Kimball** went down in Lake Huron off Point aux Barques.

Later, in 1898, the **George Stone** was one of 67 ships locked in the ice that had to be freed by an icebreaker from Detroit.

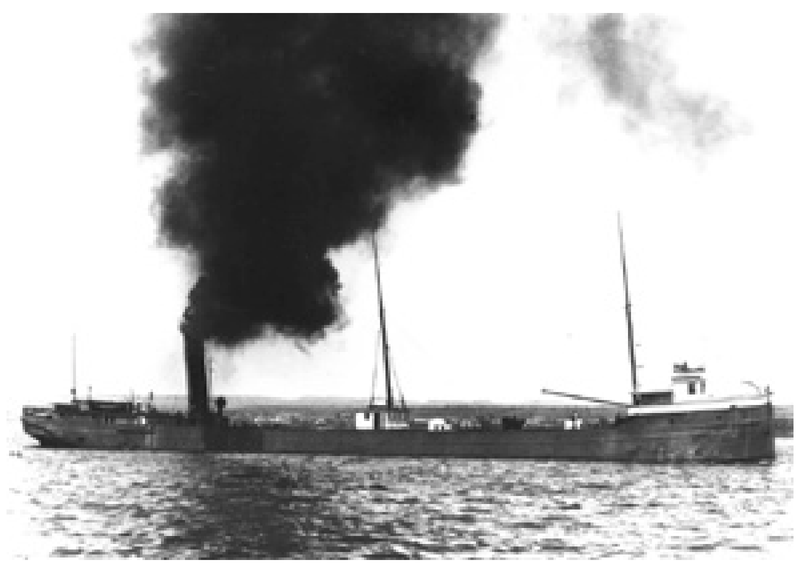
On October 13, 1909, the **George Stone** was carrying 2,800 tons of coal loaded at Ashtabula, OH for delivery to Racine, WI. A southwest gale caught the sixteen-year-old steamer in the Pelee Passage on Lake Erie, and it ran aground on Grubb Reef. A kerosene lamp in the pilothouse overturned, and the structure caught fire.

Attempts to get help were fruitless. The wooden lifeboat smashed against the hull and broke up after launching. The Captain was one of eight men who then tried to take the steel lifeboat ashore, but it overturned before reaching land. Two sailors made it, but the Master was lost as he waded the final few yards. He was overwhelmed by the undertow and swept away. His body was found the next spring near Conneaut, OH on the other side of the lake.

Conditions on the **George Stone** were deteriorating. Water poured into the hull through the seams, and the pumps became clogged with coal dust and shut down.

Fortunately, the steamer **F.M. Osborne** spotted the distressed vessel and was able to get into position to remove the ten sailors who had remained on board. Before long the **George Stone** began to break apart and was a total loss.

But the ordeal was not over. The **George Stone** had been operating with a non-union crew, and they had been pelted with stones leaving Ashtabula. Even the survivors received a rude welcome arriving at Detroit. They were met by a mob before authorities intervened and secured their safety. ⚓



George Stone

The Beatrice Hurricane: 15 September 1903

Capt. E.L. Sherrill
Norfolk, Virginia

The menhaden fishing steamer **Beatrice** was one of the casualties of the hurricane that hit the mid-Atlantic coastline on 15 September 1903. This purse-seiner, owned by the Atlantic Fisheries Company, was caught by the storm when returning to their factory at Cape Charles, VA. She had been built in 1878 by Robert Palmer and Sons, at Noank, CT, and had been lengthened from 105 feet to 135 feet in 1900. She was powered by a 170 hp reciprocating steam engine, but, like most purse seiners of her day, also carried a suit of sails. To take advantage of fair winds, she could set a jib, main, and from a mast stepped on her after deckhouse, a small mizzen.

The hurricane that was to prove fatal to the **Beatrice** and other vessels struck Florida on 12 September, crossing the state from SE to NW. News, as well as weather forecasts, traveled more slowly in those days, and it was not until three days later that the *Virginian-Pilot* newspaper in Norfolk carried a full report of the damage it had caused. The headlines on 15 September declared, “Florida swept by storm that carries death and destruction in its path.” Further down the page was noted, “Southern storm expected to be here today.” By then, however, it was too late to give any warning to the **Beatrice**, or any of the other craft then at sea.

The **Beatrice**, commanded by Capt. William Leland of Irvington, VA, had left the dock the previous Sunday night. Along with the fleets from the other fish factories on Chesapeake Bay and the Delmarva Peninsula, she would cruise the coastal waters until menhaden were spotted from the crow’s nest. They found large schools, or “places” of them, just beginning their annual southward migration, off the mouth of Delaware Bay. By Tuesday afternoon, the **Beatrice** had a full load and was heading back down the beach for Cape Charles. Following about 6 nmi behind her was the **Atlantic**, another steamer from the Atlantic Fisheries Co., and further astern was the **Alden S. Swan**, from a factory at Harborton.

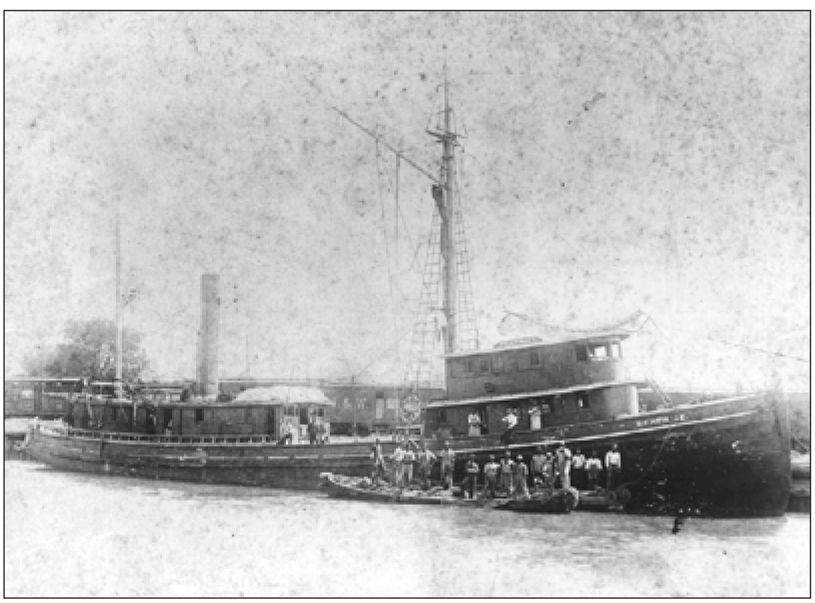
At around 2100, when off the Blackfish Banks and almost abreast of Assateague Lighthouse, the **Beatrice** ran into the hurricane. Exactly what her captain did to try and weather the storm will never be known, but we know what was done by the **Atlantic**, and can conclude that on the **Beatrice** they were doing much the same. The **Atlantic**, caught by the sudden blast of wind and a swiftly rising sea, tried to set her jib to hold her head up to it. This did not work (in any case it was too bad a night to keep any canvas aloft), and her engine - even at 350 hp - was not powerful enough to keep her driving into the seas. She was shipping water over her decks and clear over her pilothouse, but somehow they managed to get her anchor overboard. That held her until the hurricane passed, and she was able to get on her way again. The **Atlantic** had suffered heavy damage, and had lost her seine boats, net, and pieces of her rails.

The **Alden S. Swan**, when the storm struck, turned and beat her way back up the beach, finally gaining shelter at Delaware Breakwater. The **Atlantic**, badly battered, returned to Cape Charles and got her fish out. She then put back out to sea to search for the **Beatrice**, which had still not arrived. After searching all day without any sight of the **Beatrice** or the **Swan**, she put in to Norfolk for repairs. By this time, the *Virginian-Pilot* was reporting that both of these boats were missing and presumed lost.

The **Alden S. Swan** made it safely to Delaware Breakwater and was reported there on 19 September. The **Beatrice's** fate was to remain a mystery, at least for eleven days. On 26 September, her stern section, including her engine room and after deckhouse, washed ashore at Caffeys Inlet Life Saving Station, just above Duck, N.C. It had drifted 105 nmi from where she had last been seen off the Blackfish Banks. The same day, her bow and the forward part of her hull were reported ashore near Virginia Beach. No trace was ever found of the 28 souls who had been her crew.

Why had the **Beatrice** foundered, when her two consorts, the **Atlantic** and the **Swan**, had safely weathered the storm? The answer may lie in the way she had been rebuilt, three years previous. She had been lengthened 20 feet and had her main deck raised 2 feet. This may have aggravated a weak spot at her midships section where her fish hold was located - menhaden steamers tend to load and unload rapidly, which puts on a lot of hogging and sagging stresses. From her wreck having been found split into two sections, it would seem that her hull had failed in this area.

Life still had to go on, however, and in the days following the hurricane, the fleet was back out on the fishing grounds. There is no record that any monument was built for the **Beatrice** or any memorial service ever held for her crew. Her memory was preserved only by the expression of old timers in the industry, who, when caught in a blow offshore, with night coming on and safe harbor a long ways ahead, would say, "This is as bad as the night the **Beatrice** was lost."



Steamer Beatrice

Editor's note:

*Captain Sherrill is correct that the **Beatrice** was lost at sea due to a hurricane. Although the climatological records are a bit fuzzy, there were actually two storms off the Atlantic seaboard during September 1903.*

The hurricane that struck Florida had already crossed over Florida and was inland over the AL-GA border and in a weak tropical storm status by the September 15.

The second hurricane was east of the VA Capes on the 15th with peak intensity of sustained winds of 70 - 85 kt. - **Luke**

HOUSTON PORT METEOROLOGICAL OFFICER, JIM NELSON, RETIRES

By Robert Luke
VOS Program Lead

Jim Nelson, the Houston, Texas Port Meteorological Officer (PMO) retired from Government service on March 29, 2002.

Jim Nelson began his official government career 47 years ago when he joined the "wooden ships and iron men" of the U.S. Navy. Actually, he had been serving in this nomadic life for years, for he had salt in his blood from the day he was born – his father was a Navy Chief.

After basic training, Jim was sent to Oklahoma for additional military bearing, and it was there that Jim encountered his first tornado and gained an interest in weather. Jim took orders to the Navy Weather School in Lakehurst, NJ. Upon graduating, Jim saw duty at many commands like the **USS Antietam** (CVA/CVS-36), Naval Air Station Quonset Point, RI, **USS Willis A. Lee** (DL-5), and the **USS Courtney** (DE-1015). It was aboard the **Courtney** that Jim learned to navigate, shoot the Sun and Stars and use LORAN "B". While serving on the **USS Otterstetter** (DER-335), Jim encountered another rare and treacherous weather phenomena.

Jim Nelson, 1955

The **Otterstetter** was caught up in what history calls the Ash Wednesday storm that hit the European coast. On that day in 1960, this storm caused considerable damage in Holland. The **Otterstetter** ended up breaking her back in that storm, so Jim cross decked yet again to the **USS Edisto** (AGB-2), just in time to make the "exotic" port calls of Thule, Greenland, and Antarctica.

In the rest of Jim's illustrious naval career, he was assigned to the **USS Independence** (CVA-62), and Fleet Weather Centrals in Norfolk, VA and Rota, Spain.

When Jim was assigned as an Instructor back in Lakehurst where he taught aviation and

Jim Nelson, today

synoptic surface observations, meteorology, plotting and upper air, he finally got a chance to pay the Navy back for all the fun he had been given in past years.

Jim finally hung up his anchors in 1974 while serving in Charleston, SC.

Not one for sitting still, Jim started his second career right away and began working for NOAA at the National Climatic Center (later renamed National Climatic Data Center) in Asheville, NC. Jim was responsible for checking surface and upper air observations for quality and correctness.

Nine years later the moving itch finally won, and Jim transferred to Galveston, TX as a radar operator. In 1987, he assumed the duties as PMO in the Houston and Galveston region. Jim has been instrumental in the excellence of the VOS program and has been a benchmark to the kind of ambassadorship and shipmate that the waterfront knows and respects.

Jim has been married to the former Elizabeth (Betty) A. Jensen of Waltham MA for the last 41 years, and together they have 4 children and 4 grandchildren. Jim and Betty live in League City, TX and don't have any plans to move to some retirement village in Florida. Instead, Jim plans to spend most of his time working in his yard and aggravating his wife.

When asked to comment about his retirement, Jim's only words were, "YES!! I made it!!"

On behalf of the VOS program, we wish, Jim and Betty, ***Fair winds and following seas***. ⚓

VOS participants keep a close eye on the weather and notice cloud formations as indications of weather activity. This series of cloud photos taken at L41-13N Long 68-00W southeast of Frenchmans Bay was provided by Jack McAdam, Master of NOAA ship Delaware.

"Additional Observations"of a Seventeenth Century Seafarer: William Dampier

Marine meteorological logbooks submitted to the Met Office contain a wealth of information.Of course, of primary interest to the meteorologist and the climatologist are the weather observations they contain, but the 'Additional Observations' of meteorological phenomena and marine fauna and flora have similar significance for those whose interests lie within the variety of subjects in these areas.

In this latter category, there is little now reported by shipborne observers that has not been seen before—waterspouts, bioluminescence, birds, fish, storms, whales, dolphins, to name but a few topics — that can be commented upon or identified by specialists, with a high degree of confidence.To aid such analyses, today's specialist can call upon the collective knowledge of yesteryear, drawing upon the observations, research and findings of the past.

However, when the unusual does occur, whether it be (in the case of natural history) a 'common' species apparently no longer present in a previously favoured area, or perhaps a 'rarity' seen in abundance, a large amount of interest can be generated, and specialists will want to account for the anomaly, or reach a conclusion about the identity of a species.

William Dampier

Imagine, then, a time when the far corners of the globe were still being discovered; when new lands were claimed and mapped in the name of sovereignty (and fought over for years afterwards); when the locations of sea areas and land masses had still to be fully understood; when seafarers had only a rudimentary knowledge of meteorology; and when there was only minimal collective knowledge upon which to draw when faced with unidentified phenomena and wildlife in far-flung places. Welcome to the mid-seventeenth century — and enter one William Dampier. Born around 1651 in Somerset, he was apprenticed as a boy to a ship's master in Weymouth, and throughout an eventful life during which he was by turns at first a trader, a plantation manager in Jamaica, and then a log-cutter in Mexico, he found his greatest adventure sailing (as a private individual) with English buccaneers. Travelling with them provided food and shelter of sorts and also a convenient means by which to satisfy his inclinations to see the world and, between 1679 and 1691 he managed, unintentionally, and by a rather tortuous route to circumnavigate the globe.

Dampier's intention was, basically, to describe everything he came across in his travels — had there been a tourism industry in his day, then his observations would probably have been the equivalent of the detailed travel guides available today. In the rest of this article, we unashamedly dip into Dampier's journals to reveal some of the accounts from his own Additional Observations.

'Red lobsters'

In mid-November 1683, the buccaneers sailed from the "Coast of Guinea" heading for he Straits of Magellan via the Sibbel de Wards [Falkland Islands] where they would look for fresh water; Dampier found "nothing worthy remark" until 28 January 1684 when, 10 days out from the islands, he noted some flying-fish. After that, he says:

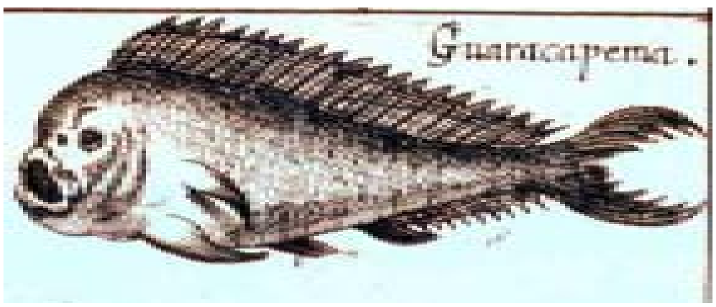
> "January 28, we made the Sibbel de Wards, which are 3 islands lying in the lat. of 51d. 25m. South, and 57d. 28m. West Longitude from the Lizard in England, by my account.

"The Day that we made these islands, we saw great shoals of small lobsters which coloured the Sea red in spots for a Mile in compass, and we drew some of them out of the Sea in our Water-buckets. They were no bigger than the top of a Man's little finger, yet all their Claws, both great and small, were like a Lobster. I never saw any of this sort of Fish naturally red but here. For ours on the English Coast, which are naturally black, are not red till they are boiled. Nor did I anywhere else meet with any Fish of the Lobster-shape so small as these, except for maybe Shrimps or Prawns."

In 1696 a marine fish catalogue was published in which was illustrated many fish and other marine species known at the time. Whether or not the illustrations were based upon whole or parts of physical specimens, first-hand accounts or just hearsay is not known, but these three examples serve to illustrate that the age of sea monsters was still very much alive.

In (a) is an apparent represntation of a Dorado, frequently reported by modern shipborne observers.

(a)



A Hammerhead shark seems to be shown in (b) although this example has been given a defined neck for some reason' a tell-tale 'seam' around the neck almost suggests that the artist was presented with only part of the shark, and was therefore forced to invent the remainder of the body!

(b)

In (c) the reader is best left to juge what the artist is trying to show - fish, bird or mammal?

(c)

(NOAA Central Library)

NOAA library

Dampier seems to have been at a loss to further identify these creatures. However, if he had had prior knowledge of the richness of life found in the cold waters of the South Atlantic Ocean, he might have been able to identify his 'red lobsters' as possibly either the squat lobster (*Munida subrugosa*) or a closely related species, or else the late larval stage of crabs. Around the Falkland Islands the adult squat lobsters have claws, swim and form swarms. The crabs in late larval stage also swim, have claws and swarm but their abdomens do not fold underneath as they do in the adult form.

On the character of the Pacific Ocean

In April 1684, his ship was sailing up the western coast of South America, and Dampier recorded his thoughts about the conditions found in the South Pacific Ocean:

"Our passage now lay along the Pacifick Sea, properly so called. For though it is usual with our Map-makers to give that Name to this whole Ocean, calling it Mare Australe, Mare del Zur or Mare Pacificum, in my Opinion, the Name of the Pacifick Sea ought not to be extended from South to

North farther than from 30 to about 4 Deg. South Latitude, and from the American Shore Westward indefinitely. For with respect to my observation, I have been in these parts 250 Leagues or more from Land, and still had the Sea very quiet from Winds. For in all this Tract of Water of which I have spoken, there are no dark rainy Clouds, though often a thick Horizon, so as to hinder and Observation of the Sun with the Quadrant. And in the Morning there is frequently hazy Weather, and thick Mists, but scarce able to wet one. Nor are there in this Sea any Winds but the Trade Wind, noTempests, no Tornadoes or Hurricanes (though North of the Equator, they are met with in this Ocean as well as in the Atlantick), yet the Sea itself, at the new and full of the Moon, runs with high, large, long Surges, which never break out at Sea, and so are safe enough, except for where they fall in and break upon the Shore and make it a bad landing."

The Galapagos Islands

The following month the buccaneers, having captured four ships, diverted their course towards the Galapagos Islands in order to avoid trouble with the authorities in Trujillo (Peru), and Dampier's ship plus one other "anchored on the East-side of one of the Eastern-most Islands, a Mile from the shore, in sixteen Fathoms Water, clean, white, hard Sand". He believed, however, that the English hydrographers had not charted the islands' location accurately, for he commented:

"The Gallapagos Islands are a great number of uninhabited Islands, lying under and on both sides of the Equator. The Eastern-most of them are about 110 leagues from the Main. They are laid down in the Longitude of 181, reaching to the Westward as far as 176, therefore their Longitude from England Westward is about 68 degrees. But I believe our Hydrographers do not place them far enough to the Westward. The Spaniards who first discovered them, and in whose draughts alone they are laid down, report them to be a great number stretching North-West from the Line, as far as 5 degrees N., but we saw no more than 14 or 15. Some of them are 7 or 8 Leagues long, and 3 or 4 broad."

He noted that the islands were not excessively hot even though they lay almost on the Equator, and also observed a continual fresh sea-breeze all day. Perhaps he was unwittingly aware of the effects of the yet undiscovered Peru (or Humboldt) Current that brings cold Antarctic waters northwards along the length of South America to wash close to the Galapagos Islands before becoming part of the South Equatorial Current.

Local effects of strong solar heating

Dampier also made observations of meteorological phenomena although he probably did not understand the physics behind them. While off the Pacific coast of Nicaragua in early August 1685, the buccaneers in an attempt on the port that then served Leon, had left their ships manned by skeleton crews, and Dampier accompanied 520 men as they attempted to paddle 31 large canoes to the harbour "about eight Leagues from shore" [in this case one league is taken to be the old English measurement equivalent to approximately 2.2 km]. He says:

"We had fair Weather and little wind till two o'clock in the Afternoon, then we had a Tornado from the shore, with much Thunder, Lightning, Rain and such a gust of Wind that we were all likely to be foundered. In this extremity we put right before the Wind, every Canoe's Crew making what shift they could to avoid the threatening danger…The fierceness of the Wind continued about half an hour and abated by degrees, and as the Wind died away, so the fury of the Sea abated. For in all hot countries, as I have observed, the Sea is soon raised by the Wind and as soon down again when the Wind is gone. Therefore there is a Proverb among Seamen: Up Wind, Up Sea, Down Wind, Down Sea."

Even though the sea was like a millpond by the evening, the canoes could not make land before darkness, and so they stayed offshore, being about 10 km away by daylight. Intending to stay offshore until darkness once more, the buccaneers sat out the daylight hours in the tropical heat, but during the afternoon they were hit by another tornado more fierce than the one experienced during the previous afternoon.

In both cases the term 'tornado' is taken to mean a sudden localised thunderstorm rather than either the land-based phenomenon that bears the name today, or tropical revolving storms. The cause might well have been intense solar heating and consequent convection which is a common trigger for the formation of thunderstorms around the time of maximum temperatures, particularly in the tropics. Had Dampier been able to carry a thermometer with him in his travels, he might have worked out for himself the connection between strong solar heating and the incidence of local storms, and perhaps the buccaneers might have thought twice before committing themselves to their long-distance paddle. However, they did literally live to fight another day.

Orographic cloud

As with the aforementioned events that Dampier obviously could not fully explain, he met with a similar puzzle when he noted what we know as orographic clouds. Whilst the ship in which he travelled was in the North Pacific Ocean in May 1686 searching for the island of Guam in order to find much-needed food and water, hopes of a landfall were raised when some light rain was experienced, and he noted that "… the Clouds settling in the West were an apparent token that we were not far from Land." He had watched how low clouds particularly seem to move quite rapidly, but that sometimes clouds seen at the horizon do not move or change very much and could be associated with land. The phenomenon was evidently of interest to him because he also comments "I have often taken notice of it, especially if it is high Land, for then you shall have the Clouds hang about it without any visible Motion."

(R.A. Ketchington)

A typhoon, bioluminescence and corposants

In June 1687, Dampier and his 'companions' arrived at the "Island Prata" [Dongshaondao, South China Sea] where they stayed for about five weeks. Although having little understanding of meteorology as a science, Dampier and the seamen of his day must have made use of a collective knowledge relating to the occurrence of particular natural phenomena and their association with subsequent meteorological events, and could act accordingly. At the beginning of July, Dampier had noted that the wind "had been whiffling about from one part of the Compass to another for two or three Days, and sometimes it would be quite calm"; as such behaviour was often a warning of a 'tempest', the ship was put to sea as a precaution. Sure enough, two days later the storm arrived. Dampier's journal reads:

"But the day ensuing, which was the 4th Day of July, about Four o'clock in the Afternoon, the Wind came to the N. and freshened upon us. The Sky looked very black in that quarter, and the black Clouds began to rise apace and move towards us, having hung all the Morning on the Horizon. This made us take in our Top-sails, and the Wind still increasing, about Nine o'clock we reefed our Main-sail and Fore-sail. At Ten o'clock we furled our Fore-sail, keeping under a Main-sail and Mizzen. At Eleven o'clock we furled our Main-sail and ballasted [steadied] our Mizzen, at which time it began to rain, and by Twelve o'clock at Night it blew exceeding hard, and the Rain poured down as through a Sieve. It thundered and lightened prodigiously, and the Sea seemed all of a Fire about us, for every Sea that broke sparkled like Lightning. The violent Wind raised the Sea presently to a great height, and it ran very short and began to break in on our Deck."

He then describes how the seas "struck away the Rails of our Head, and our Sheet-Anchor … was violently washed off, and was likely to have struck a Hole in our Bow, as it lay beating against it." The ship had to be manoeuvred before the wind so that the anchor could be retrieved, but conditions were then too dangerous to turn back into it for fear of foundering, so the ship continued "scudding right before Wind and Sea, from Two till Seven o'clock in the Morning [of 5 July]…"

The wind decreased so the ship was turned once more into the wind and sailed with only a mizzen, it then moderated further and a flat calm of two hours followed, but the storm blew up from the south-west accompanied by very heavy rain, and Dampier's ship was again forced to run before the wind under bare poles until the evening. The whole account appears to indicate a close encounter with an intense tropical depression, or even a typhoon.

During the morning (apparently some time after four o'clock) the rain and thunder had abated, and then St Elmos's fire had been seen. This phenomenon seems to have been associated with either good 'omens' or bad depending upon its location about the ship.

The journal reads:

"…and then we saw a Corpus Sant at our Main-top-mast Head, on the very Top of the Truck of the Spindle. This sight rejoiced ourMen exceedingly, for the height of the Storm is commonly over when the Corpus Sant is seen aloft. But when they are seen lying on the Deck, it is generally accounted a bad Sign.

"A Corpus Sant is a certain small glittering Light. When it appears, as this did, on the very Top of the Main-mast or at a Yard-arm, it is like a Star. But when it appears on the Deck, it resembles a great Glow-worm… I have heard some ignorant Seamen discoursing how they have seen them creep, or, as they say, travel about in the Scuppers, telling many dismal Stories that happened at such times. But I never saw any one stir out of the place where it was first fixed, except upon Deck, where every Sea washes it about. Nor did I ever see any except when we have had hard Rain as well as Wind, and I therefore believe it is some Jelly: … "

The illustration shows a shipwreck, storm and corposants (from *Meteorologia philospohico-politica,* Franz Weiner (1661–1708) NOAA Central Library) and corposants can be seen on yard-arms. There seem to be two sources or varieties of the phenomenon in Dampier's account, but perhaps only one of them (that associated with the mast and yard-arms) is really the static electrical type. The form that is mentioned as being washed around the deck or in the scuppers might have been an organism(s) such as jellyfish which have often been reported displaying luminescence by modern seafarers, or perhaps a *pyrosoma* (a hollow cylindrical colony of individual organisms swimming as a single entity, and brightly luminescent). If such were washed on board in heavy seas, they would no doubt continue to show this light as they were tossed about on their way back to the scuppers, or else whilst sliding about on a wet deck. In darkness their true animal form would not

be seen and it is supposed that they could have been interpreted as corposants ("Glow-worm") on deck. In the first part of Dampier's observation, the seas that were "all of a Fire" and that "sparkled like Lightning" might well have been a manifestation of bioluminescence too, probably caused by dinoflagellates at the surface.

A waterspout

Waterspouts were no doubt as frequent an occurrence in the seventeenth century as they are in the twenty-first, and modern seafarers will find much that is familiar in Dampier's observation of this phenomenon, in the Celebes Sea on 30 November,1687.

"A Spout is a small ragged piece of Cloud hanging down seemingly about a Yard from the blackest part of it. Commonly it hangs down sloping, or sometimes appears with a small bending or elbow in the middle. I never saw any hang perpendicularly down. It is small at the lower end, seemingly no bigger than one's Arm, but still fuller towards the Cloud from where it proceeds. When the Surface of the Sea begins to work, you shall see the Water for about 100 Paces in Circumference foam and move gently round till the whirling Motion increases. And then it flies upwards in a Pillar about 100 Paces in Compass at the bottom, but lessening gradually upwards to the smallness of the spout itself, until it reaches the lower end of the Spout, through which the rising Seawater seems to be conveyed into the Clouds. This visibly appears by the Cloud's increasing in bulk and blackness. Then you shall presently see the Cloud drive along, although before, it seemed to be without any Motion. The Spout keeps the same Course as the Cloud, and still sucking up Water as it goes along, they make a Wind as they go. Thus it continues for the space of half an Hour, more or less, until the sucking is spent. Then, breaking off, all the Water which was below the Spout, or pendulous piece of Cloud, falls down again into the Sea, making a great Noise with its fall, and a clashing Motion in the Sea."

(R. J. Fletcher)

Waterspouts are not a significant problem for modern seafarers, and are often reported upon in ships' meteorological logbooks as an interesting diversion, but they were considered a threat to sailing ships, and Dampier's like others, was kept at a great a distance as possible from them. Not without reason apparently, for he knew (or had been told) of an event where a ship had received what might be called a 'direct hit' from a water-spout and had lost not only its bowsprit but the foremast and mizzen mast too. One method by which it was thought possible to weaken a water-spout that could not be avoided by a ship was to fire deck guns into it. However, Dampier is dismissive of such efforts — "But I never heard that it proved to be of any Benefit".

The halo

Optical phenomena can be seen approximately one day in three if the observer is keen enough not to look towards the sun or moon alone and is suitably placed to cast an eye around other parts of the sky. Nevertheless, haloes remain the most frequently reported examples of phenomena caused by the passage of light through ice crystals in cirriform clouds. Cirrus cloud invading the sky is often the first sign of an approaching depression, and so in Dampier's day it is understandable that the halo was seen as a precursor to bad weather. Strangely, more importance was placed on the appearance of a solar halo than of one around the moon.

On 18 May 1688, Dampier and his consorts were navigating from the Nicobar Islands towards Sumatra. In his journal he wrote of the halo:

"It was indifferent clear till Noon and we thought to have had an Observation, but we were hindered by the Clouds that covered the Face of the Sun when it came on the Meridian. We also then had a very ill Presage, by a great Circle about the Sun five or six times the Diameter of it, which seldom appears without storms of Wind or much Rain ensuing. Such Circles about the Moon are more frequent but of less import. We commonly take great notice of those that are about the Sun, observing if there is any breach in the Circle, and in what Quarter the Breach is. From there we commonly find the greatest Stress of the Wind will come. I must confess that I was a little anxious at the Sight of this Circle, and wished heartily that we were near some Land."

A violent storm indeed followed, and it was bad enough for Dampier to believe that his end was imminent. He did survive, however, but no doubt he continued to regard the appearance of a solar halo with considerable apprehension.

Epilogue

Unknown to Dampier at the time of the search for Guam, in May 1686, the vessel had narrowly avoided a mutiny — or worse.

The ship had been at sea for about two months and supplies were so low that the daily ration for each man was 10 spoons of boiled maize, and there was enough left for only three more days. He was to learn later that had the island not been found, then the crew had decided to kill the captain when the food had run out, and eat him followed by everybody who had sanctioned the voyage to the original destination of the Philippines.

Such a grisly end would have deprived later generations of his valuable contributions. As it happened, he eventually returned to England in 1691, and died in London in 1715 at the age of 63.

Acknowledgements

With thanks to Dr Frank Evans (Dove Marine Observatory) and Professor Peter Herring (Southampton Oceanography Centre) for their help and advice with 'Red Lobsters' and 'A typhoon (?), bioluminescence and corposants'.

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Editors Note:

WOW! what an adventure...This great story was written for and first published in the October 2001 issue of the UK Met Office's ***Marine Observer****. Who would have imagined that by sailing the seven seas in search of adventure and a few pieces of eight, your name would be listed in the annals of science for your great exploration and discoveries.* ***-- Luke***

Marine Prediction Center Sets Sail on First Alliance

Pictured on left: MPC Chief of Operations David Feit; MPC Deputy Director Kevin McCarthy; MPC Director James Hoke; MITAGS Executive Director Glen Pain; and MITAGS Director of Training, Walt Megonicgal.

Awareness can be as important as prevention when navigating a vessel through a storm, and the best method of awareness is through education and knowledge.

The National Centers for Environmental Prediction's (NCEP) Marine Prediction Center (MPC) and the Maritime Institute of Technology and Graduate Studies (MITAGS) have teamed up to embark on a maiden voyage to provide marine weather forecast instruction – using National Weather Service (NWS) official products – and to work together on projects of mutual interest designed for professional mariners. Also, MPC will work with MITAGS to identify and raise the standards of training on weather related courses for advanced maritime safety. MITAGS is a non-profit continuing education center for professional mariners that provides training to civilian and military mariners from around the globe.

This agreement marks the first organizational partnership for MPC and adheres to two NCEP strategic goals – to exercise global leadership and to forge stronger bonds with NWS partners and users. "This is a major step in realizing MPC's vision to be the mariners weather lifeline," said Dr. James Hoke, director of the MPC. "Working with MITAGS offers a great opportunity for MPC to be in direct contact with our primary users to get feedback and ideas on how to keep MPC their first choice for marine weather information."

Glen Paine, Executive Director of MITAGS, stated that "This partnership allows us to reemphasize the mariner's need for accurate and timely weather information and the requirement for the skills to apply that information. As we have seen in the past, weather information correctly applied greatly reduces the impact adverse weather can have on a crew and its vessel. We at MITAGS look forward to our interaction with the National Weather Service."

The MPC is one of nine NCEP centers located in Camp Springs, MD. MPC issues forecasts and warnings for regional, offshore and high sea areas of the Atlantic and Pacific Oceans. Operating seven days a week, 24 hours a day, the MPC forecasts and analyzes sea conditions such as wind, wave, fog and ice accretion and issues sea surface temperature products. The center also produces marine forecasts in response to emergency situations identified by NOAA, the NWS Regional Offices, the Federal Emergency Management Agency and the U.S. Coast Guard Search and Rescue. MPC works closely with the Tropical Prediction Center and the Weather Forecast Offices in Anchorage and Honolulu to provided comprehensive coverage of the Atlantic and Pacific Oceans as well as the Gulf of Mexico.

For more information about MITAGS, MPC or NCEP visit the World Wide Web sites: www.mitags.org, www.mpc.ncep.noaa.gov, and www.ncep.noaa.gov, respectively. ⚓

The VOS Climate Project

UK Met. Office

Introduction

Final preparations for the Voluntary Observing Ships (VOS) Climate Project are now complete, and initial recruitment of participating ships has begun.
The following article provides an overview of the objectives of the project, its status, and how it is intended to operate.

Background

The project is a natural extension of the earlier Voluntary Special Observing Programme for the North Atlantic (VSOP –NA)[1], which demonstrated that the quality of observed measurements depends significantly upon the types of instruments used, their exposures, and the observing practices of shipboard personnel. It made a number of substantive recommendations in these areas aimed at providing ship observations of a quality appropriate to global climate studies.

Objectives

Whilst VOS observations continue to be an essential ingredient for numerical weather prediction, there is a growing need for higher quality data from the observing fleet. Specifically, recent trends, such as the increasing availability of data from satellite sensors and the increased concern with regard to climate analysis and prediction, are making further demands on the quality of ship observations.

The project aims to provide a high-quality subset of marine meteorological data, available in both real time and in delayed mode, which can be used for:

·Satellite ground truth verification

An important role for accurate VOS data is the detection of biases in remotely sensed satellite data due to instrument calibration changes or changing atmospheric transmission conditions. Ship and buoy observations can, for example, be used to detect and correct biases in satellite data caused by varying atmospheric aerosol loading due to volcanic eruptions. Without such real time bias corrections, errors can occur in satellite-derived data. Consequently, for satellite verification purposes, there is an established need for a dataset of accurate ship observations with known error characteristics.

Climate Change Studies

Data from observing ships are increasingly being used for climate change studies, e.g., to quantify global changes of sea-surface and marine air temperature. However, the detection of climate trends is only practicable if, as far as is possible, observational biases owing to the changing methods of observation are corrected. Sea temperature data, for example, have different bias errors, depending on whether temperatures were obtained using wooden, rubber or canvas buckets, or using engine room intake thermometers. It is therefore important to clearly document the observing practices that are being used on board ships.

Climate Research and Climate Prediction

Increasingly, coupled numerical models of the atmosphere and ocean are being used for climate research and climate change prediction. The simulated air-sea fluxes of heat, water and momentum must therefore be shown to be realistic if there is to be confidence in model predictions. Accordingly, model predictions of near surface meteorological variables (air temperature, humidity, sea-surface temperature (SST), etc.) need to be verified against high-quality in situ observations from buoys and specially selected voluntary observing ships.

In addition to the above, the project will provide a reference data set that can be used to assess the quality of data received from the rest of the voluntary observing fleet.

Ship selection and recruitment

Ship recruitment is a critical component of the project, and it is hoped that the ships selected will provide more or less global coverage in both space and time. To this end, ships which make frequent and regular ocean crossings, as well as ships sailing in the southern ocean, Antarctic supply vessels and research ships, have been identified as potential recruits. Where feasible it has also been decided that ships engaged in the Ship of Opportunity Programme and the Automated Shipboard Aerological Programme should be recruited.

A relatively small target of ~200 ships has been set for recruitment to the project, and provisional lists of participating ships have been prepared by Australia, Canada, France, Germany, India, Japan, Poland, UK and USA. Several other countries are also potential project participants, and it is anticipated that the target number of ships should be achieved.

The UK is aiming to recruit approximately 30 observing ships to the project, with emphasis being given to those ships which routinely return to the UK, have a good observing record, and are preferably fitted with hull sensors and the Royal Netherlands Meteorological Institute's TurboWin software. The selected vessels will be drawn from those operating

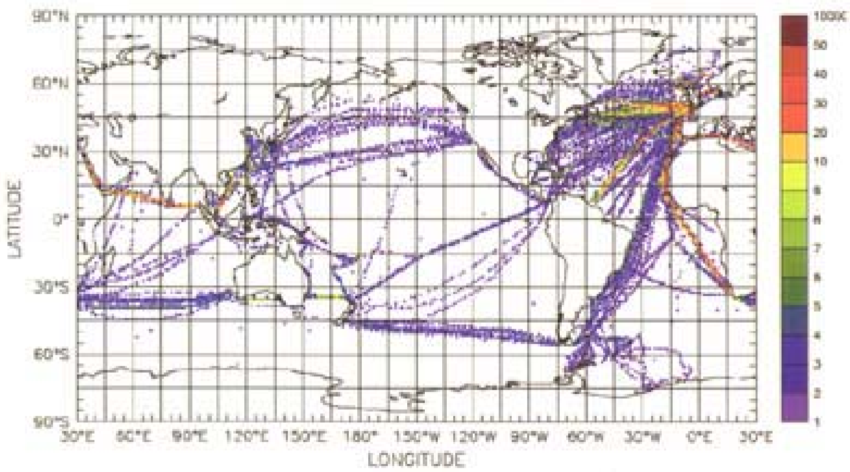

Figure 1 - Extent of coverage anticipated from UK voluntary observing ships participating in the VOS Climate Project. (Courtesy of Southampton Oceanography Centre.)

both on world-wide and near continental voyages and will include some research vessels providing observations in data sparse areas. Figure 1 shows the extent of coverage expected from UK voluntary observing ships, whilst Figure 2 indicates the projected global coverage.

These preliminary maps showing the potential route coverage of the proposed project ships have been prepared by Southampton Oceanography Centre, who have been actively involved in setting up the project. Such maps will assist in planning national recruitment and will also allow the selective targeting of obvious data sparse areas as recruitment proceeds.

Data Assembly Centre

Data collected during the project will undergo quality control (QC) and be archived by a Data Assembly Centre (DAC). The National Climatic Data Center, NOAA, USA, has agreed to perform this role which requires them to merge the real-time observation reports with the delayed mode reports, eliminate any duplicates, and compile a complete project data set which will be available to users.

The DAC will also create and maintain a relational database so that the information on instrument types, exposure and observing practice can be automatically associated with each observation. The database will also be freely accessible to registered users.

Real Time Monitoring Centre

The project will require real time monitoring of the observational data and comparison with model fields. To this end, the Met Office (which already undertakes such monitoring of ship observations on a routine basis), has agreed to act

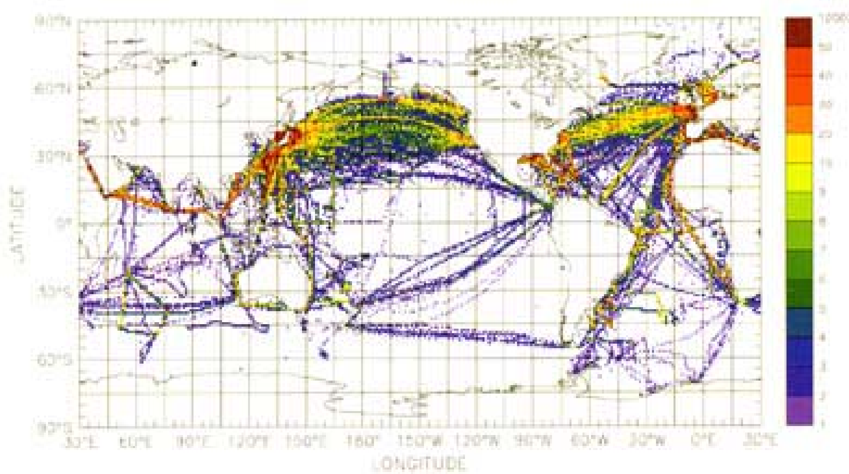

Figure 2 – Project global coverage of ships taking part in the VOS Climate Project [(drawn from raw reports from the Global Telecommunication System (GTS) using data from November 1999 to October 2000), downloaded from http://www.cdc.noaa.gov/ncep_obs/]

as Real Time Monitoring Centre (RTMC) for the project.

Priority will be given to the following six parameters: wind direction and speed; sea level pressure; sea-surface temperature; air temperature; and humidity. The Met Office will monitor these variables for all project ships and forward the resultant statistics to the DAC for inclusion on a dedicated project Web site.

Statistics on the 'fit 'of the observed variables to the numerical weather prediction Global Model's background forecasts will be used to produce lists of 'suspect' ships, i.e., ships will be flagged as suspect if the mean and standard deviations of their observation-minus-background (o-b) values meet certain agreed criteria. Lists of flagged ships will be forwarded by the RTMC to the DAC each month, and to participating countries on a weekly and monthly basis. As ships' call signs are subject to change when there are changes in registry, it will be necessary for the RTMC to regularly check call signs to ensure the correct ships are being monitored.

Any project ships identified as having submitted suspect observations will be followed up by the Port Met. Officer networks as quickly as possible, and the results of any corrective action taken thereafter notified to the DAC.

In addition to the monitoring function, the RTMC will extract the six observed variables for each project ship received in real time from the Global Telecommunication System (GTS) and associate them with the co-located model field values. The resultant data sets will then be transferred on a regular basis to the Data Assembly Centre.

Instruments

Although relevant, the quality of ships observing instruments has less effect upon the quality of data than their use and exposure. It will therefore be essential for the project to ensure that observing instruments, their physical exposure, and the associated observing practices confirm to high standards and that up-to-date instrument records are maintained and catalogued.

Ideally, it is recommended that ships taking part in the project should have the following instrumentation and facilities:

- Accurate and well-exposed thermometers with precision to 0.1 °C;
- Sea surface temperature measuring instruments from hull contact sensors;
- Permanently-mounted, well-exposed anemometers to 0.1 m s^{-1} precision;
- Precision marine barometers to 0.1 hPa precision, preferably connected to a static head; and
- Electronic logbook facility, to include true wind computation, QC checks and updated encoding in the revised code forms required by the project.

It is recognized, however, that common instrumentation is unlikely to be achieved. For instance, UK observing ships traditionally estimate the wind speed and direction from the sea state and are not provided with calibrated anemometers.

Regular checks upon the serviceability and calibration of instruments by Port Met. Officers will be essential to the project, e.g., calibration of temperature sensors can be performed using a water bath, and it is possible to calibrate some types of wind speed sensor by mechanically rotating the propeller.

Inter-comparison of instruments is a difficult and time-consuming task; it is possible to compare typical samples of each type or source of manufacture, but often variations between members of the same type are greater than between different instruments. This problem will be addressed by inter-comparison of the observations of the VOS climate subset with large-scale model fields, or with neighbouring ships at sea. At a later stage in the project development, it is expected that consideration will be given to enhancing or upgrading participating ship instrumentation as necessary, in line with VSOP –NA recommendations.

Metadata

To achieve the accuracy required by the project, it will be essential to have comprehensive information about the type and location of meteorological instruments. This will include information of the date of any changes to instruments and details of their exposures supported by digital imagery. Details of such 'metadata ' will be stored in a master index of ships which will be developed as a supplement to, but separate from, the main WMO ship catalogue (International List of Voluntary Observing Ships WMO –No.47.) The catalogue will be continuously updated and made available through the Data Assembly Centre. It will contain details of the instrument locations for each ship in an agreed format, together with details of the results of inspections performed by Port Met. Officers.

Port Met. Officer involvement

The Port Met. Officer networks of participating countries will be essential for the project's success, as close liaison with ships' masters, observing officers and ship owners will be needed. PMOs will, in the first instance, visit individual ships to explain the project to observers and to assess their likely commitment to the project. They will also record details of the exposure of the observing instruments, noting any permanent structural features which might affect the observation, e.g., water outfalls, airflow obstructions, air-conditioning vents, etc., and the relevant ship specifications. In addition to detailed written descriptions, the location of instruments will be marked on simple arrangement drawings and supported by photographs in digital format.

Final selection of ships will take note of existing instrumentation and exposure, past performance, and the general impression gained by the Port Met. Officers. Difficulties may arise where a ship is well equipped for one parameter but not another, e.g., no anemometer, but mounting a hull sensor for sea-surface temperature. The value of the ship's contribution will be assessed in terms of the importance of the parameters which are acceptable.

The information obtained by PMOs for selected ships will be forwarded to the Data Assembly Centre for compilation of the metadata catalogue. PMOs will also explain the use of new coding requirements and new logbooks (electronic or hard copy) being developed for the project. Later visits will be needed to check that instrument exposure has not changed and to discuss any problems with observers. These observer 'contact'visits will be extremely important in maintaining the interest of the observers and the impetus of the project.

Ship survey and inspection forms

Special ship recruitment and inspection report forms are being designed for the project and will be made available in French, Russian and Spanish versions. The forms, together with associated instructions, will be downloadable from the new project Web site and will be suitable for use in both hard copy and electronic format.

Immediately following recruitment to the project, Port Met. Officers will complete the initial ship survey report form. Each recruiting country's PMOs will conduct follow-up ship inspection visits when project ships are visiting their home ports, as far as possible on a quarterly basis (the current UK practice). Some ships not on regular trades may also need to be inspected by their participating (i.e. non-recruiting) countries, and care will be needed to ensure there is no duplication of inspections. In order to establish a complete metadata and inspection history for each ship, the completed inspection reports will be submitted to the DAC via e-mail.

Observation codes

To ensure that the project provides timely and complete information and that no reports from participating ships are lost, data will be submitted in both real time and delayed mode. Although real time observations will continue to be transmitted in the Ships' International Meteorological Code (FM13 –XI), the delayed mode observations will be augmented by additional code groups. These extra codes are essential to the success of the project and comprise details specific to each ship. (Refer to Ship Parameters chart).

Originally, the intention had been to require these additional code groups in both real time and delayed mode. However, proposals to modify the ship code were not supported by WMO because of their long-term ambition to phase out the use of such alphanumeric codes in favour of new table-driven codes (e.g. BUFR[2] and CREX[3] codes).

Recognizing that it would be impractical to re-train observers to use complex new code forms in time for the start of the project, it was decided that the additional code groups were not absolutely essential in real time, provided that the expected delay in the non-real time data delivery did not exceed 6 –12 months.

To enable the international exchange of the extended observation reports in delayed mode, a revised version of the International Maritime Meteorological Tape Code (IMMT) has also been developed for the project.

Paper and electronic logbooks

Observations will be recorded for delayed mode submission using either hard copy or electronic logbooks. In order to collect and process the additional delayed mode observation data in hard copy format it will be necessary to either implement new logbooks (or logsheets), or to modify existing ones. Similarly, new versions of electronic logbook software programs (e.g. TurboWin, SEAS 2000 etc.) are being developed to incorporate the additional delayed mode data. The logbooks (or logsheets) will need to be collected on a regular basis by Port Met.Officers, who will also download the electronic log files.

The use of software programs such as TurboWin will greatly simplify the collection of delayed mode data required by the project, as they will electronically record the observations in the revised IMMT format at source. This avoids the need for observations to be manually digitised following receipt at participating national meteorological services, which is presently the case for paper logbooks. For that reason, it is hoped to equip the majority of UK ships participating in the project with such software, either loaded into dedicated 'notebook' computers or, if acceptable, loaded into one of the ships' computers.

Data Transmission

Observational and instrumentation data submitted by project ships will be subjected to various procedures and relayed via a number of centres before it eventually reaches the Data Assembly Center. A simplified flow diagram

Ship parameters		
Code 1	**ss**	Instantaneous ship's speed in knots at time of observation
Code 2	**DD**	Ship's heading in tens of degrees true
Code 3	**LL**	Maximum height in metres of deck cargo above summer maximum load line
Code 4	**hh**	Departure of summer maximum load line from actual sea level (m)
Wind		
Code 5	**ff**	Relative speed in knots or m s^{-1} (in conformity with wind code indicator)
Code 6	**DD**	Relative wind direction in tens of degrees (00 to 36) off the bow.

showing the data will be routed is given in Figure 3.

The national meteorological services participating in the project will apply minimum QC procedures to the digitised observations in the revised IMMT format. The digital data sets will then be forwarded to the two Global Collecting Centres (GCCs) for the WMO Marine Climatological Summaries Scheme (located in Hamburg in Germany and in Bracknell in the UK). The GCCs will thereafter apply their normal QC and related procedures and forward the data to the Data Assembly Centre in IMMT format (using an appropriate medium, or via the Internet) with a minimum delay.

The Met Office, in its capacity as the RTMC, will also transfer datasets of the real time reports and associated model field values to the Data Assembly Centre. As this data will be transmitted in BUFR code (which is now regarded as the preferred standard for the international distribution of weather data) decoding software will be needed in order that the DAC can merge the received real time and delayed mode reports and compile a complete project data set.

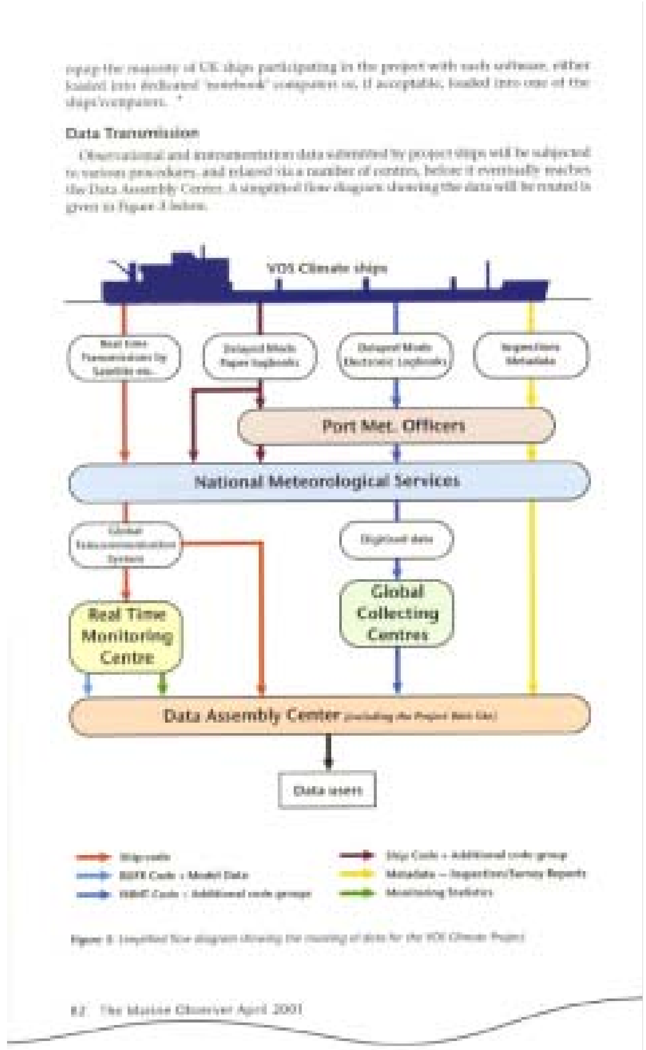

Figure 3 - Simplified flow diagram showing the routeing of data for the VOS Climate Project.

Project promotion literature and logo

Draft literature to promote the project, and an associated logo for the project have been developed. The logo will, in due course, appear on a plaque that will be presented to participating ships. The promotional literature will include a small explanatory brochure that will be made available to participating shipping companies and officers, and will be available in multi-lingual format. As the project unfolds, observers will inevitably have questions about why the additional observations are needed and about how they will be used. The brochure will therefore address these points, and a copy of the brochure is included at the end of this article.

Project Web Site

The primary means of information exchange for the project will be via a dedicated Web site which will be both developed and maintained by the DAC, with contributions to be made by both participants and users. Information to be made available through the Web site will include:

- metadata catalogue of participating ships;
- regular project update reports;
- monitoring and data application results;
- project newsletter for participating ships;
- data catalogues;
- links to other relevant Web sites;
- project focal points and other relevant contact details;
- the project document and other publications; and
- any other information relevant to the project.

Access to the ship metadata catalogue will be via the ship name, call sign or IMO number, which will then allow selection of any required subsets of ships' instruments, etc. This catalogue will also allow access to ship status reports, with links to the observational data and monitoring reports.

The project data (observations, metadata, real time monitoring data and the additional observational data) will also have a direct access through the Web site for ftp download. Similarly, ship survey and inspection forms (including instructions for their completion) will be available from the Web site for download. Some password protection to guard against abuse and to safeguard potentially sensitive information is anticipated.

Project newsletter

A project newsletter is also considered to be an essential component of the project, providing a means of informing and communicating with participating ships as well as among meteorological services, data centres, users and other participants. It is hoped that it will help to maintain interest and enthusiasm among observers, regularly informing them of the status of the project in general, and of their own specific contributions.

The newsletter will contain information, reports and statistics on participating ships together with information drawn from all participants, including the Port Met. Officers, participating ship operators, the RTMC, the DAC and the ships' crews themselves whenever possible. It will be issued biannually and edited by the WMO Secretariat. It will be made available on the project Web site in a suitable format to allow downloading by participating operators for printing and distribution to ships.

The future benefits

The potential benefits of the project are clear. For the shipping industry, it will encourage the development of new marine meteorological systems, which will result in improved marine weather forecasts and real time weather information for operational purposes. Moreover, the improved quality of ship observational data will help us to better understand the large-scale weather changes associated with climate change.

The success of this ambitious project will therefore depend upon the close involvement and co-operation of the national meteorological services, the Port Met. Officer networks and, of course, the ships' voluntary observers. It will require careful management if it is to achieve the aim of developing into a long-term, operational programme. ⚓

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[1] See *The Mariner Observer,* January 1992, 24

[2] Binary Universal Form for the Representation of meteor logical data (FM94 –XI Ext.BUFR)

[3] Character form for the Representation and EXchange of data (FM95 –XI Ext.CREX.

Editors Note:

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VOS Climate (VOSClim) Project

Contship Spirit/Contship Containerlines Ltd.

World Meteorological Organization

Why do we want the VOS Climate (VOSClim) Project?

The main purpose of the Voluntary Observing Ship (VOS) Climate (VOSClim) Project is to provide a high quality set of marine meteorological observations and detailed information on how the data were obtained. Such observations are of great value to operational marine forecasting. Furthermore, climate studies rely on the increased accuracy of good observations. Improved climate models, better ground truth for checking satellite observations, and a more accurate high-quality marine dataset, will be possible with the cooperation of international ship participants.

For the VOSClim Project we are asking port meteorological officers to collect extra information about the selected VOS. Why do we want that information? What will it be used for? Here are answers to some of the questions you may have.

Q: *As a ship's officer how will it change the way I take observations?*

A: Hardly at all. If you use an electronic logbook or coding system (e.g. "Turbowin") you will be issued with an upgraded version. If you fill in logbooks you will be asked to report the relative wind speed, direction and ship's speed and head at the time of the observation. In return, you will benefit from enhanced support from the port meteorological officers and you will be able to learn more about the various ways in which your observations are used.

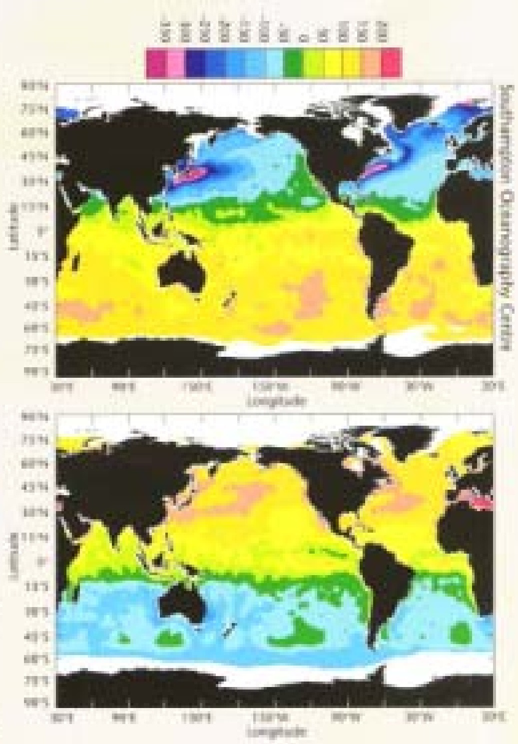
Q: *What do you mean when you say the ships observations will be used to study the climate?*

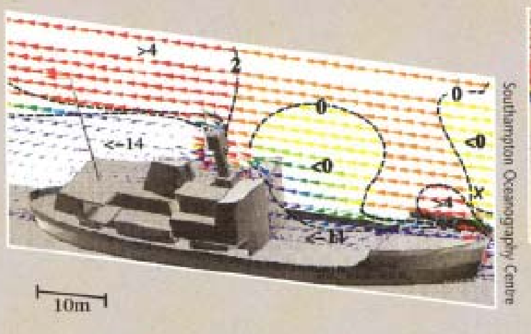
A: The map on the right shows the transfer of heat between the ocean and the atmosphere for an average month of January.

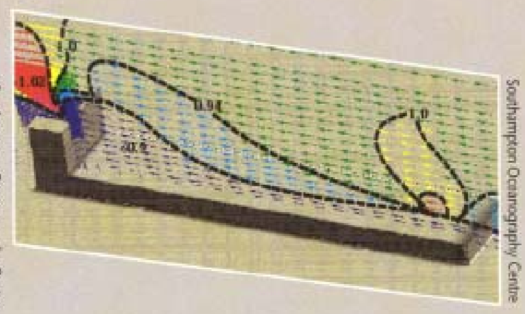
In the northern hemisphere it is winter and the blue colours (top map) show that the ocean is loosing large amounts of heat to the atmosphere — especially over the Gulf Stream and the Kuroshio.

The bottom map is for the month of July. Now the northern hemisphere oceans are being warmed and the cooling is occurring in the southern oceans where the sea ice has spread out from Antarctica.

We could only draw these maps because of the millions of observations which have been taken by merchant ships in the past. Nowadays we obtain information from satellites and computer models, but ship data are as important as ever. In fact we need really good ship observations to check the models and calibrate the satellites. That is the aim of the VOSClim Project. Better observations really will make a difference!







Q: *Why do you want to know the dimensions of the ship and the position of the anemometer?*

A: The ship disturbs the airflow. The anemometer will not measure the true value that the wind would have if the ship were not there. Using computer models we can calculate the flow around the ships and find out how big this error is. Or we can place a model of the ship in a wind tunnel and measure the error for different wind directions.

The plot below is for an anemometer on the port yardarm of the main mast of the ship in the computer model. The winds are speeded up over the wheelhouse except when the wind is from astern (or from the starboard beam when the anemometer is in the wake of the mast).

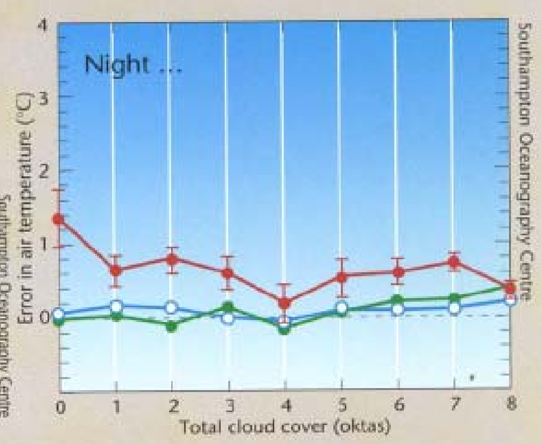
The example above is taken from a research ship which has been used for special experiments. We cannot hope to study each VOSClim ship in great detail but if we know the main dimensions of the ship we can use simple models, like the "tanker" beside it, to estimate how much the wind speed is likely to change for a typical anemometer position on a merchant ship.

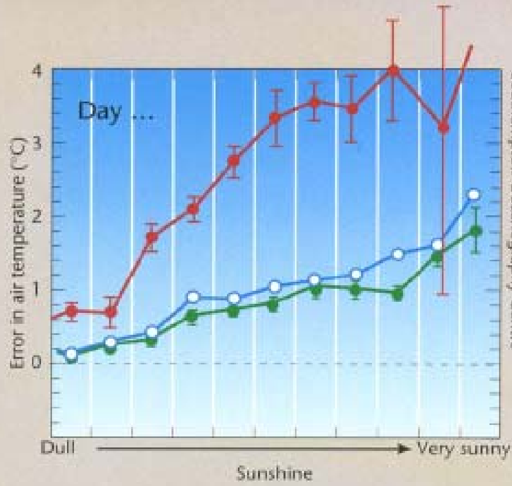
This is the airflow over a very simplified model of a tanker or bulk ore carrier. It was generated from a computer model. Among other factors, the airflow over the wheelhouse depends on the distance between the main deck and the wheelhouse top — one of the dimensions that you are being asked to specify for the VOSClim Project.

Q: *Why do you want to know the type of instrument used to measure air temperature and where it is situated?*

A: Let us taken an example. The graph below shows the average error in air temperature measurement for thermometer screens on different ships. The different lines show how well the screen was situated (green = good, blue = moderate, red = bad).

At night, the badly exposed screens were, on average, half to one degree too warm. The other screens gave good readings. Now look what happened during the day (above right). In sunny conditions, all the screens tend to





read too warm. For screens with good or moderate exposure, the over-heating is reasonably uniform and we can devise a correction. The screens with bad exposure read much too high — several degrees — and there are big differences between different screens. We cannot correct these errors but it is important that we know about them.

Q: *Why is it important to know the method of sea surface temperature determination?*

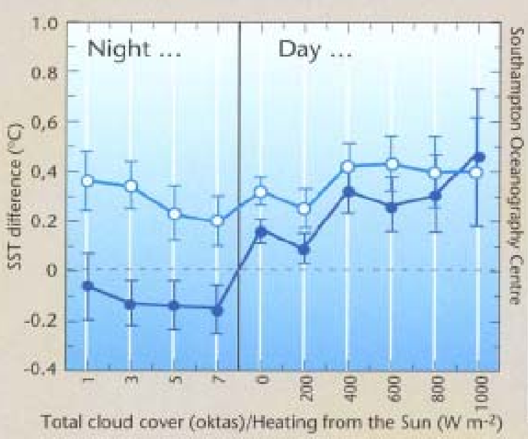
A: The value of the sea surface temperature (SST) depends to some extent on how it is measured. An increasing number of ships are being fitted with thermometers that are fastened to the inside skin of the hull (called hull contact sensors). Provided that they are kept in calibration, we believe that these instruments give the most accurate SST values. The plot (below left) shows the average difference between SST values from engine room intake (ERI) thermometers and those from hull contact sensors (light blue line).

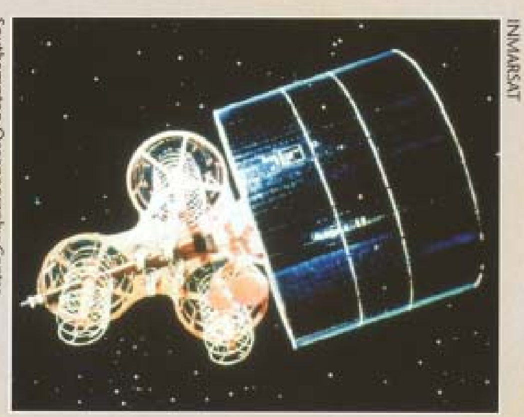
For both day and night, the ERI values are warmer by about 0.3 to 0.4°C. Bucket readings are close to, or slightly colder than, the hull contact readings at night. However during daytime, the bucket readings tend to become warmer if the Sun is shining.

Q: *But what about satellites. Nowadays don't they tell you everything you need to know?*

A: NO! For example, for about 20 years satellite data have been used to determine the SST over the globe, but when the Mount Pinatubo volcano erupted in June 1991 large quantities of ash were thrown high into the atmosphere. This ash cloud circled the tropics and caused the satellite sensors to report that the tropical SST was suddenly about 1°C colder than usual but the ships and buoys showed that really the SST was about 0.5°C warmer than usual! The graph (next page, above right) shows that it took a whole year for the satellite readings to return to the correct value. So satellite data are always checked against ship and drifting buoy data and corrected, as necessary, before they are used.

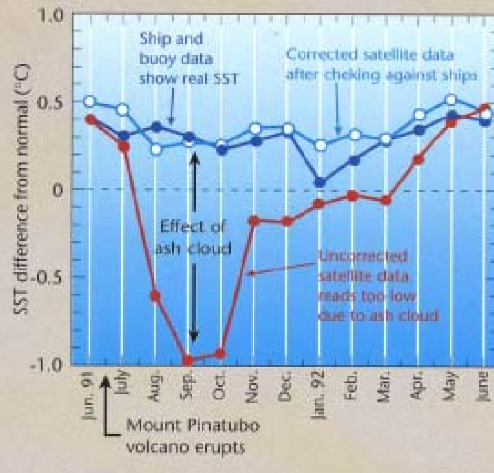
There are other problems with satellite data. Satellites may not measure storm force winds correctly. Some instruments cannot see through clouds or do not provide values close to the sea surface.





Rick Hoblitt/USGS, Cascades Volcano Observatory

Mount Pinatubo erupts

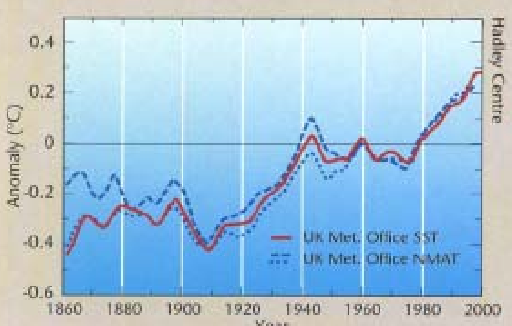


Adapted from Reynolds and Smith (1994)

Despite all the advances made in space technology, we still need good data from merchant ships!

Q: *But how much does it all really matter?*

A: Very much! As an example, the graph below shows the changes in global SST and night-time marine air temperature (NMAT) since 1860. Compared to the period between 1960 to 1990, in earlier years both the air and the sea were colder by a few tenths degree centigrade. In more recent years, warmer air and sea temperatures have been observed. These changes, detected in the weather reports from VOS, suggest that rapid global warming is occurring perhaps due to changes in the atmosphere caused by man. As a result, many countries have agreed to limit the release of gases like carbon dioxide into the atmosphere. Some countries have taken measures which have a direct impact on the everyday lives of their citizens — taxes on power consumption for example. In other countries, there remain doubts as to the degree of warming. After all, the changes are relatively small and the graph could only be plotted after making significant corrections to the data. To really understand these changes, it is important that, in the future, we obtain data of the highest accuracy — the VOSClim Project will help in this.



Hadley Centre

Remember, if the predictions are correct, rising sea level could be catastrophic for some island States. Storms of increasing frequency and strength would be associated with high winds and more frequent damaging floods. Your observations will help us tell to what extent this is already happening. In fact, we urgently need to understand the climate better. We need high quality data. We are asking you to help!

Q: *I have been making marine weather observations for many years. Why are they particularly important now?*

A: We have described how the marine weather observations from the past are providing vital information on the world's climate and have highlighted the present increases in global temperatures. With improving understanding of the weather, more data from satellites, and improved computer models to help in weather

Drought Monitoring Centre (DMC), Nairobi

forecasting, there is now an emphasis on obtaining ever higher quality measurements over the ocean. The ships in the VOSClim Project have been chosen as the ships which we believe can provide the high quality reports which we need.

Q: *Will the way we make weather observations change in the future?*

A: Better instrumentation has already been successfully tested on research ships and prototype systems are being installed on a few VOS. But these instruments are very expensive. Once the VOSClim Project has demonstrated the value of a chosen high quality subset of the VOS, the possibility of equipping them with advanced instrumentation will be much higher.

Q: *So are there any direct benefits to the shipping industry?*

A: The VOSClim Project will help in the development of future marine meteorological systems which are expected not only to produce better marine weather forecasts, but also to give ships much more comprehensive real-time weather information for operational purposes. By participating in the VOSClim Project, the shipping industry will also be helping mankind face one of its greatest challenges — the large-scale weather changes associated with changing climate.

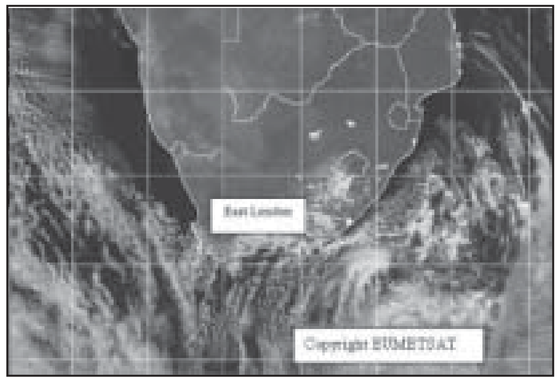
Meteorological instrument on research ship

Robin Pascal/Southampton Oceanography Centre

For more information:
Please ask your port meteorological officer
or
visit the VOSClim Web site at
http://www.ncdc.noaa.gov/VOSClim.html.

Attention Ship Owners, Ship Operators and Navigation Officers

Ian T Hunter
Manager, Marine Services
South African Weather Service



This satellite image (right) was captured onboard EUMETSAT's geostationary satellite METEOSAT VII at 12h00 UTC on Tuesday 07 May 2002.

The cloud mass centred approximately 150 nautical miles south-east of East London represents a deep secondary vortex which developed rapidly overnight on the eastern Agulhas Bank. The primary vortex is clearly visible further offshore with its frontal band spiralling in from the southern Mozambique Channel.

Of all the numerical models available to the South African Weather Service, not one accurately analysed the secondary system. As a result, it was expected that both winds and waves would be under-forecast off South Africa's east coast. But how to quantify this ?

Fortunately the **Sealand Voyager** (KHRK) provided invaluable observations at both 06 and 12h00 UTC as she journeyed southwards off the Transkei coast. Her 06h00 observation (including a 55-knot southwesterly wind) helped analysts to gauge the depth of the new low. By 12h00 she was estimating the wind wave component at 10 m and the swell at 9 m. (An abnormal wave warning for the Agulhas Current had been issued the previous day and was still in force.)

Some comments and a heartfelt plea :

- KHRK was the only ship observation all day between Durban and Cape Town (a distance of some 800 nm). Although this is a major sea route, this scarcity of ship observations around the Southern African coast is by no means unusual. In terms of tanker traffic alone, the Cape Sea Route carries over 10% of the world's sea-borne oil trade.
- Land-based winds, particularly around this coast in winter are notoriously non-representative of conditions offshore.
- Satellites are not the be all and end all. Cloud imagery is not always easy to quantify, and satellite-derived winds are by no means always available.

PLEASE - WE NEED YOUR 'OBS'.

As can be seen from the above example, VOS data can still have a marked impact on the accuracy of marine predictions – and thus maritime safety. ⚓

Marine Weather Review
North Atlantic Area
September through December 2001

George P. Bancroft

Introduction

From September through November, low-pressure systems tracked northeast from the Canadian Maritimes to the vicinity of Greenland and Iceland before turning east. With the exception of late September and early October, high pressure of varying strength was present off the coast of western Europe. By early December the high pressure shifted to the British Isles and strengthened, forcing low-pressure systems moving off the U.S. East Coast and the Maritimes to turn north or even northwest toward Greenland and the Davis Strait.

There was considerable tropical cyclone activity during the first three months, with eight named systems either moving into or forming in MPC's waters north of 31°N. and west of 35°N. Three of these were of subtropical origin, forming from cut-off occluded lows in the far southern MPC waters. The others either moved around the west and north sides of the subtropical ridge and weakened, were absorbed by, or became extratropical lows (those found outside the tropics, typically associated with fronts).

Tropical Activity

Hurricane Erin: Erin, the first hurricane of the Atlantic season, moved northwest into MPC's

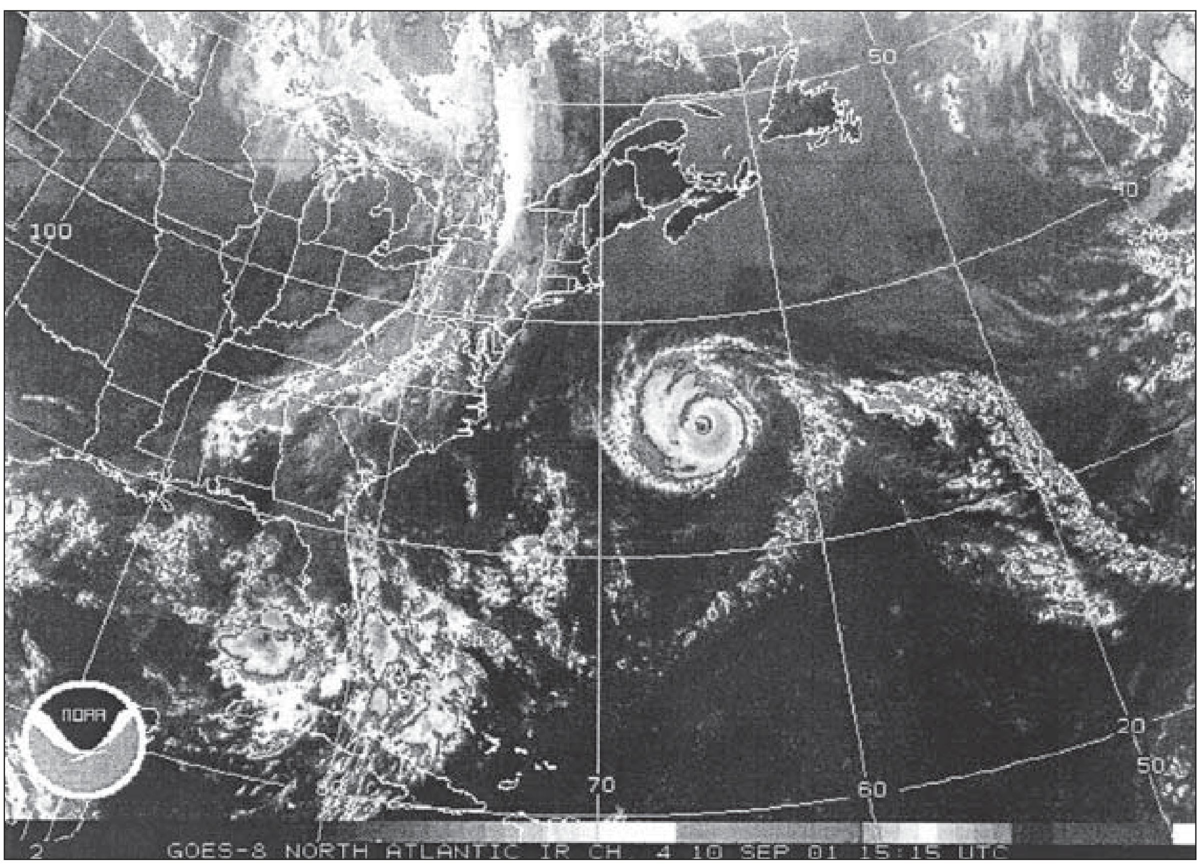


Figure 1 - GOES-8 enhanced infrared satellite image of Hurricane Erin valid 1515 UTC September 10, 2001. Colder, higher cloud tops such as in the central dense overcast and spiral cloud bands around the center or "eye" of Erin appear near 35°N 65°W.

waters just east of Bermuda on the morning of September 9 and attained a peak intensity with maximum sustained winds of 105 kt with gusts to 130 kt near 33.3°N. 63.3°W. at 0000 UTC September 10. Erin was the strongest tropical cyclone to affect MPC's waters during this season. Figure 1 is an enhanced infrared satellite image of Erin, still near maximum strength about 15 hours later, with a well-defined "eye." Erin subsequently turned northeast and weakened before re-intensifying as an extratropical storm by 0000 UTC September 16 (Figure 2). As the center passed to the west, the seas at Buoy 44141 (42°N. 56°W.) jumped from 3.5 meters (11 ft) to 9.5 meters (31 ft) during the 10-hour period ending at 1000 UTC September 14. The maximum wind reported by a ship was a southwest wind of 45 kt from the **SeaLand Pride** (WDA3673) near 36°N. 61°W. at 0000 UTC September 13. Buoy 44140 (43.7°N. 51.8°W.) reported a southwest wind of 35 kt with 6.5-m seas (22 ft) at 2100 UTC September 14. The system is shown at maximum intensity as an extratropical storm in the second part of Figure 2. The QuikScat image in Figure 3 is valid about 7.5 hours later, indicating winds of 50 kt or higher south and southeast of Cape Farewell, with even some 70 kt wind barbs. The storm subsequently passed east of Greenland and weakened on the 16th.

Hurricane Felix: Like Erin, Felix moved into MPC's waters as a hurricane, shown in Figure 2. Unlike Erin, Felix peaked in strength while south of 31°N., was in a slow weakening trend, and followed a more east-northeast track while in MPC's area. The center passed east of 35°W. by 0600 UTC September before weakening to a tropical storm near 35°N. 31°W. at 1200 UTC September 17. At that time, the ship **C6PW2** reported a northeast wind of 35 kt and 7-m seas (23 ft) near 38°N. 34°W. A high-pressure ridge east and north of the center halted further eastward progress at that time. At 0600 UTC September 19 the system weakened to a remnant low near 35°N. 31°W.

Hurricane Gabrielle: Figure 2,shows Tropical Storm Gabrielle moving on a northeast track toward MPC's offshore waters. At 0000 UTC September 16 the **Lykes Discoverer** (WGXO) near 32°N. 80°W. reported a north wind of 50 kt and 8-m seas (27 ft). The **Discoverer** was one of several ships reporting winds of 50 kt west and northwest of the center through 1200 UTC September 16. **Frying Pan Shoals** (FPSN7) at 33.5°N. 77.5°W. reported a north wind of 45 kt at 1800 UTC September 15. Winds reached 35 kt from the northeast at Buoy 41004 (32.5°N. 79.1°W.), along with seas to 4.5 meters (15 ft) at 0600 UTC September 16. Gabrielle then intensified to a hurricane near 33°N. 71°W. at 0000 UTC September 17 and developed maximum sustained winds of 70 kt with gusts to 85 kt near 35°N. 67°W. twelve hours later, before beginning to weaken. Gabrielle became an extratropical storm near 43°N. 55°W. at 0600 UTC September 19 with a 976-mb central pressure. The ship **MZGK7** near 46°N. 42°W. encountered south winds of 55 kt eighteen hours later. The system continued to move northeast and re-intensified east of Labrador. By September 22, it had weakened east of Greenland and turned southeast.

Hurricane Humberto: Humberto entered MPC's forecast area near 31°N. 68°W. at 1200 UTC September 23 as a strong tropical storm and became a hurricane six hours later while continuing to move north at about 10 kt. The maximum strength was reached at 1200 UTC September 26 near 41°N. 59°W., with maximum sustained winds of 90 kt and gusts to 110 kt. The system then turned east and weakened to an extratropical gale near 41°N. 42°W. at 0000 UTC September 28. At that time the ship **PGBO** south of the center near 39°N. 40°W. reported southwest winds of 35 kt and 5-m seas (17 ft).

Hurricane Karen: Karen began as a frontal wave of low pressure that underwent initial rapid intensifcation in the 24-hour period ending at 0000 UTC October 12. Figure 4 depicts the system as an intense occluded cyclone, which, after initial weakening, re-intensified while losing its frontal structure. The Tropical Prediction Center (TPC) classified it as a subtropical storm (Figure 4) before naming it Tropical Storm

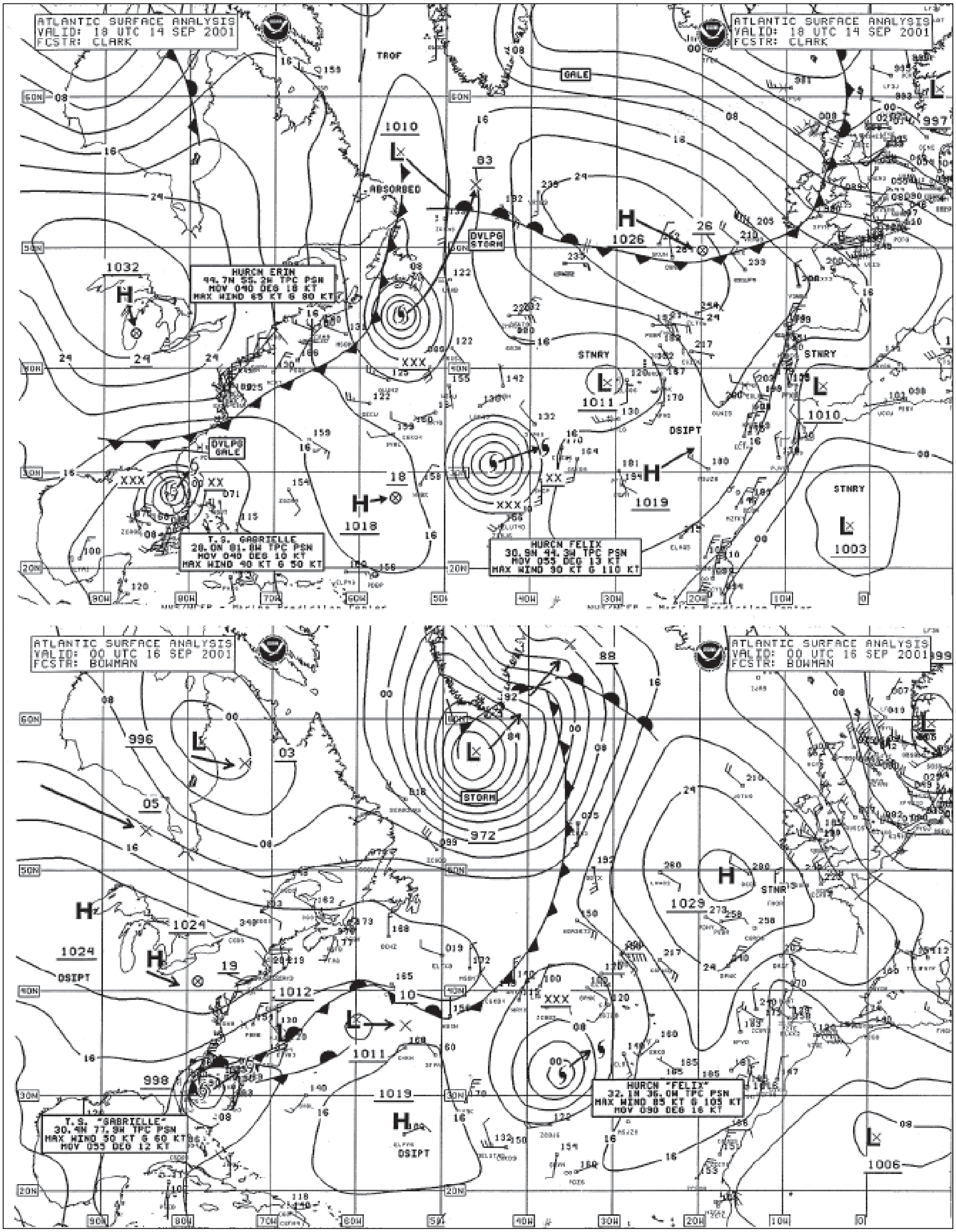


Figure 2 - MPC North Atlantic surface analysis charts valid 1800 UTC September 14 and 0000 UTC September 16, 2001.

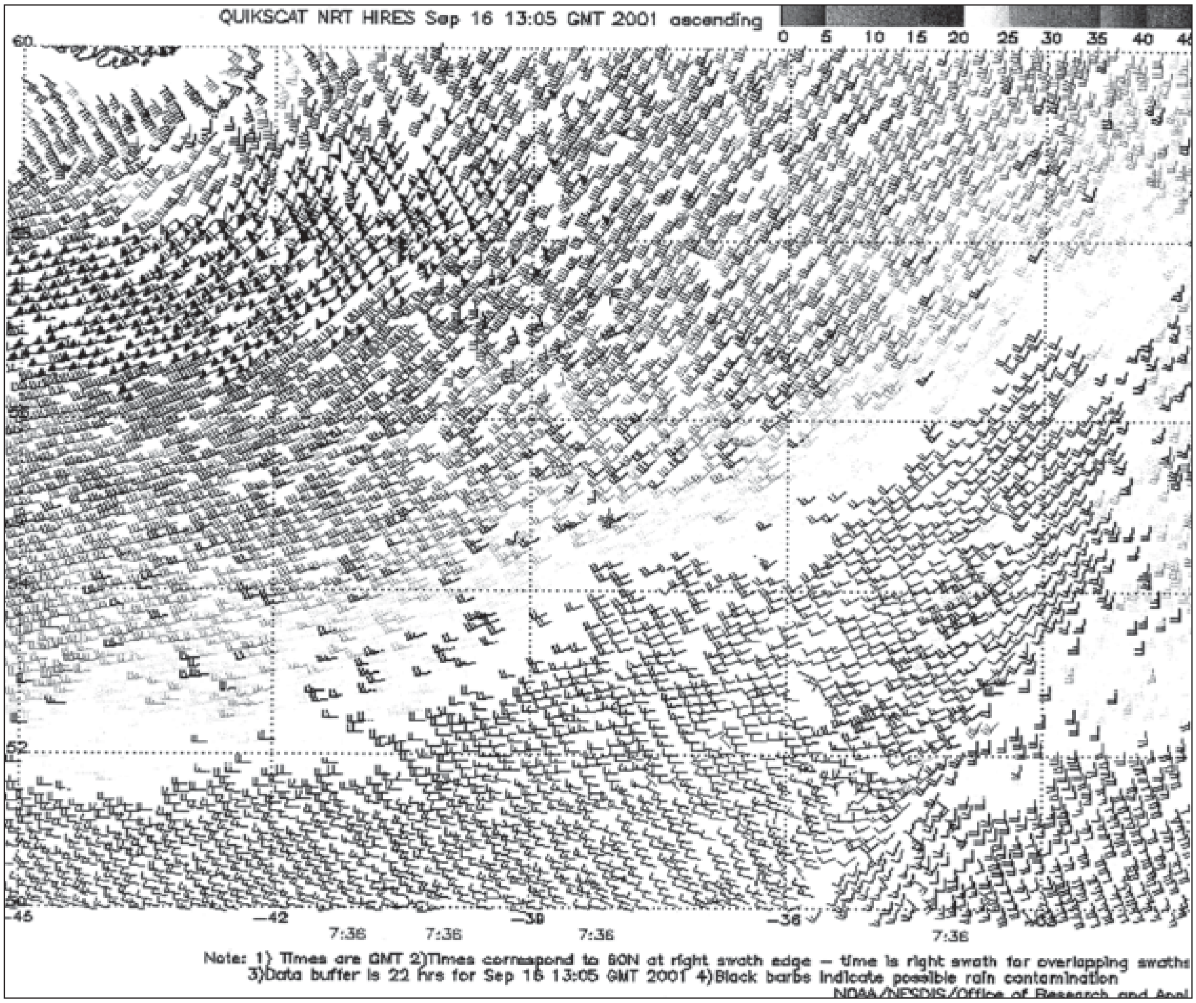


Figure 3 -High-resolution QukScat scatterometer winds valid at 0736 UTC September 16, 2001. The resolution of the wind barbs is 12.5 km, versus 25 km in regular QuikScat imagery. Image is courtesy of NOAA/NESDIS Office of Research and Applications.

Karen at 1200 UTC October 13. Figure 5 is a QuikScat image valid about the time of the first analysis in Figure 4, showing winds to 60 kt on the backside of the system. Figure 6 is a satellite image valid at 2215 UTC October 13 showing Karen with indications of a central area or ring of convection around an "eye." Karen was upgraded to a hurricane shortly before that time. At 0600 UTC October 14 Karen reached peak intensity near 39°N. 64°W., with maximum sustained winds of 70 kt and gusts to 85 kt, before weakening to an extratropical gale over the Canadian Maritimes on October 15 and continuing to move north.

Tropical Storm Lorenzo: Lorenzo moved northwest to a position near 31°N. 46°W. at 1200 UTC October 30 before turning to the north-northeast and was only a minimal tropical storm with maximum sustained winds of 35 kt and gusts to 45 kt. Lorenzo then became extratropical and merged with an approaching cold front on October 31.

Hurricane Noel: The development of Noel was similar to that of Karen. Low pressure developed on a northeast to southwest oriented front near 35°N. 43°W. early on November 1 and drifted southwest before

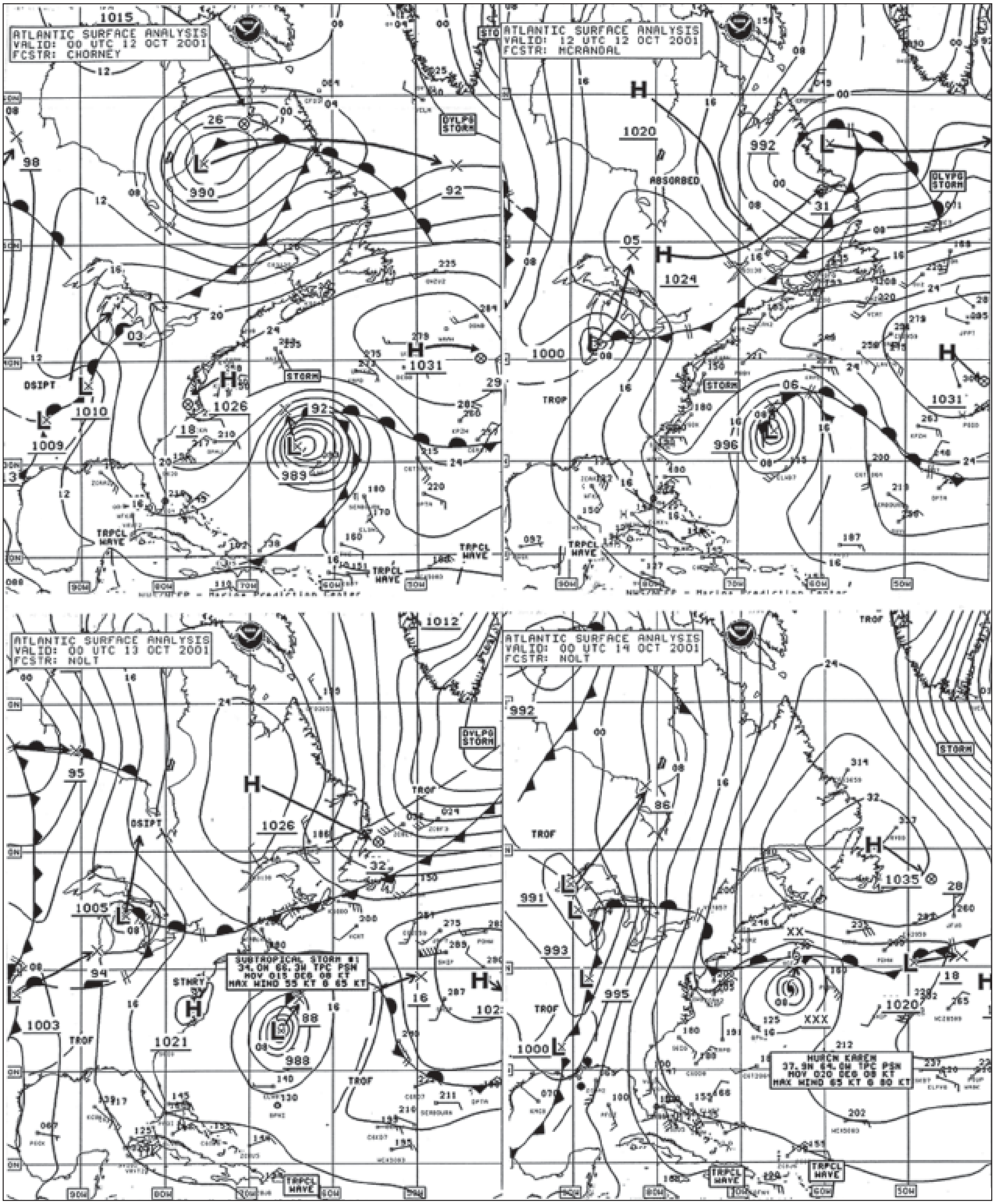


Figure 4 - MPC North Atlantic surface analysis charts (Part 2) valid 0000 UTC and 1200 UTC October 12, and 0000 UTC October 13 and 14, 2001. The time interval between charts is 12 hours, except 24 hours between the third and fourth charts.

turning northwest and intensifying to an occluded storm analyzed with 984-mb central pressure near 34°N. 50°W. at 1800 UTC November 3. The system then drifted north and weakened to a gale at 1200 UTC November 4 (Figure 7), before re-intensifying and developing tropical characteristics such as persistent convective clouds near the center (Figure 8). Based on a report of a southwest wind of 65 kt from the ship **Tellus** (**WRYG**) near 37°N. 50°W. at 1400 UTC November 5, TPC upgraded the system to Hurricane Noel in a 1600 UTC November 5 advisory. Six hours later the ship **ELRT2** near 36°N. 48°W. encountered southwest winds of 35 kt and 8-m seas (27 ft). The system weakened to a tropical storm near 40°N. 50°W. at 0000 UTC November 6 before merging into a developing extratropical storm over the Canadian Maritimes. The first analysis in Figure 9 has the remains of Noel near 47°N. 47°W., where they are about to be absorbed.

Hurricane Olga: Like Karen and Nöel, Olga formed from a low on a front, this time south of MPC's waters, which initially developed into an occluded cut-off low. This system subsequently lost its frontal structure as it drifted into MPC's

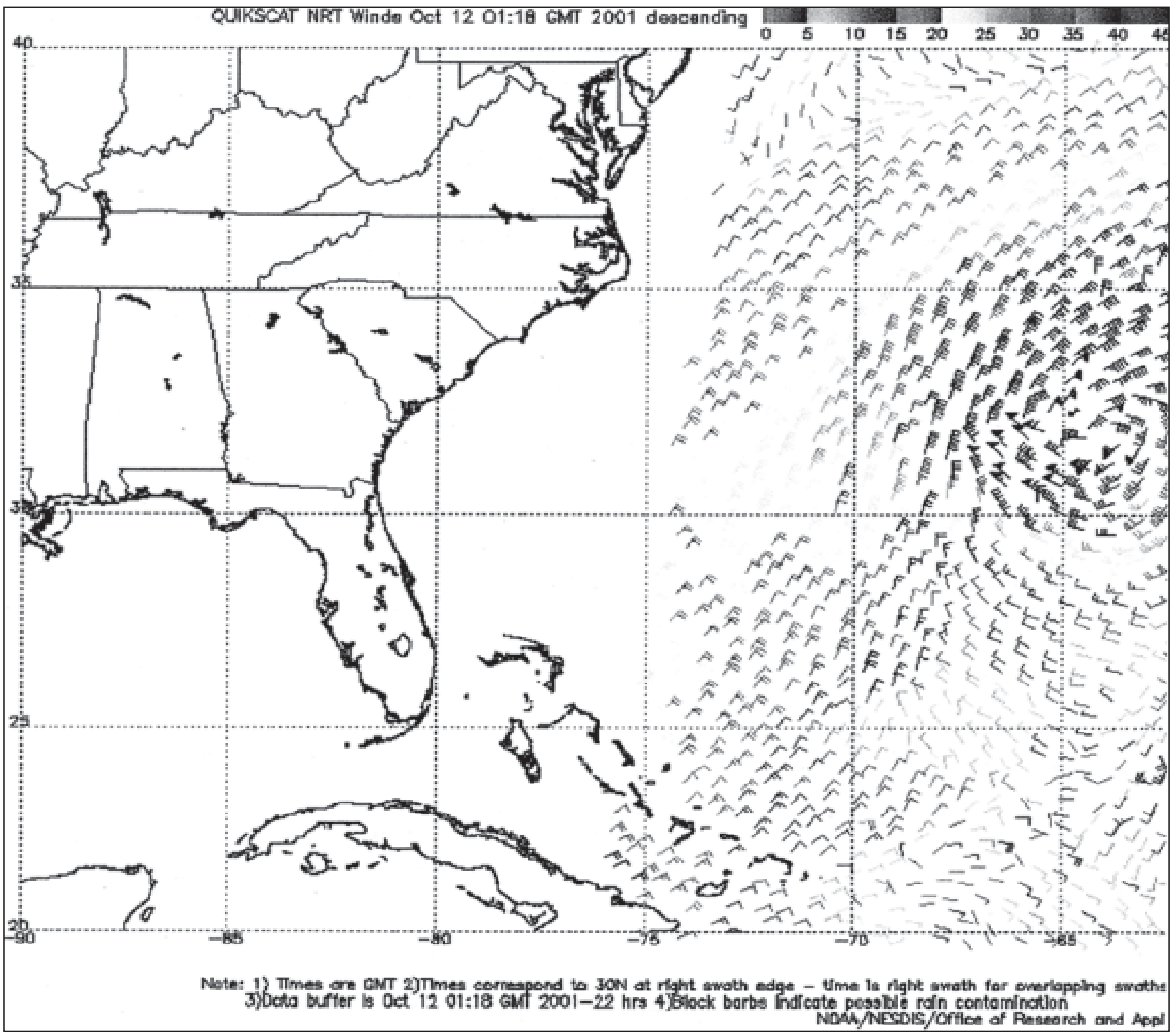


Figure 5 - QuikScat satellite-sensed scatterometer winds valid about 0000 UTC October 12. Image is courtesy of NOAA/NESDIS Office of Research and Applications.

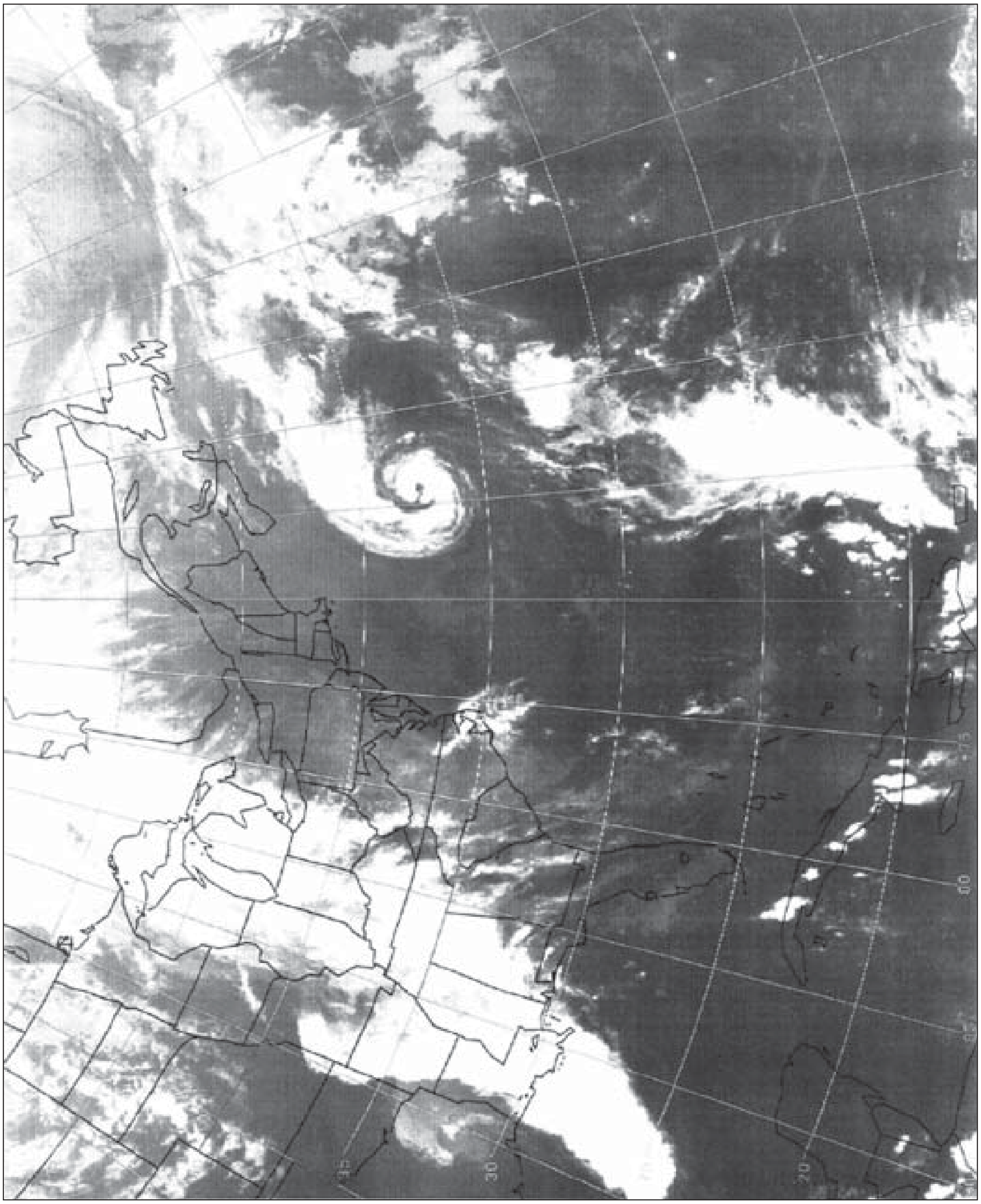


Figure 6 - GOES infrared satellite image valid at 2215 UTC October 13, 2001. Satellite senses temperature, which is displayed in various ahdes of gray, ranging from white (cold) to black (wwarm) in this type of image.

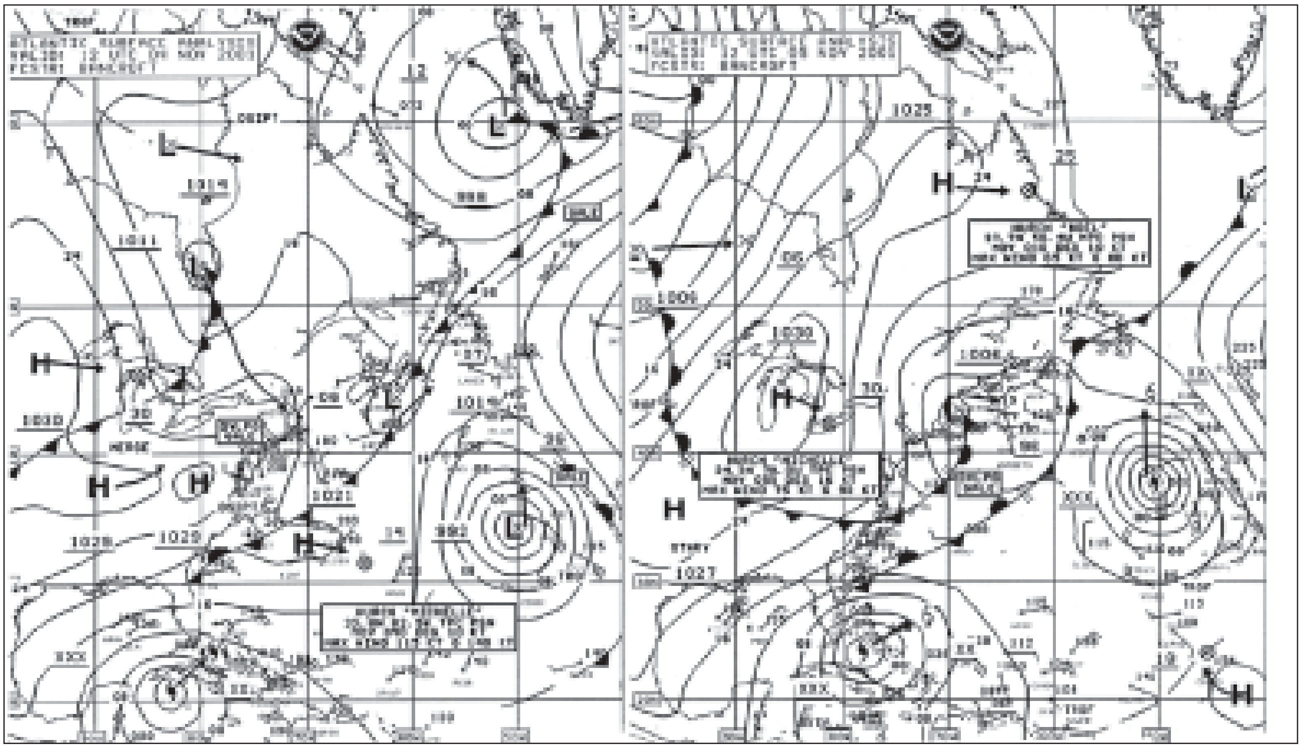


Figure 7 - MPC North Atlantic surface analysis charts (Part 2) valid 1200 UTC November 4 and 5, 2001.

waters late on November 24 and continued to intensify, with TPC classifying it as a subtropical storm (Figure 10). With a strong high-pressure ridge to the north, a large area of gale to storm force northeast winds developed north and west of the center. Several gale-force reports are plotted in Figure 10. The highest wind reported by a ship was a north wind of 55 kt, along with 10-m seas (33 ft) from the **Liberty Sun** (**WCOB**) near 31°N. 56°W. at 1800 UTC November 25. The storm continued to intensify during the next two days while remaining nearly stationary, with TPC upgrading it to Hurricane Olga near 31.5°N. 56°W. at 2100 UTC November 26. The intensity peaked late on the 27th when maximum sustained winds reached 80 kt with gusts to 100 kt. The 500-mb analysis in Figure 11, with the same valid time as Figure 10, shows this system nearly vertically stacked. A 500-mb ridge building to the north eventually forced Olga to move southwest and weaken. By early on the 29th Olga weakened to a tropical storm south of MPC's area.

Other Significant Events of the Period

Western Atlantic/Canadian Maritimes Storm of 7-8 November: Referring again to Figure 9, the 960-mb storm shown in the second analysis formed from the merger of the low over Nova Scotia with the secondary system at 39°N. 58°W., the remains of Tropical Storm Noel and the storm center near 30°N. 63°W. which was formerly Hurricane Michelle. At 0600 UTC November 7 the ship **ELRT2** near 36°N. 57°W. reported a south wind of 60 kt. The **Atlantic Cartier** (**C6MS4**) encountered southeast winds of 60 kt near 46°N. 49°W. at 1800 UTC November 7. The buoy 44140 (43.8°N. 51.7°W.) at that time reported 7.5-m seas (25 ft). The **Sea-Land Developer** (**KHRH**) reported seas to 9.5 meters (31 ft) along with 35-kt southwest winds, also at that same time. This was the strongest storm in terms of central pressure in the western North Atlantic during this four-month period. The system subsequently moved north-northeast and weakened, before re-intensifying while passing east of Greenland by November 10.

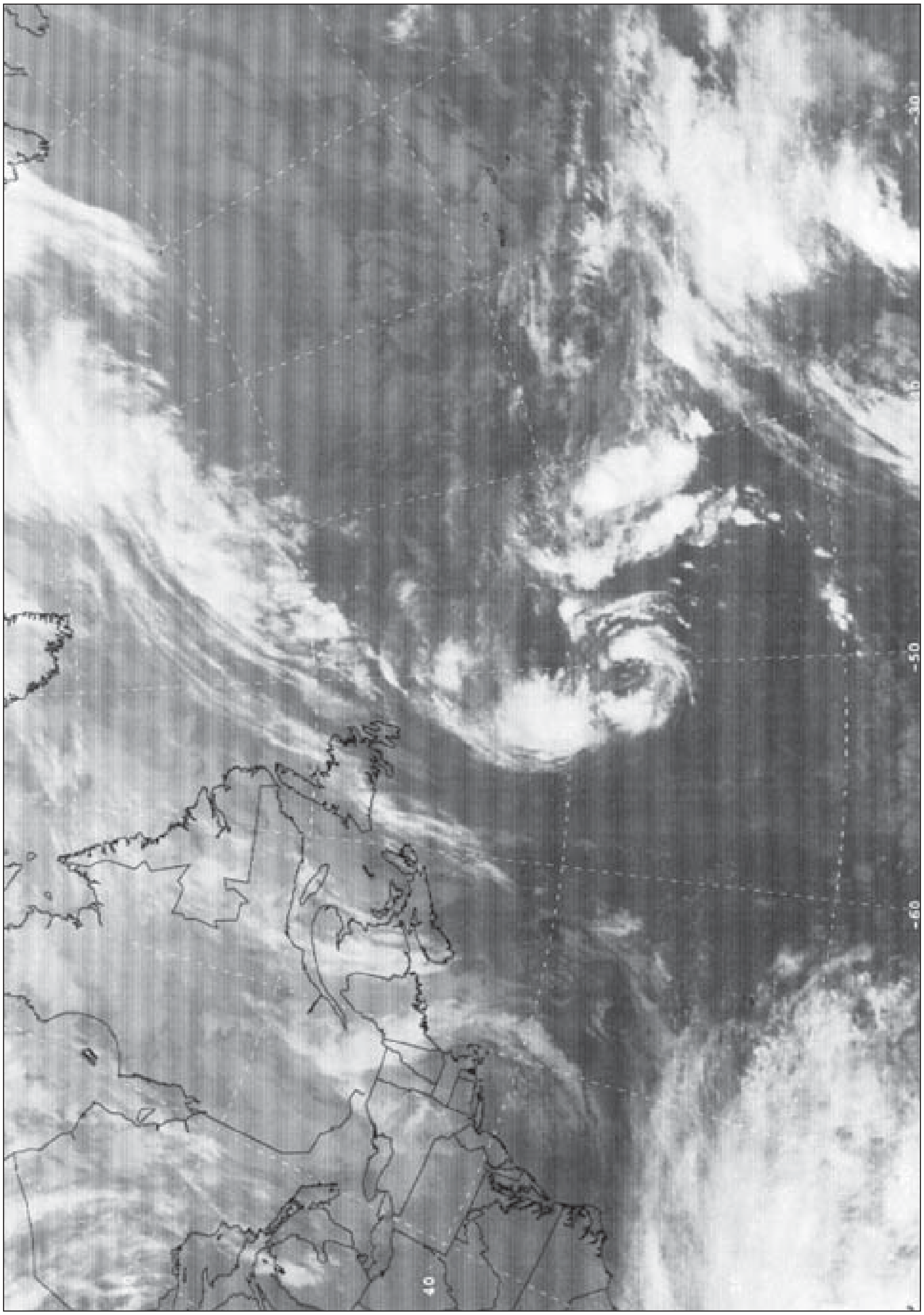


Figure 8 - GOES-8 infrared satellite image valid 1215 UTC November 5, or approximately the valid time of the second analysis in Figure 7.

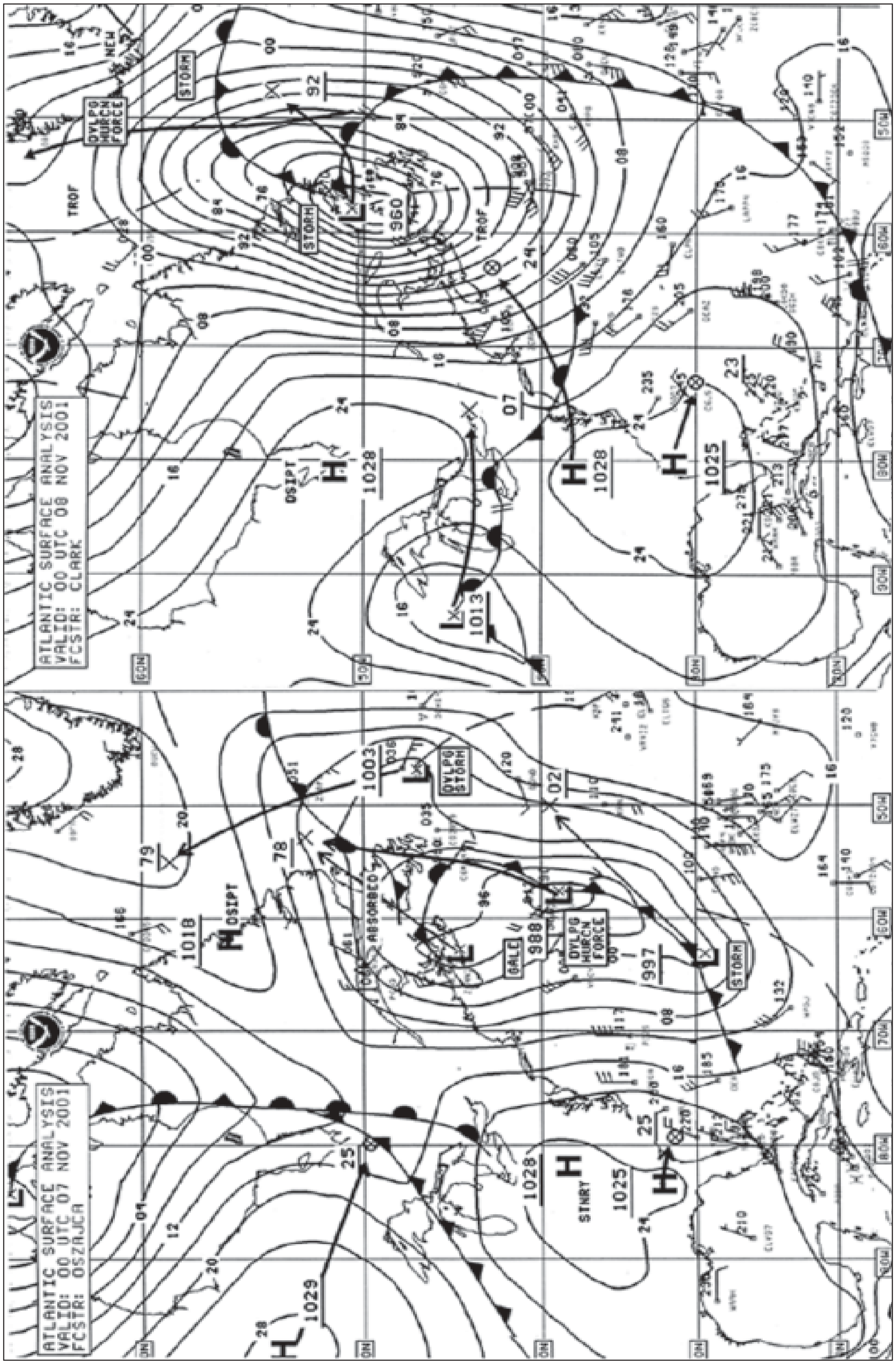


Figure 9 - MPC North Atlantic surface analysis charts (Part 2) valid 0000 UTC November 7 and 8, 2001.

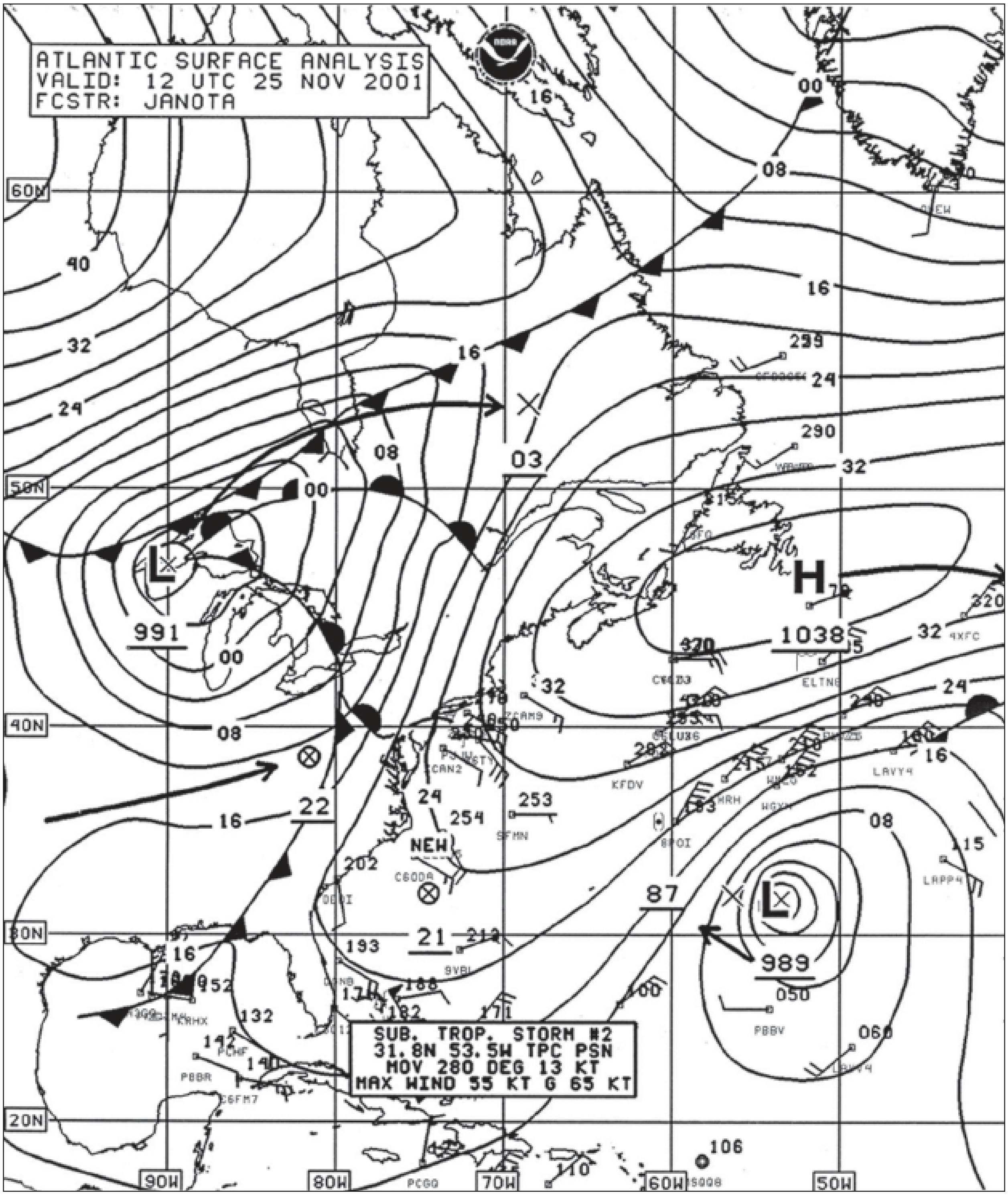


Figure 10 - MPC North Atlantic surface analysis chart (Part 2) valid 1200 UTC November 25, 2001.

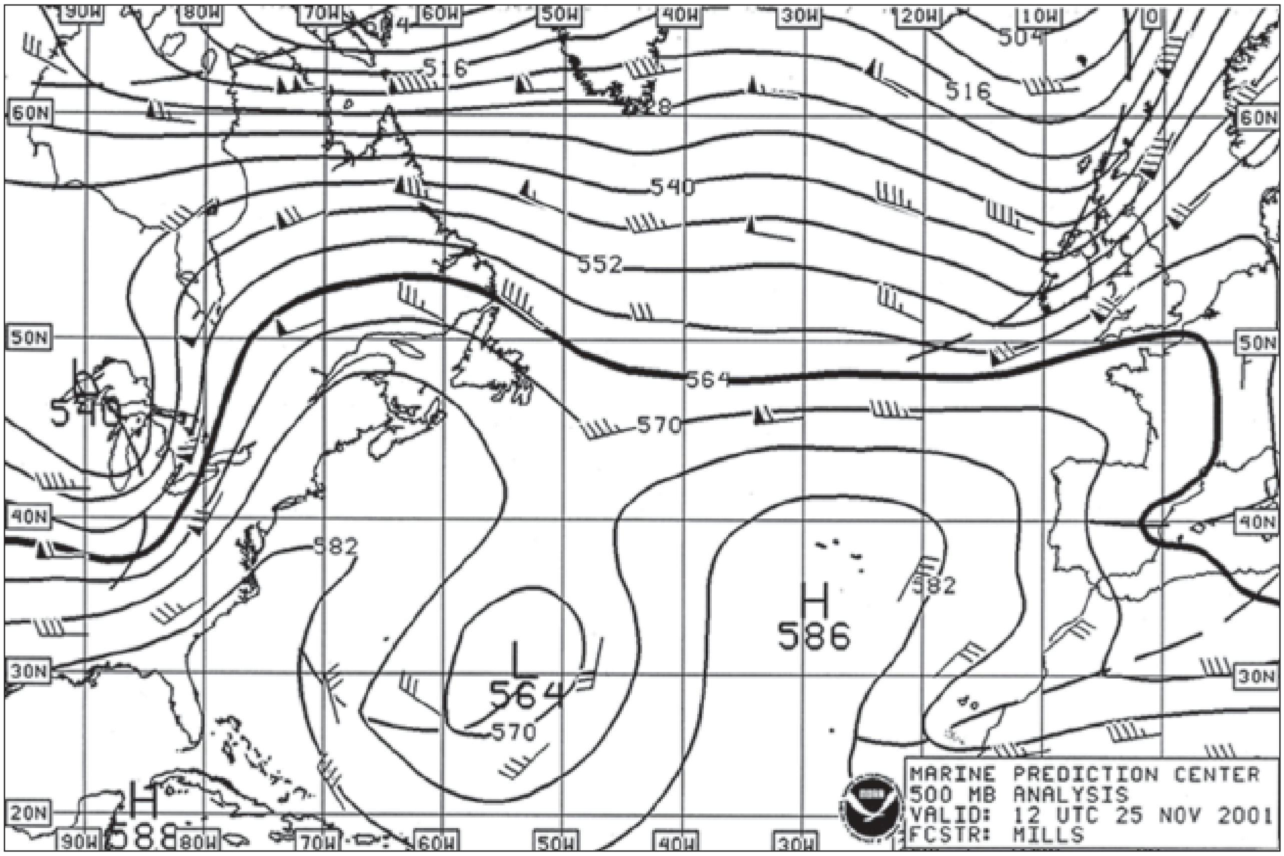


Figure 11 - MPC 500-mb analysis valid 1200 UTC November 25, 2001. Short-wave troughs are depicted as broken line segments.

North Atlantic Storm of 9-14 December: This storm is depicted in its most rapid phase of development in Figure 12. The central pressure dropped 24 mb, to 979 mb, in the 24-hour period ending at 1800 UTC December 10. This development certainly qualifies as a meteorological "bomb." At 1200 UTC December 10 the ship **ELVG7** reported a west wind of 60 kt and 8-m seas (26 ft) near 40°N. 51°W. Figure 13 is a QuikScat image showing winds to 70 kt west and northwest of the center near 44°N. 39°W. Upon passing east of Newfoundland and approaching 35°W., the storm was forced north and slowed by a blocking high over the British Isles. The **Fidelio** (**WQVY**) reported 13.5-m seas (45 ft), along with northwest winds of 55 kt, near 44°N. 44°W. at 0000 UTC December 14. The storm weakened near 49°N. 34°W. on the 14th but was replaced by another storm following a similar track on the 16th. This helped to maintain a long band of southeast gale to storm force winds from south of Greenland to near 40°N. 28°W. through December 18, with the strong high pressure persisting to the east. The **Lykes Liberator** (**WGXN**) near 47°N. 27°W. reported a southeast wind of 45 kt and 10.5-m seas (35 ft) at 1800 UTC December 17.

East Coast Storm of 18-19 December: This system developed near Long Island at 1800 UTC December 18 and moved slowly north-northeast across the Canadian Maritimes through the 19th before turning more northwest and weakening, blocked by strong high pressure to the east. The central pressure bottomed out at 965 mb near 46°N. 57°W. at 1200 UTC December 19. The **Sea-Land Motivator** (**WAAH**) reported northwest winds of 45 kt and 13-m seas (42 ft) near 39°N. 62°W. at this time. The highest wind reported by a ship was a northwest wind of 60 kt from **VCRT** near 44°N. 58°W., also at 1200 UTC December 19. ⚓

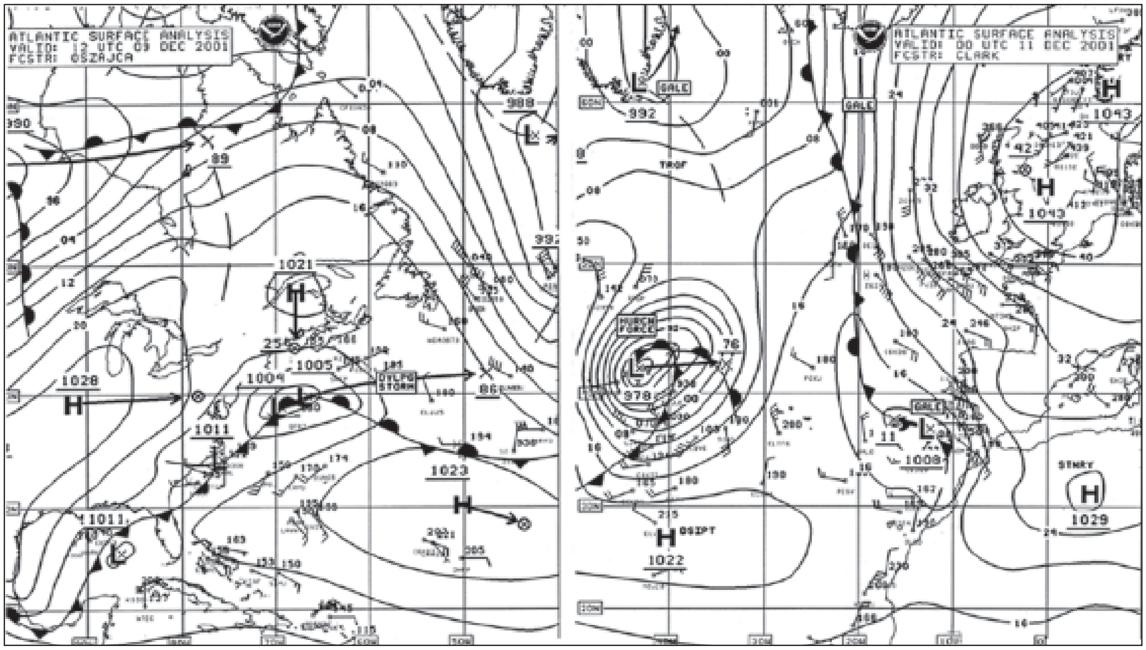


Figure 12 - MPC North Atlantic surface analysis chart (Part 2) valid 1200 UTC December 9 and a second surfsce analysis (Part 1) valid 0000 UTC December 11, 2001.

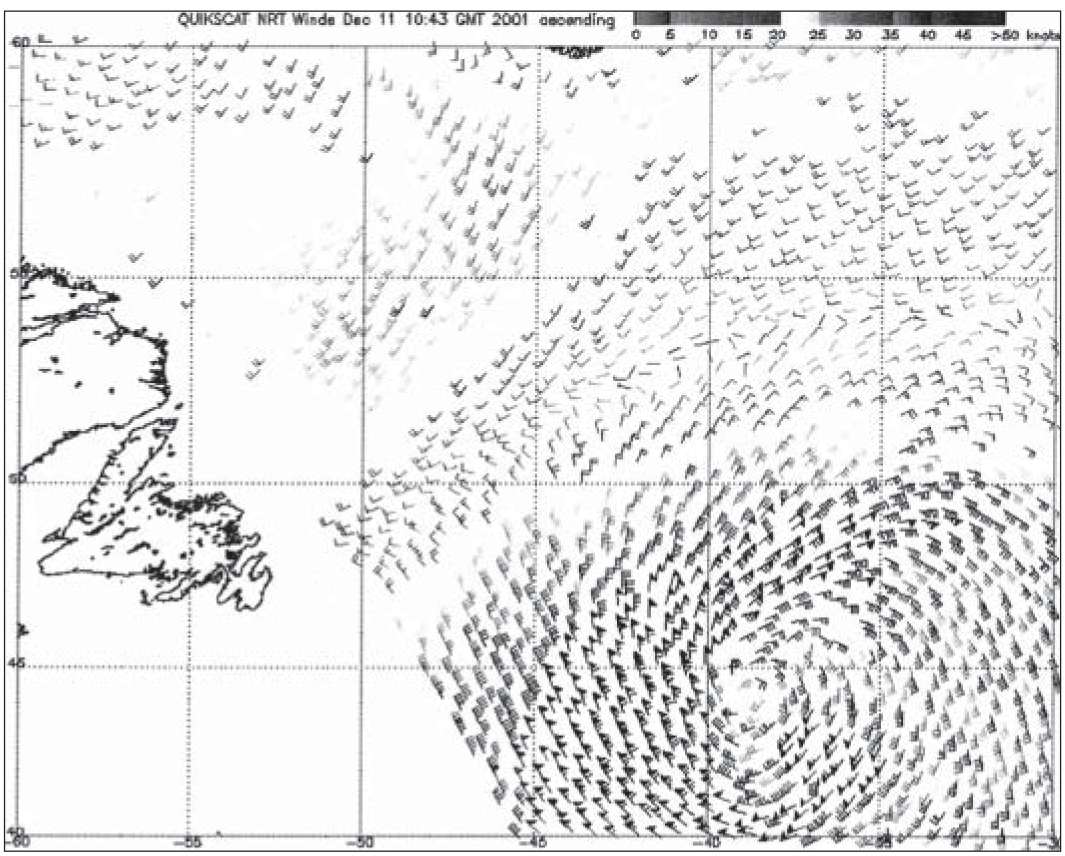


Figure 13 - QuikScat scatterometer winds valid about 0745 UTC December 11, 2001. Imagery is from NOAA/NESDIS Office of Research and Applications (North Atlantic Storm of 9-14 December).

Marine Weather Review North Pacific Area September through December 2001

George Bancroft

Introduction

The weather pattern began with low-pressure systems tracking east across or just south of the Bering Sea and into the Gulf of Alaska with former tropical systems in the mix, especially through October when the tropics were most active. There were seven tropical cyclones which appeared on MPC oceanic analysis charts and either became extratropical before entering MPC's high seas area (see Reference 2) or actually moved into the high seas waters as tropical cyclones. All came from the tropical western North Pacific and passed near or east of Japan before recurving northeast.

As the fall season progressed the main track of lows shifted south with a southern track from near Japan to the Gulf of Alaska becoming more active, producing some intense lows. Sometimes the upper-air flow pattern became more amplified and steered storms coming off Japan northward toward the Kamchatka Peninsula or the southwest Bering Sea. Many of the low-pressure systems produced storm force winds; hence, attention is focused mainly on those out-of-the-ordinary systems producing hurricane-force winds.

Tropical Activity

Typhoon Wutip: Still a typhoon with maximum sustained winds of 70 kt with gusts to 85 kt near 31°N. 150°E at the start of September, Wutip weakened to a tropical storm at 1800 UTC September 1. At 1200 UTC September 1 the ship **DGLO** reported a southwest wind of 45 kt and 10-m seas (32 ft). Wutip became extratropical at 0000 UTC September near 39°N. 161°E and raced northeast along a front associated with a gale in the Bering Sea without redeveloping.

Tropical Storm Danas: Just east of Japan near 42°N. 146°E at 0000 UTC September 12 with maximum sustained winds of 45 kt with gusts to 55 kt, Danas moved northeast and became an extratropical gale near the Kurile Islands within 12 hours. The system later intensified into a storm just south of the eastern Aleutians at 1200 UTC September 14. The ship **ELXX6** near 44N. 166E reported a southwest wind of 45 kt at 0600 UTC September 13. QuikScat scatterometer winds at 0600 UTC September 14 showed winds to 60 kt west and southwest of the center (not shown). The storm then weakened to a low in the southern Gulf of Alaska late on September 16.

Typhoon Vipa: Vipa passed just south of Japan on September 19 with maximum sustained winds of 70 kt with gusts to 85 kt. By 1800 UTC September 21 Vipa was a tropical storm with maximum winds 45 kt with gusts to 55 kt. The system then merged with a low in the western Bering Sea by 1200 UTC September and moved east while intensifying, developing a 968-mb central pressure in the western Gulf of Alaska at 0000 UTC September 14. The ship **ELOT3** reported a northwest wind of 50 kt and 10.5-m seas (35 ft) near 52°N. 170°W., and the same wind with 13-m seas (42 ft) near 52°N. 171°W. at 1800 UTC September 13 and 0000 UTC September 14, respectively. The **President Truman** (WNDP) near 54°N. 164°W. experienced northwest winds of 60 kt at 1200 UTC September 14. The storm then weakened and drifted east.

Typhoon Francisco: Francisco attained maximum strength with maximum winds of 100 kt and gusts to 125 kt near 26°N. 148°E at 1200 UTC September 23 and began to weaken 24 hours later while drifting north. Francisco then weakened to a tropical storm near 37°N. 150°E at 0600 UTC September 25 and accelerated northeast, becoming an extratropical storm 44°N. 160°E eighteen hours later. The system then weakened while passing south of the Aleutians on the 26th and 27th, before re-intensifying to a storm near the Queen Charlotte Islands at 1200 UTC September 29. Buoy 46004 reported southwest winds of 40 kt and 7.5-m seas (25 ft) at this time. The system moved inland and weakened later that day.

Typhoon Krosa: Tropical Storm Krosa formed south of Japan near 16°N. at 0600 UTC October 4 and moved northwest, rapidly intensifying to a typhoon with maximum sustained winds of 105 kt with gusts to 130 kt near 20°N. 137°E at 1200 UTC October 5 before recurving northeast and weakening. Figure 1 depicts Krosa as a tropical storm merging with a frontal zone to the north and rapidly re-intensifying into a hurricane-force extratropical storm over a 36-hour period. The central pressure dropped 32 mb in the 24-hour period ending at 1800 UTC October 10. The **President Wilson** (WCY3438) encountered south winds of 65 kt near 40°N. 177°E at 0600 UTC October 10. Twelve hours later this ship was at 39°N. 178°W. reporting west winds of 50 kt and 13.5-m seas (44 ft). A QuikScat image for 1548 UTC October 10 (Figure 2) reveals hurricane force winds up to 75 kt to the south and north of the center. The storm subsequently tracked northeast and weakened in the northern Gulf of Alaska on October 12.

Super Typhoon Podul: Podul attained a maximum strength of 140 kt with gusts to 170 kt at 0600 UTC October 24 near 17°N. 157°E while drifting north northeast, then began to weaken after 0600 UTC October 26. Figure 3 shows Podul approaching a front to the north and becoming extratropical 24 hours later. The typhoon actually entered the MPC high seas area at 1200 UTC October 27 before becoming extratropical. Figure 4 is a GMS infrared satellite image showing Podul as a white circular cloud mass entering the southern end of a northeast to southwest frontal band. The ship **JRZH** reported north winds of 50 kt and 9-m seas (30 ft) near 36°N. 157°E at 1200 UTC October 27. The system then redeveloped northeast near the eastern Aleutians on the 28th and reached the Gulf of Alaska on October 30.

Super Typhoon Faxai: Faxai approached the southwest corner of MPC's high seas waters near 29°N. 158°E at 1800 UTC December 25 as a minimal typhoon, before becoming extratropical six hours later near 31°N. 161°E. Prior to this, Faxai was once a super typhoon with maximum sustained winds of 150 kt and gusts to 180 kt. The system then moved east and rapidly weakened.

Other Significant Events

Gulf of Alaska Storm of 2-3 November: This system developed rapidly as depicted in Figure 5, absorbing an arctic low-pressure system and cold front to the north, and deepening by 29 mb in the 24-hour period ending at 1800 UTC November 3. The system was at maximum intensity in the second analysis of Figure 5. The GOES-10 infrared satellite image of the storm (Figure 6) reveals an "eye" at the center, a characteristic of an intense system. Figure 7 is a high-resolution QuikScat image of scatterometer winds around the storm about 14 hours prior to the time of maximum intensity. There are 70 kt wind barbs off the coast of Southeast Alaska. At 1541 UTC November there was a ship (callsign unknown) reporting south winds of 70 kt near 55°N. 132°W. The vessel **WCD7842** at 57°N. 143°W. reported southwest winds of 50 kt and 9-m seas (30 ft) at 2100 UTC November 3. The storm then drifted toward the west and weakened.

Western Pacific Storm of 12-14 November: Figure 8 depicts the rapid development of this storm over 36 hours. Initial deepening was 32 mb in the 24-hour period ending at 0600 UTC November 13, with this storm certainly qualifying as a meteorological "bomb". Between 0000 UTC and 0600 UTC November 13 the storm center passed the ship **DHDH** which reported an east wind of 35 kt shifting to west 115 kt with the latter location at 39°N. 155°E. This latter wind may appear high

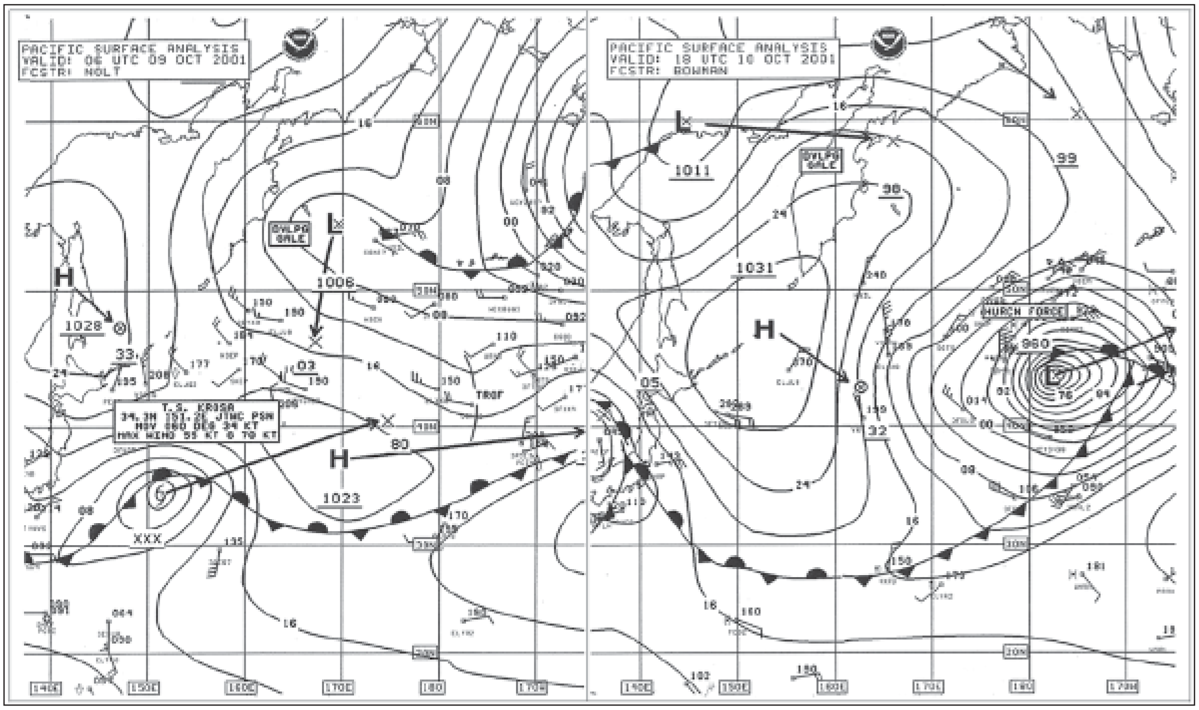


Figure 1 - MPC North Pacific surface analysis charts (Part 2) valid 0600 UTC October 9 and 1800 UTC October 10, 2001.

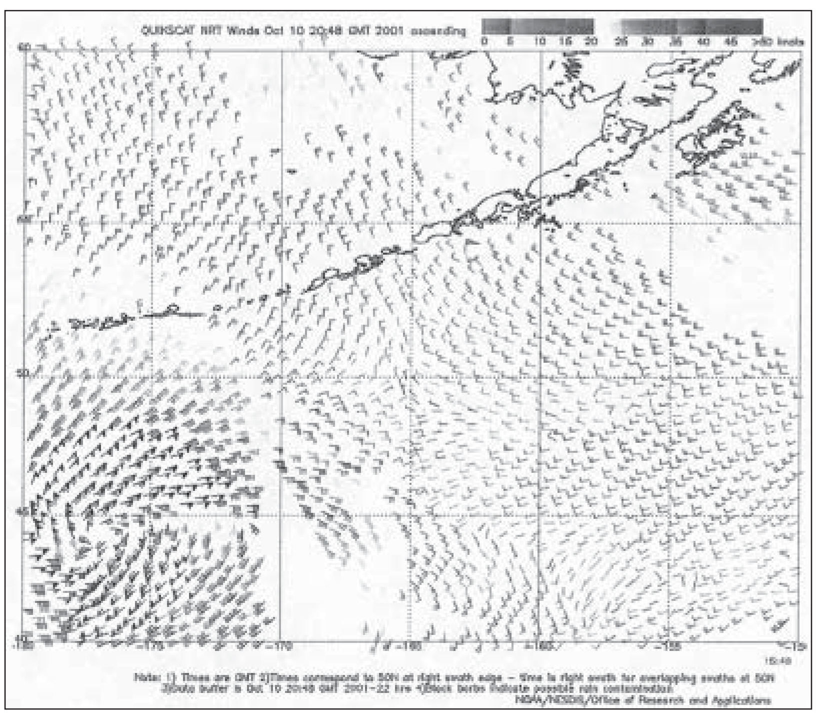


Figure 2 - QuickScat scatterometer winds valid about 1548 UTC October 10, 2001. Image is courtesy of NOAA/NESDIS/Office of Research and Applications.

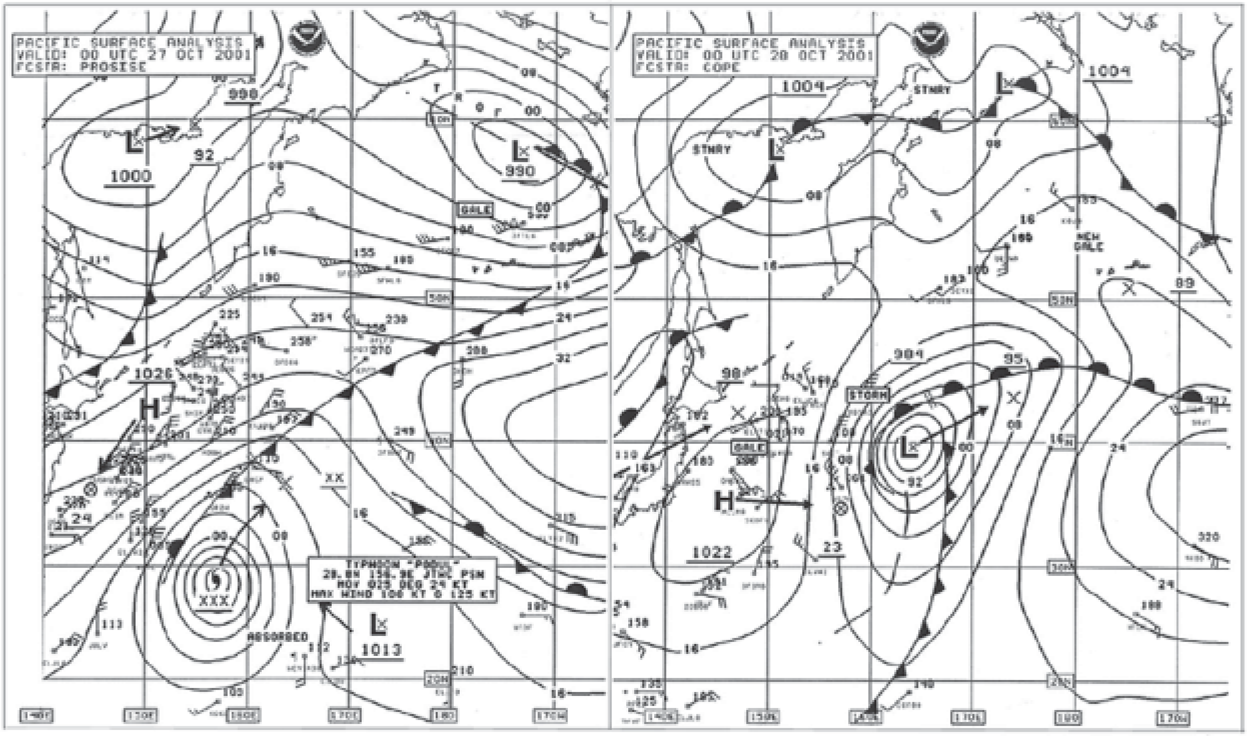


Figure 3 - MPC North Pacific surface analysis charts (Part 2) valid 0000 UTC October 27 and 28, 2001.

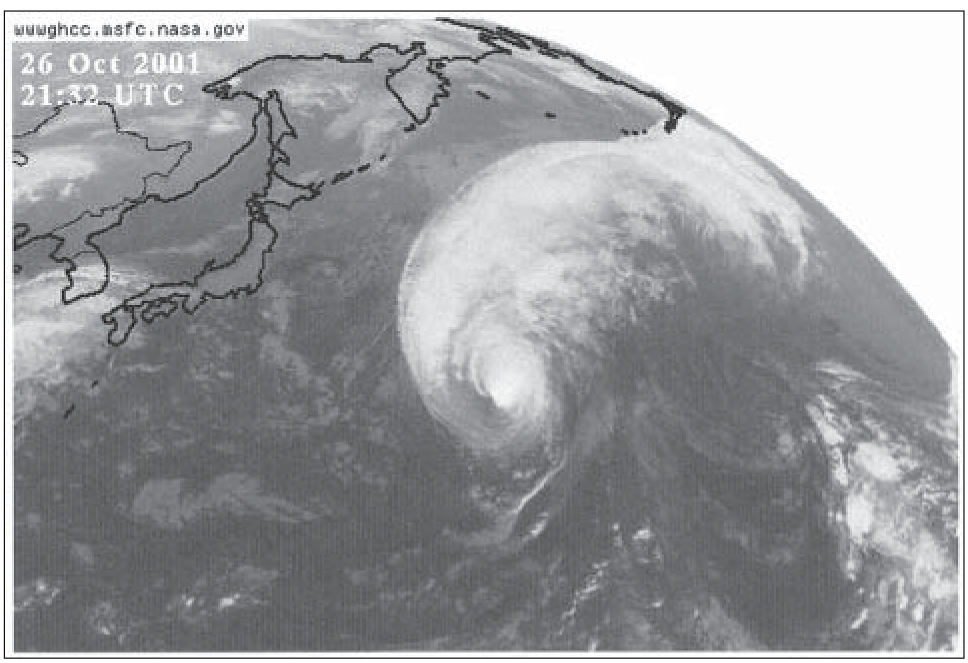


Figure 4 - GMS-5 infrared satellite image valid 2132 UTC October 26, 2001. Satellite senses temperature on a scale from cold (white) to warm (balack) in this type of image. The valid time is about two and one-half hours prior to time of first surface analysis in Figure 3. (from NASA Global Hydrology and Climate Center)

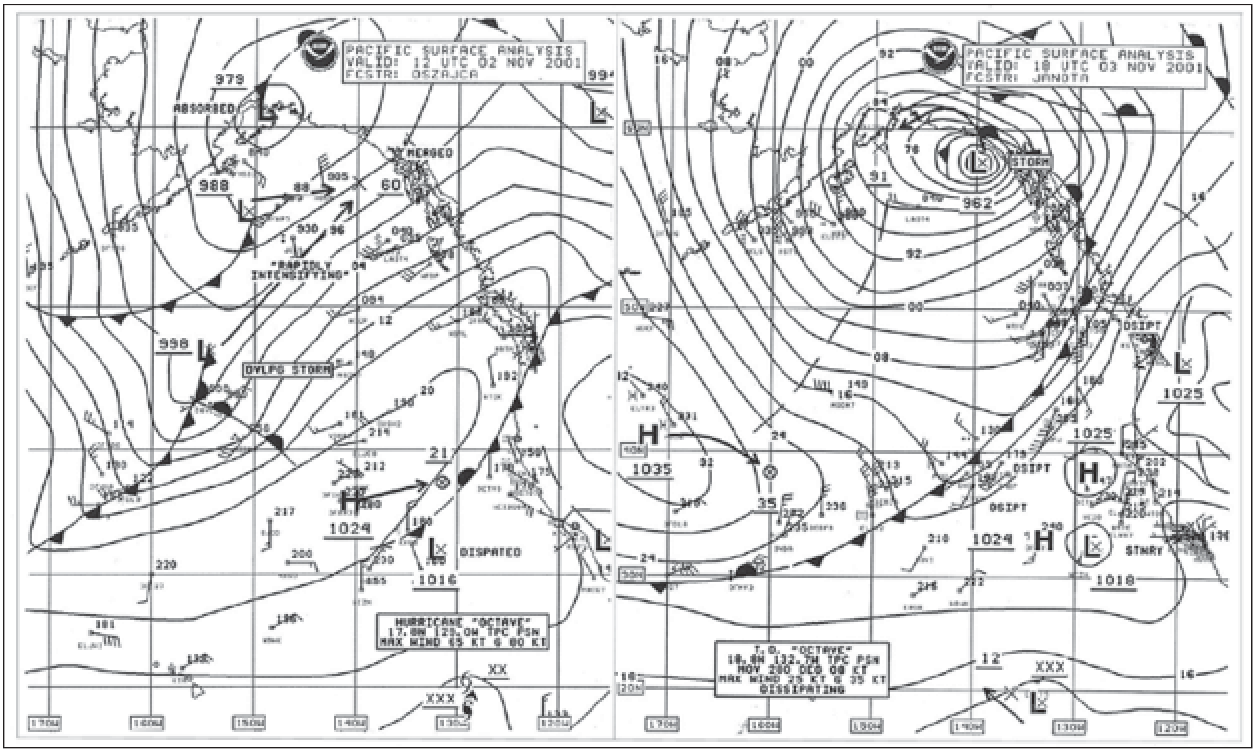


Figure 5 - MPC North Pacific surface analysis charts (Part 1) valid 1200 UTC November 2 and 1800 UTC November 3, 2001.

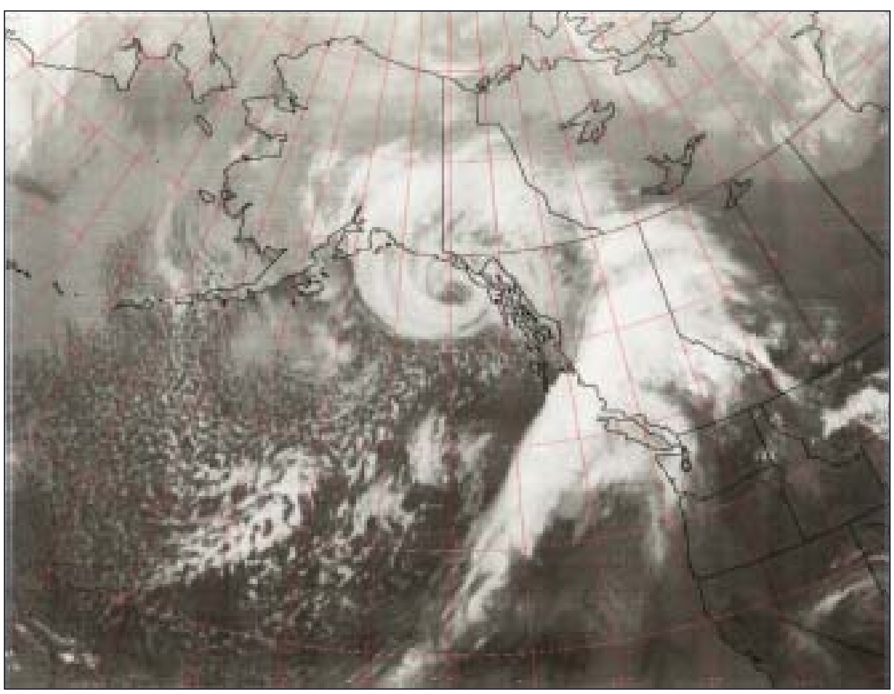


Figure 6 - GOES-10 infrared satellite image valid 1800 UTC November 3, 2001 (same as valid time of second analysis in Figure 5).

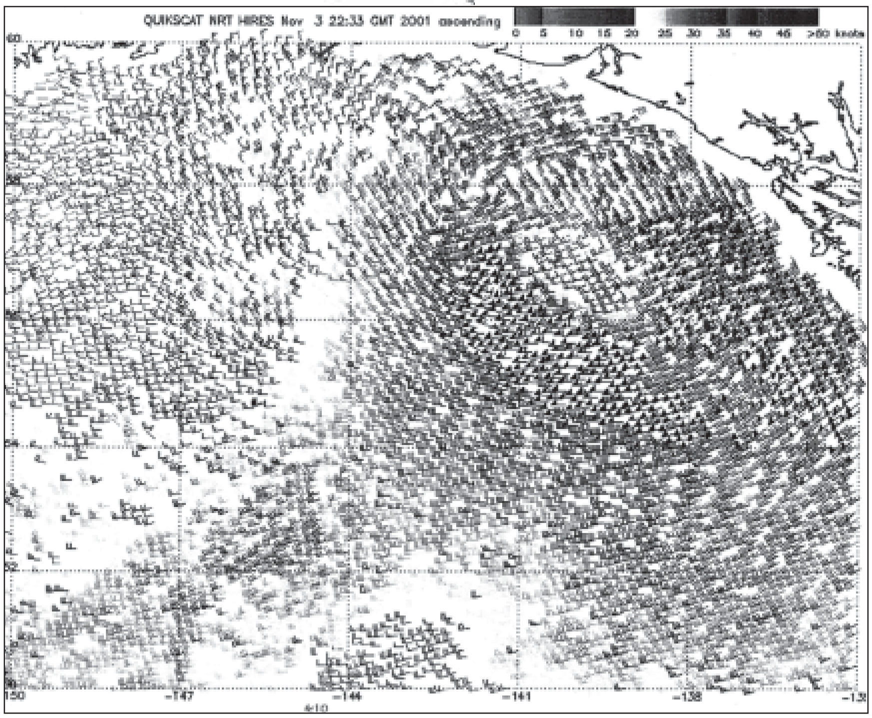


Figure 7 - High-resolution QuickScat image of scatterometer winds valid about 0410 UTC November 3, 2001. The resolution is 12.5 km in this image, versus 25 km for regular QuickScat imagery. (from NOAA/ NESDIS Office of Research and Applications)

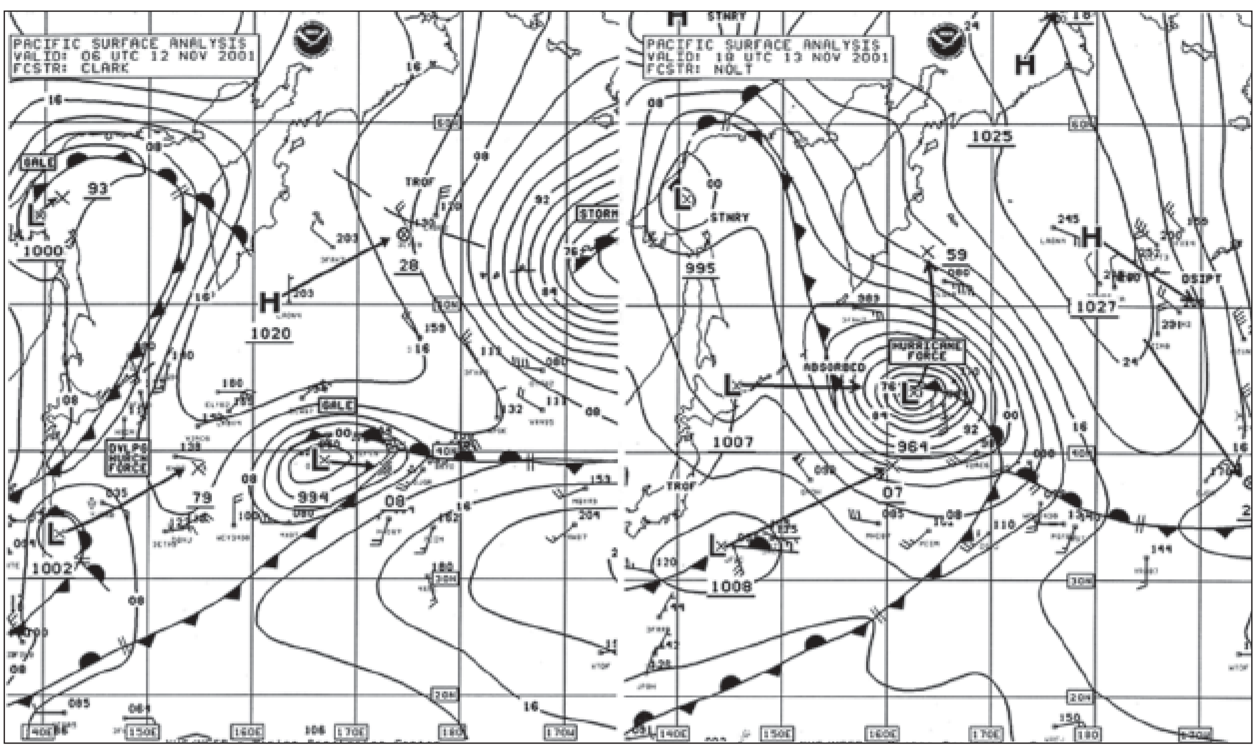


Figure 8 - MPC North Pacific surface analysis charts (Part 2) valid 0600 UTC November 12 and 1800 UTC November 13, 2001.

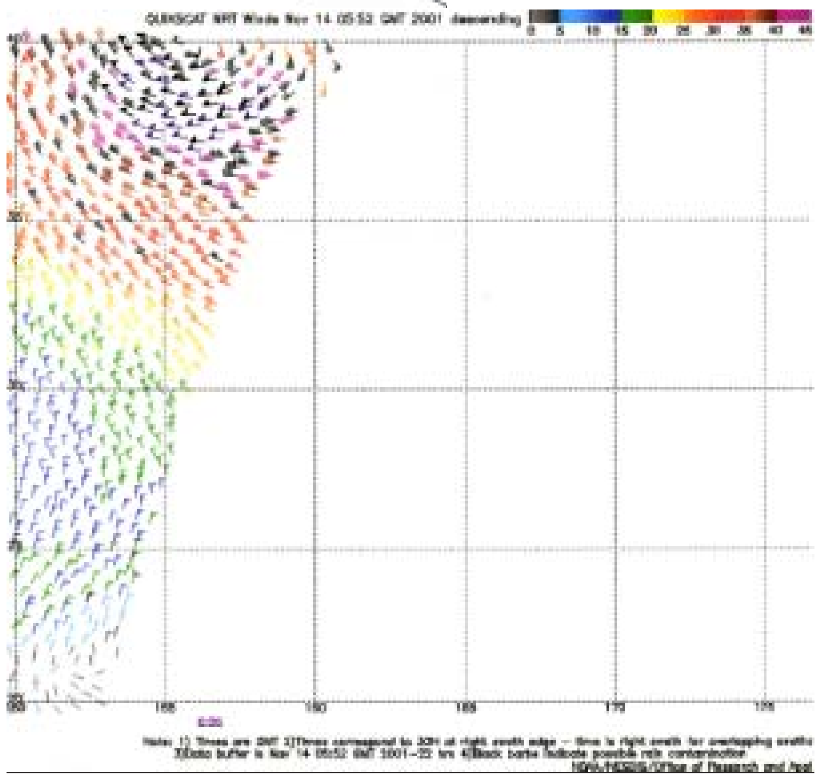


Figure 9 - QuikScat satellite image of scatterometer winds valid 0826 UTC November 13, 2001. (from NOAA/NESDIS/Office of Research Applications)

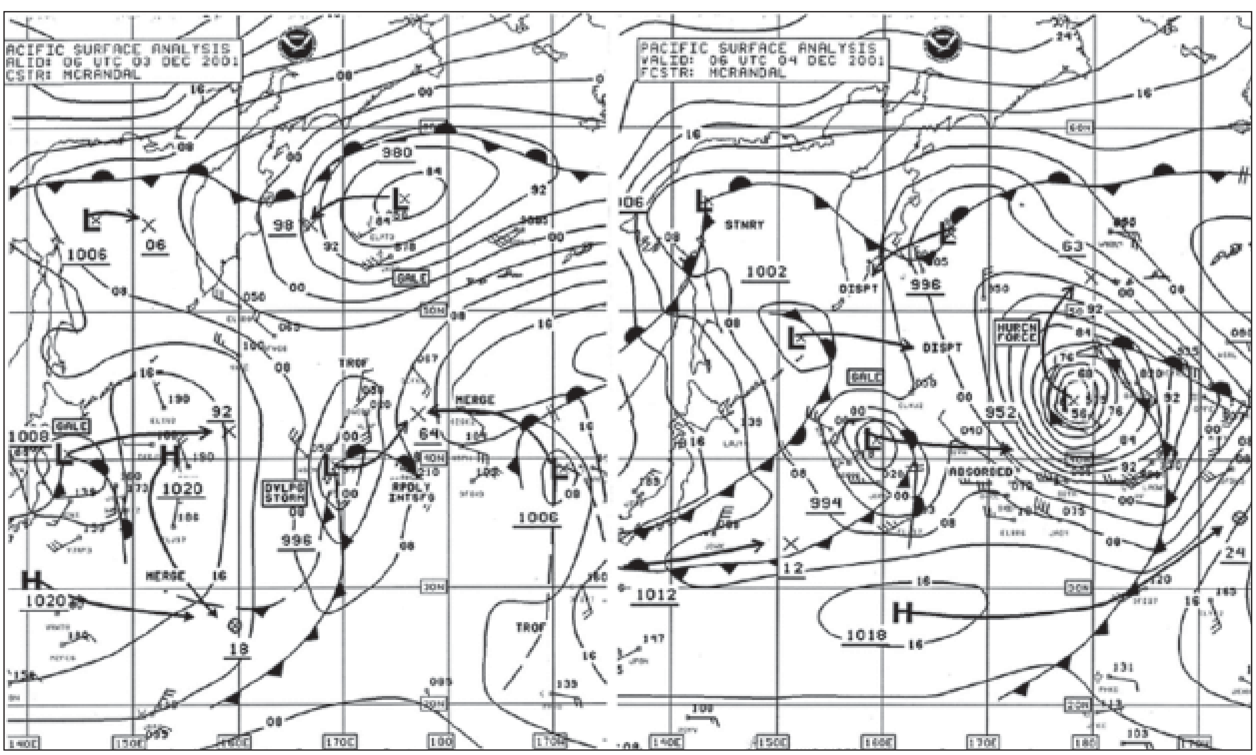


Figure 10 - MPC North Pacific surface analysis charts (Part 2) valid 0600 UTC December 3 and 4, 2001.

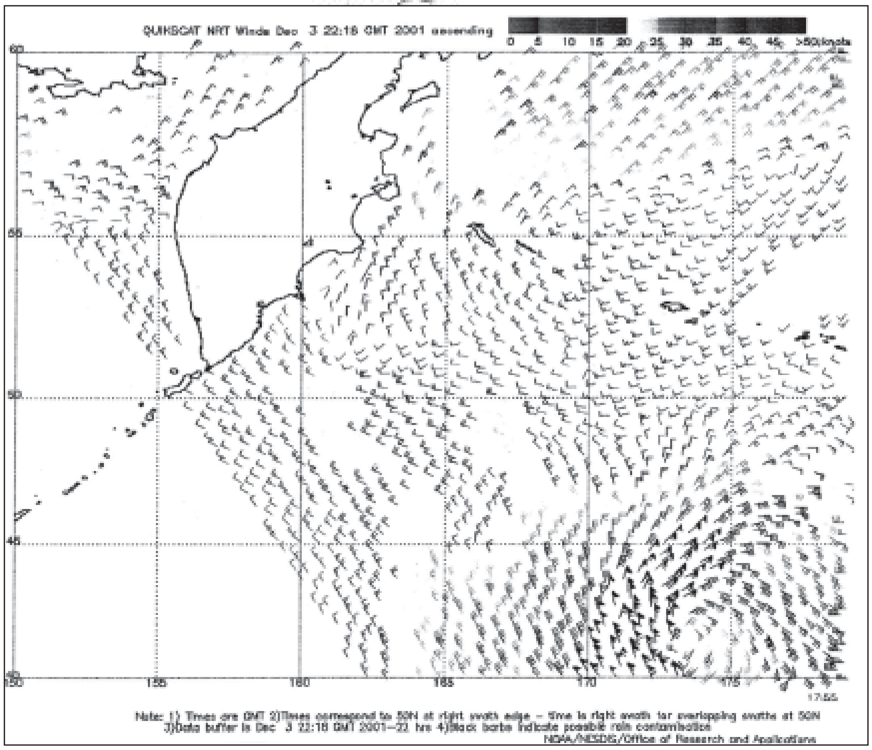


Figure 11 - QuickScat scatterometer winds valid 1755 UTC December 3, 2001. (from NOAA/NESDIS/Office of Research and Applications)

for the open ocean outside a typhoon, but a QuickScat pass for 0826 UTC November 13 (Figure 9) has an 80 kt wind barb near the location of the ship. Reported seas were 9.5 meters (31 ft) in the second report. The storm then moved north to near the Kamchatka Peninsula with a 960 mb central pressure before beginning to drift southwest and weaken. The **APL China** (S6TA) encountered southwest winds of 50 kt and 11.5-m seas (38 ft) near 50°N. 171°E at 1800 UTC November 14.

Western Pacific Storm of 3-4 December: In Figure 10 the 996-hPa developing storm is depicted deepening by 44 hPa in the 24-hour period ending at 0600 UTC December 4. This is perhaps the most impressive intensification rate in either ocean during the four-month period. The **APL China** reported a northwest wind of 69 kt and 16.5-m seas (54 ft) near 39°N. 172°E at 1800 UTC December 3, while the **Essen Express** (**DHEE**) nearby encountered northwest winds of 65 kt. The **Westwood Belinda** (**H9IM**) at 39°N. 171°E reported northwest winds of 50 kt and 16-m seas (53 ft) at 0000 UTC December 4, while ahead of the system, the **Mayview Maersk** (**OWEB2**) encountered southeast winds of 60 kt and 8-m seas (27 ft) near 45°N. 179°W. Figure 11 is a QuikScat image of satellite-sensed winds valid at 1755 UTC December 3 featuring 65-kt north wind barbs on the back side of the storm. This system then turned toward the north, to just south of the Aleutians at 1800 UTC December 4, before drifting northwest and weakening.

Two Hurricane-Force Storms in North Pacific, 22-24 December: This situation was made possible by the presence of two major upper-level troughs and a very strong jet stream. Figure 12 depicts the surface developments over a 36-hour period, while the 500-mb analysis in Figure 13 corresponds to the time of rapid intensification of both systems and depicts strong jet streams and short-wave troughs supporting development. See Reference 1 for more information on the relationships of the 500-mb chart to surface features. The western storm is shown in the second part of Figure 12 at maximum intensity. This was the most intense storm of the four-month period in either ocean. The eastern storm is shown rapidly intensifying, but the peak intensity of 960 mb was reached six hours prior to the valid time of the second surface analysis. Figure 14 is an infrared satellite image of the North Pacific showing both storms, with the western storm at maximum intensity. The spiral cloud pattern around the well-defined center is indicative of a very intense system. The highest wind reported by a ship was a southwest wind of 61 kt from the **Westwood Marianne** (C6QD3) near 40°N. 156°W. at 1200 UTC December 22. The same ship reported a northwest wind of 50 kt and 14.5-m seas (48 ft) near 39°N. 156°W. six hours later, the highest reported in these two storms. Ship data was lacking near the western storm, except on the fringes. The **Mackinac Bridge** (JKES) near 46°N. 164°W. reported a south wind of 60 kt and 8-m seas (26 ft) at 0000 UTC December 24. Buoy 46035 (57°N. 178°W.) had northeast winds up to 40 kt and seas of 10.5 meters (34 ft) at 0600 UTC December 24. On the southern periphery of the storm, the **CSX Reliance** (WFLH) near 39°N. 170°W. encountered northwest winds of 45 kt and 11-m seas (36 ft). A QuikScat image (Figure 15) valid about 0439 UTC December 23 reveals hurricane force winds on the back side of the eastern storm, and also shows the eastern edge of the western storm which has some 60-kt wind barbs.

The eastern storm subsequently moved into the Gulf of Alaska and weakened later on December 24. The stronger western storm endured a bit longer, drifting east while slowly weakening and becoming absorbed by a storm passing to the south by December 27. ⚓

References

1. Sienkiewicz, J. and Chesneau, L., *Mariner's Guide to the 500-Mb Chart* (Mariners Weather Log, Winter 1995).

2. Bancroft, G., *High Seas Text Bulletins Issued by MPC* (Mariners Weather Log, Vol. 40, No. 2, Summer 1996).

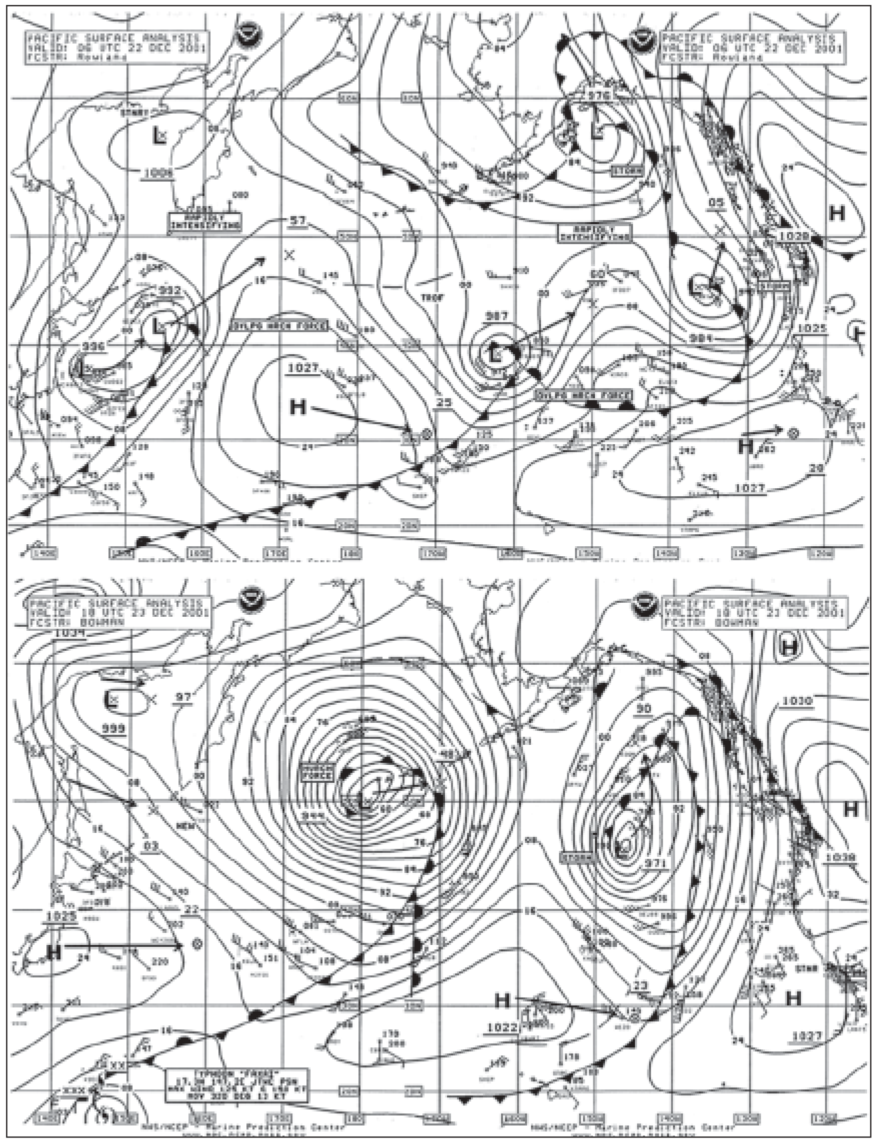


Figure 12 - MPC North Pacific surface analysis charts valid 0600 UTC December 22 and 1800 UTC December 23, 2001.

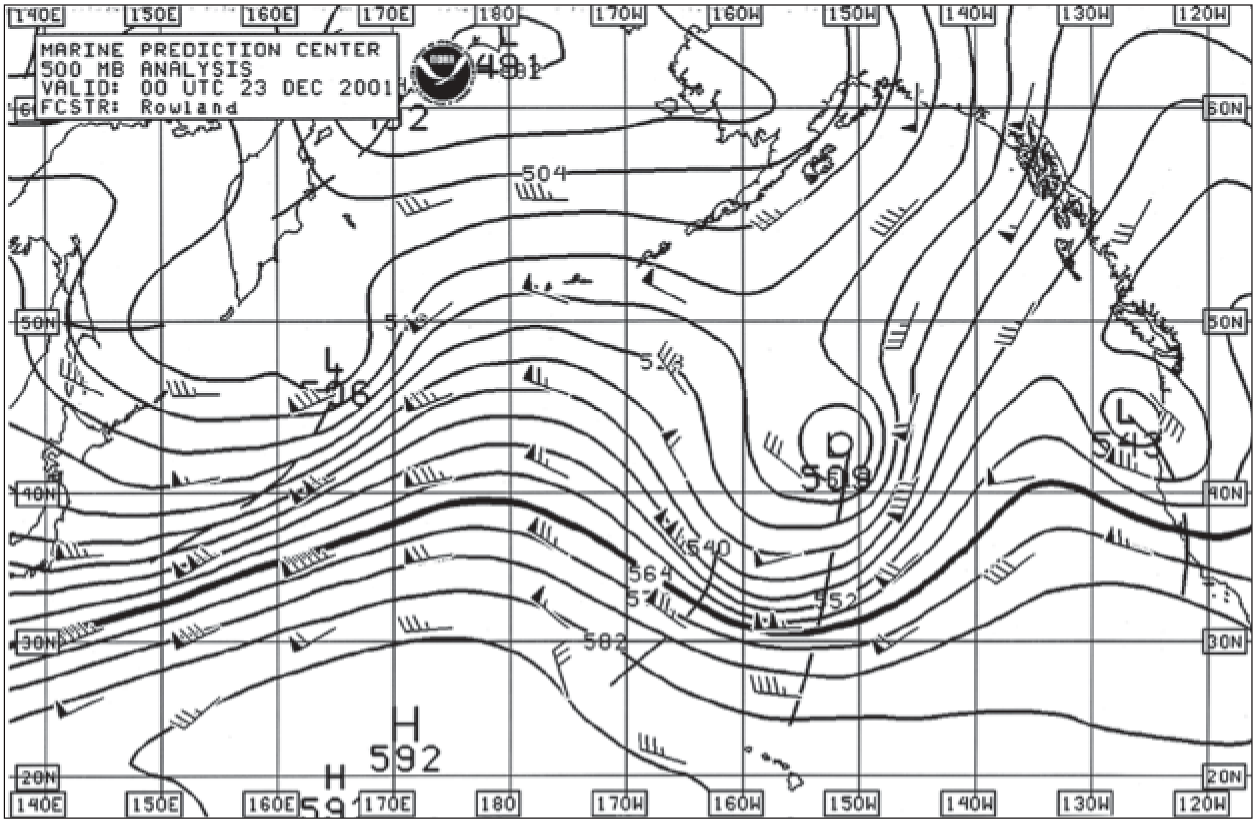


Figure 13 - MPC 500-hPa analysis valid 0000 UTC December 23, 2001. The valid time is halfway between the analysis times of the two charts in Figure 12.

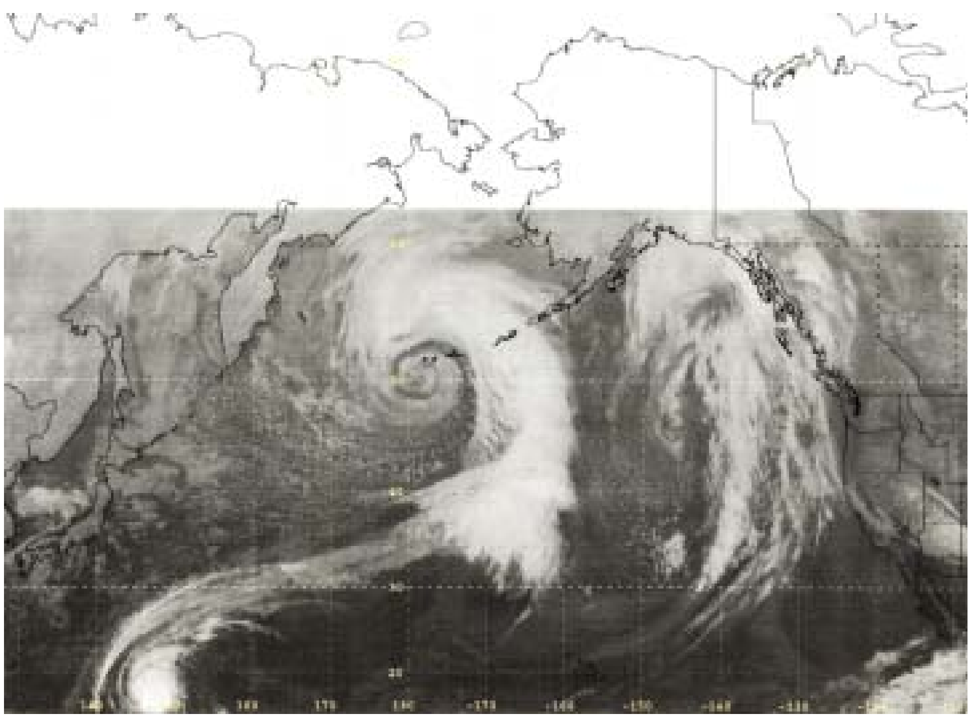


Figure 14 - Composite image made up of GOES-10 and GMS infrared satellite imagery valid 1830 UTC December 23, 2001.

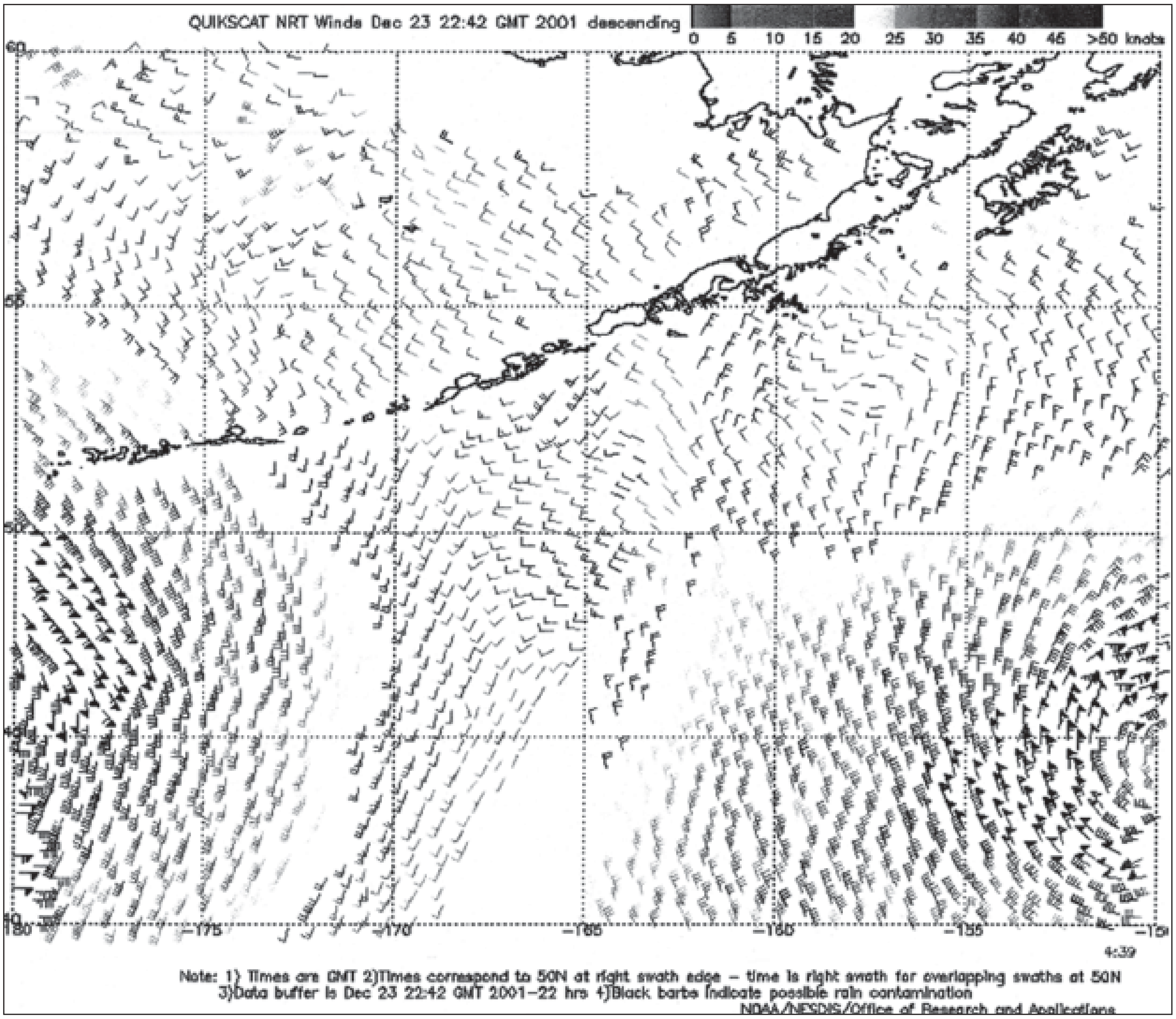


Figure 15 - QuikScat scatterometer winds valid abour 0439 UTC December 23, 2001. (from NOAA/ NESDIS/Office of Research and Applications.

TROPICAL REVIEW
September 2001 - December 2001

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Introduction

The Tropical Prediction Center/ National Hurricane Center (TPC/ NHC) became much busier as activity in the Atlantic significantly increased. A total of 20 tropical storms and hurricanes occurred in the Atlantic and eastern Pacific during the summary period. Several non-tropical gale events also affected the TPC high seas forecast areas.

The Tale of the Tellus

Most hurricane seasons bring many encounters between ships and tropical cyclones, and examples of how ship observations aid the TPC in analysis and forecasting. One of the best such examples from the 2001 season was that of the **Tellus** (WRYG) and the storm that became Hurricane Noel.

A non-tropical low formed in the eastern Atlantic late on 1 November near 32°N. 40°W. This system strengthened into a storm center the next day as it drifted northwestward. Convection began to increase near the center on 3 and 4 November, which suggested that the storm might be acquiring tropical characteristics. The **Tellus** began its encounter with the storm at 0000 UTC 5 November (Table 1) as it traveled westward into the now northward-moving circulation. The key observations were at 1200 UTC and 1400 UTC. Figure 1 shows an image of the soon-to-be Noel at 1145 UTC with the 1200 UTC ship observations plotted on it. Note that while **Tellus** was reporting 60 kt and 992.0 hPa from near the center, other nearby ships were reporting 30 kt or less. This indicated the storm had developed a strong inner core characteristic of a tropical cyclone, even though its appearance on satellite images was less than classically tropical. The 1400 UTC observation of 65 kt indicated that the system was at hurricane strength. Subsequent **Tellus** observations helped determine the size of the wind field on the southwest side of the storm.

Table 1. Observations from the Tellus during its encounter with Hurricane Noel, 5-6 November

Date/Time (UTC)	Lat. (°N)	Lon. (°W)	Wind dir/speed (deg/kt)	Pressure (mb)
5/0000	36.9	45.5	100/27	1009.0
5/0600	37.0	47.5	140/35	1001.2
5/1200	**37.0**	**49.5**	**180/60**	**992.0**
5/1400	**37.0**	**50.1**	**240/65**	**994.0**
5/1500	37.0	50.5	240/51	994.2
5/1600	36.9	50.8	250/45	996.2
5/1700	36.9	51.0	270/45	996.9
5/1800	36.8	51.3	270/48	997.8
5/2000	36.8	51.9	290/46	1001.5
5/2100	36.8	52.1	290/45	1002.5
5/2200	36.7	52.5	290/45	1003.6
5/2300	36.7	52.8	290/45	1004.6
6/0000	36.7	53.1	270/45	1006.2
6/0100	36.7	53.4	270/45	1007.5
6/0200	36.6	53.7	270/45	1008.2
6/0300	36.6	54.1	270/40	1009.0
6/0600	36.6	55.2	230/18	1009.2

Based on the observations from the **Tellus** and satellite microwave data indicating the system was warm-core, the TPC/NHC wrote the first advisory on Hurricane Noel at 1500 UTC 5 November (Figure 2). After this time, Noel continued northward and weakened to a tropical storm later that day. It became extratropical about 285 nmi southeast of Cape Race, Newfoundland on 6 November and was soon absorbed into another extratropical low.

The TPC normally requests in its Forecast/Advisories that all ships with 300 nmi of a tropical cyclone send three-hourly observations. Increased observations (three-hourly and hourly) are also useful when a tropical cyclone is first forming regardless of whether it forms from a non-tropical low or a tropical disturbance, or when the observed weather is significantly different than indicated in forecast or analysis products.

The 2002 Hurricane Season

The 2002 hurricane season begins in the eastern Pacific on 15 May and in the Atlantic on 1 June. Both seasons run through 30 November. The names for this season's storms are listed in the table below.

Hurricane Names for the 2002 Hurricane Season			
Atlantic		Eastern Pacific	
Arthur	Lili	Alma	Marie
Bertha	Marco	Boris	Norbert
Cristobal	Nana	Christina	Odile
Dolly	Omar	Douglas	Polo
Edouard	Paloma	Elida	Rachel
Fay	Rene	Fausto	Simon
Gustav	Sally	Genevieve	Trudy
Hanna	Teddy	Hernan	Vance
Isidore	Vicky	Iselle	Winnie
Josephine	Wilfred	Julio	Xavier
Kyle		Kenna	Yolanda
		Lowell	Zeke

Significant Weather of the Period

A. Tropical Cyclones: Twelve tropical cyclones occurred in the Atlantic basin during the summary period, making this one of the most active September-December periods ever. These included one tropical depression, two tropical storms, and nine hurricanes. Four of the hurricanes reached Category 3 or higher on the Saffir-Simpson Hurricane Scale. The eastern North Pacific basin produced ten tropical cyclones, including one tropical depression, four tropical storms and five hurricanes, with Hurricane Juliette reaching Category 4 status on the Saffir-Simpson scale.

1. Atlantic

Hurricane Erin: Erin formed from a tropical wave on 1 September and quickly became a tropical storm about 660 miles west-southwest of the Cape Verde Islands (Fig. 2). It moved west-northwestward over the next few days, with maximum sustained winds reaching 50 kt on 3 September. After that, westerly wind shear caused the cyclone to weaken to an area of disturbed weather about 400 miles east of the northern Leeward islands on 5 September. The shear then decreased and a new center formed the next day about 475 miles north-northeast of the northern Leeward Islands. The reborn Erin moved north-northwestward and strengthened into a tropical storm on 7 September and to a hurricane on 8 September. It passed about 90 nmi east of Bermuda on the 9 September just before maximum winds peaked at 105 kt (Fig. 3). After a slow recurvature from 11 to 13 September, Erin accelerated northeastward and passed near Cape Race on the 14 September at just below hurricane strength. It became extratropical shortly thereafter.

Several ships encountered Erin, with the most notable observation

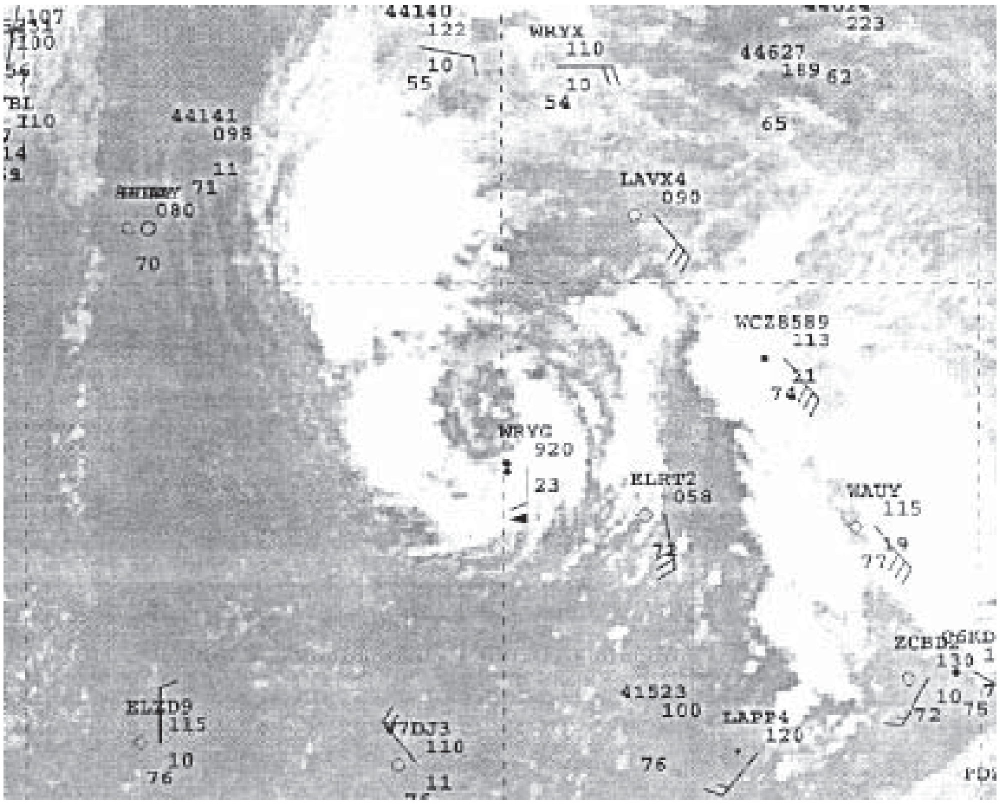


Figure 1. GOES-8 infrared image of hurricane Noel at 1145 UTC 5 November 2001 with 1200 UTC ship observations overlaid on the imagery.

coming from the **Semyonovosk** (UCTR) which reported 48kt winds at 1500 UTC 14 September. Also noteworthy was data from the **Sealand Pride** (WDA367) which intermittently reported tropical storm winds from 1200 UTC on 12 September to 0000 UTC on the 14 September. Other significant ship observations in Erin are included in Table 2.

Erin brought strong winds and heavy rains to portions of southeastern Newfoundland, with Cape Race reporting 46-kt sustained winds and gusts to 58 kt at 0200 UTC 15 September. Bermuda reported a gust to 36 kt. There are no reports of damages or casualties.

Hurricane Felix: A tropical wave developed into a tropical depression on 7 September southwest of the Cape Verde Islands (Fig. 2). Late on 8 September, the westward-moving depression encountered strong shear and weakened to a tropical wave. As the wave continued westward, the shear relaxed enough to allow a new center to form early on 10 September about 1000 miles east of the Lesser Antilles. This made the system the season's fourth topical cyclone to dissipate in the deep tropics and then regenerate. The depression tracked steadily west-northwestward and became Tropical Storm Felix on 11 September. During the next two days Felix turned northwestward and then northward, becoming a hurricane late on 12 September. Maximum winds reached 100 kt as Felix curved northeastward late on 13 September. Slow weakening occurred thereafter. Felix turned eastward on 15 September and continued this motion until it weakened back to a tropical storm on 17 September, at which time it stalled about 350 miles southwest of the Azores. Increasing shear and cooler waters caused Felix to weaken to a depression early on 18 September and to dissipate

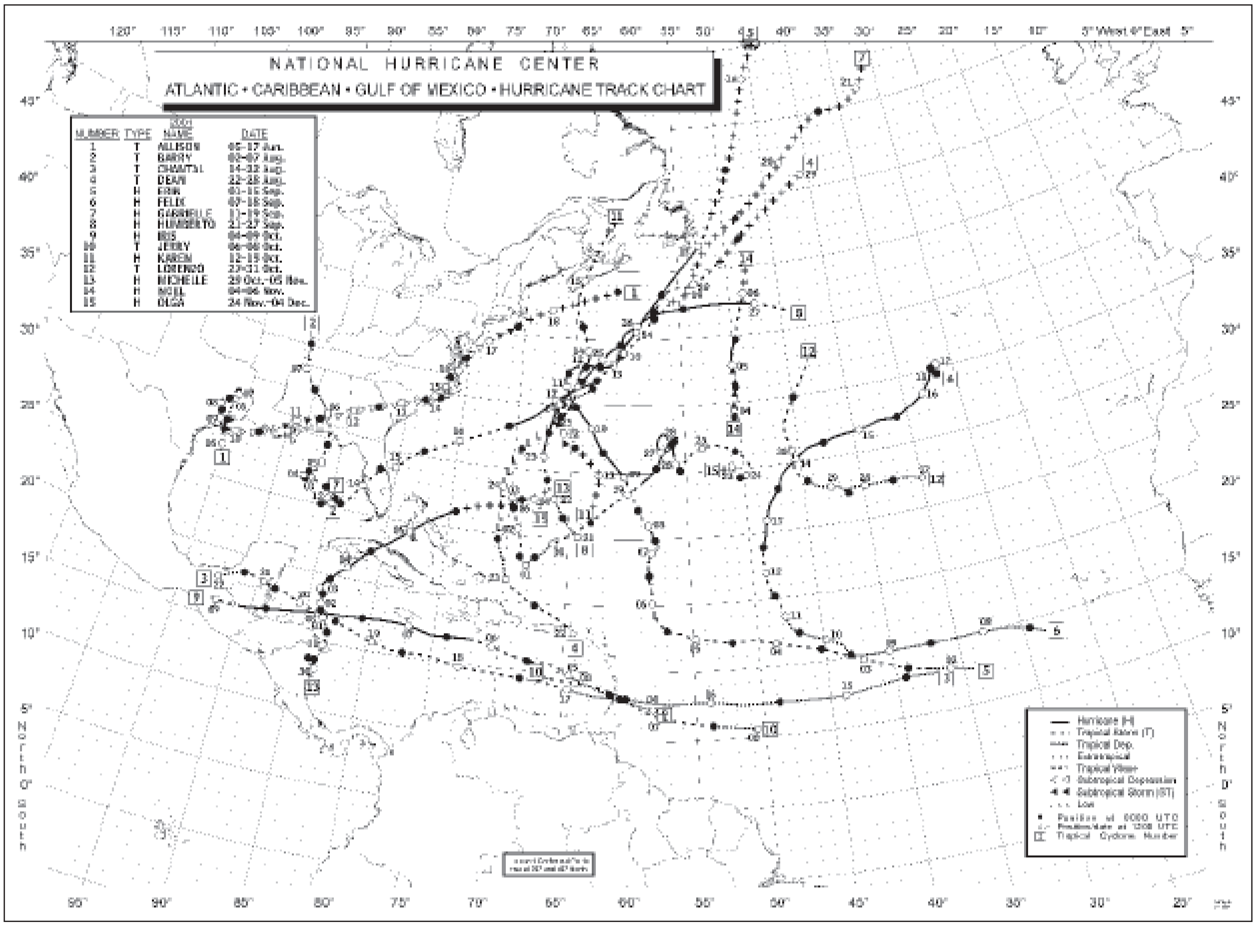


Figure 2 - Atlantic tropical storms and hurricanes of 2001.

later that day about 400 miles southwest of the Azores.

Only a few ships encountered Felix. The **LTC Calvin P. Titus** (KAKG) reported 35 kt winds at 1800 UTC on 16 September, while the **Nariva** (C6PW2) reported 34 kt winds at 1200 UTC on 17 September. There were no reports of damages or casualties.

Hurricane Gabrielle: Gabrielle formed over the southeastern Gulf of Mexico on 11 September from a non-tropical low (Fig. 2). It looped slowly for two days before moving northeastward on 13

Table 2 - Selected ship and buoy observations of 34 kt or greater winds for Hurricane Erin, 1-15 September, 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (hPa)
4/0200	Drifting Bouy 41559	17.2	48.9	090/41	1009.0
9/1800	**Irving Primrose/** 8POI	32.5	59.7	140/34	1017.3
9/1800	**Artisgracht/PCUI**	32	65	/35	N/A
13/0000	**Sealand Pride/** WDA367	36.1	60.6	230/43	1004.0
13/0000	**Lykes Navigator/** WGMJ	36.4	65.7	360/34	1010.8
14/0000	**Lykes Navigator/** WGMJ	36	66	/35	N/A
14/1500	**Semyonovosk/** UCTR	43.2	51.7	230/48	1006.0

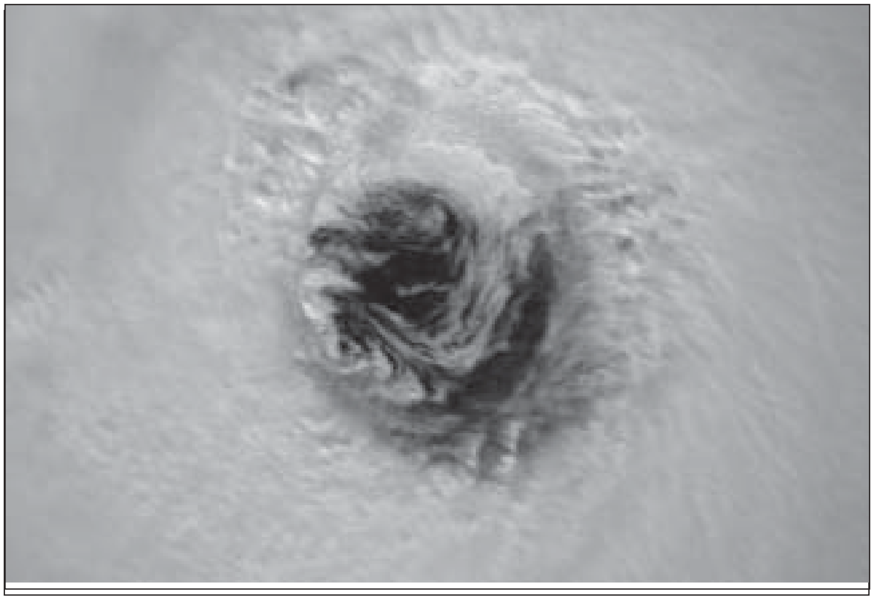


Figure 3 - Close-up of image of Hurricane Erin with winds peaked at 105 kt. Image is MODIS data acquired by direct broadcast from the NASA Terra spacecraft at the Space Science and Engineering Center, University of Wisonsin-Madison.

September as it became a tropical storm. Gabrielle moved inland near Venice, Florida on 14 September as a tropical storm with 60-kt tropical storm winds. After meandering across the Florida Peninsula, the storm moved northeastward into the Atlantic near Cape Canaveral on 15 September. Gabrielle continued northeastward and became a hurricane with 70-kt winds on 17 September while located about 250 miles north of Bermuda. It weakened to a tropical storm on 18 September and became extratropical the next day about 330 miles south of Cape Race.

Even while it was a hurricane, Gabrielle had a large wind field similar to that of an extratropical low. Selected observations from some ships it affected are given in Table 3. The most significant observations were from the **KRPDD** (name unknown) which reported 58-kt winds at 0000 and 1800 UTC 16 September. Additionally, a buoy off the southwest Florida coast reported 44-kt sustained winds with a gust to 85 kt at 1210 UTC on 14 September. At the shore, the Coastal Marine Automated Network (C-MAN) station at St. Augustine, Florida reported 51-kt sustained winds with gusts to 65 kt, while a marine laboratory at New Pass, Florida also reported 51-kt sustained winds.

Gabrielle is blamed for one death and $230 million in damage in the United States.

Table 3. Selected ship and buoy observations of 34 kt or greater winds for Hurricane Gabrielle, 11-19 September, 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
13/1200	CZ523	24.0	83.5	170/35	1006.4
13/1800	Santa Maria/DCUW	25.3	83.9	160/45	1003.9
14/0600	El Yunque/WGJT	29.5	80.0	060/36	1008.0
14/1210	Fl COMPS NA2	27.2	82.9	360/44	N/A
14/1800	Nedlloyd Holland/ KRHX	28.1	80.1	180/37	1000.5
15/1800	Lykes Discoverer/ WGXO	30.4	80.4	030/40	1003.0
16/0000	WPGJ	29.5	80.1	050/37	1006.5
16/0000	Shanghai Express/ DGSE	30.5	78.5	360/49	999.0
16/0000	Lykes Discoverer/ WGXO	31.4	79.9	010/48	1006.0
16/0000	Galveston Bay/ WPKD	32.5	78.7	030/50	1006.8
16/0000	KRPDD	32.7	74.2	080/58	1008.1
16/0600	P&O Nedlloyd Auckland/PDHW	32.7	77.7	050/43	1007.0
16/0600	Transworld Bridge/ ELJJ5	33.2	77.8	010/44	1009.0
16/1200	KS004	24.9	75.4	280/45	N/A
16/1800	KRPDD	32.8	68.3	140/58	1009.1
16/1800	Queensland Star/ MZBM7	34.1	73.1	040/40	1003.1
17/0000	Sealand Hawaii/ KIRF	29.3	69.8	200/36	1009.2
17/1800	Archangelgracht/ PCTG	34.6	60.6	200/39	1006.9
18/1200	Chesapeake Bay/ WMLH	41.4	57.2	100/36	1005.0
18/1200	Faust/WRYX	33.2	66.0	260/35	1009.0
18/1800	Chesapeake Bay/ WMLH	41.4	59.7	090/35	984.5

Tropical Depression Nine: A tropical wave moving through the Caribbean spawned a tropical depression about 50 nmi north-northwest of San Andres Island on 19 September (Fig. 4). The system moved west-northwestward and made landfall near Puerto Cabezas, Nicaragua early on 20 September. It dissipated over land later that day, and there were no reports of damages or casualties.

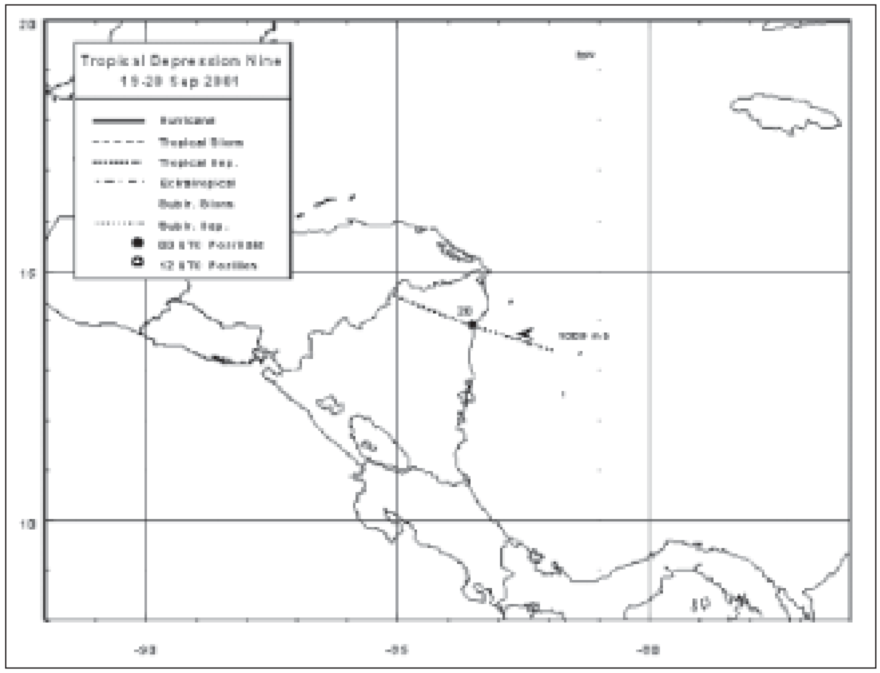


Figure 4 - Best track of Tropical Depression Nine, 19 - 20 September 2001.

Hurricane Humberto: Humberto had an unusual origin in that it formed from a trough extending southwestward from Gabrielle. The cyclone developed on 21 September about 490 miles south of Bermuda (Fig. 2). It moved northwestward and strengthened into a tropical storm on 22 and 23 September. On 23 September Humberto gradually turned northward and became a hurricane, passing about 140 miles west of Bermuda. Winds reached 85 kt early on 24 September, followed by some weakening while Humberto turned northeastward. The cyclone unexpectedly re-intensified on 26 September, and maximum winds reached 90 kt while Humberto was centered about 200 miles south-southeast of Sable Island, Nova Scotia. The hurricane turned eastward and weakened to a tropical storm on 27 September. Humberto became extratropical later that day, and the remnant circulation was eventually absorbed by a larger low over the far north Atlantic.

Ships generally avoided Humberto. The **Sealand Expedition** (WPGJ) and the **Onejskyi** (UCTI) reported 37-kt winds at 1800 UTC 23 September and 1200 UTC 27 September, respectively. Bermuda reported a gust to 37 kt. There were no reports of damages or casualties.

Hurricane Iris: Iris developed from a tropical wave near the Windward Islands on 4 October (Fig. 2). Moving west-northwestward into the Caribbean Sea, it became a tropical storm on 6 October. Iris turned westward and reached hurricane status on 7 October just south of the Barahona Peninsula of the Dominican Republic. The hurricane passed near the southern coast of Jamaica later that day, before rapidly intensifying while crossing the western Caribbean. Maximum winds reached 125 kt just before landfall near Monkey River Town in southern Belize on the evening of 8 October. Iris weakened rapidly after landfall and dissipated over eastern Mexico on 9 October.

Although Iris was a Category 4 hurricane on the Saffir-Simpson scale at landfall, the core was very small with hurricane force winds extending no more than 25 nmi from the center. Tropical-storm force winds generally extended no more than 100 nmi from the center. No ships reported tropical storm winds from Iris. However, a marine tragedy occurred at landfall when the **M/V**

Wave Dancer capsized in harbor near Big Creek, Belize with the loss of 20 lives.

Iris caused severe damage from winds and an 8- to 15-ft storm surge within a 60 nmi wide area of southern Belize. Including those on the **Wave Dancer**, Iris was responsible for 31 deaths, and damage in Belize was estimated at $66 million.

Tropical Storm Jerry: Jerry developed from a tropical wave on 6 October about 540 nmi east-southeast of Barbados (Fig. 2). Moving west-northwestward, it reached tropical storm strength later that day. Jerry moved through the Windward Islands at its maximum intensity of 45-kt winds on 7 and 8 October. The system then became disorganized in the eastern Caribbean Sea and dissipated late on 8 October.

There are no ship reports of tropical-storm-force winds from Jerry. The town of Caravelle on Martinique reported 39 kt sustained winds with gusts to 50 kt on 8 October. There were no reports of damages or casualties.

Hurricane Karen: A frontal system stalled about 200 nmi southeast of Bermuda on 10 October. A low formed on the front early on 11 October, and the low became a strong subtropical storm as it tracked northwestward just southwest of Bermuda early the next day (Fig. 2). The storm turned northward later that day. The cyclone then became better organized, transforming into Tropical Storm Karen early on 13 October and progressing to hurricane status later that day. Karen moved generally northward for the next 2 days, with maximum winds reaching 70 kt early on 14 October. It made landfall in western Nova Scotia on 15 October as a 40-kt tropical storm and became extratropical while moving toward western Newfoundland, where it merged with a large mid-latitude low pressure system.

The **Nordic Empress** (ELJV7) was anchored at Bermuda while the subtropical storm passed and reported 79-kt sustained winds with a gust to 103 kt at the anemometer height of 153 ft. The ship also reported a 991.0 mb pressure. Other ship observations for hurricane Karen are included in Table 4.

Official land observations on Bermuda included 58-kt sustained winds with gusts to 78 kt. There were unofficial reports of sustained winds near 65 kt with gusts to 85 kt. These winds caused tree and power line damage, leaving more than 23,000 people without power and causing the **Norwegian Majesty** to break anchor at the height of the storm. Cape George, Nova Scotia reported 41-kt sustained winds with a gust to 56 kt when Karen made landfall.

Tropical Storm Lorenzo: Lorenzo formed from a non-tropical low in the eastern Atlantic that developed on 26 October. The low became a tropical depression on 27 October about 850 miles southwest of the Azores and moved slowly westward (Fig. 2). Late on 29 October it reached minimal tropical storm strength about 1250 miles west-southwest of the Azores. Lorenzo turned to the northwest and then to the north on 30 October with little change in strength. Accelerating rapidly to the north-northeast early on 31 October, Lorenzo lost tropical characteristics ahead of an approaching cold front about 700

Table 4 - Selected ship observations of 34 kt or greater winds associated with Hurricane Karen, 12-15 October 2001.Best track of Tropical Depression Nine, 19 - 20 September 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
11 / 2317	Nordic Empress/ ELJV7[13]	32.3	64.8	111 / 79G103	991.0
12 / 1500	Zenith/ELOU5	34.8	71.3	030 / 38	1015.0
13 / 1800	Taiko/LAQT4	37.5	66.9	060 / 35	
14 / 1200	Royal Princess/ GBRP	48.4	62.0	180 / 39	1027.7
15 / 0000	P&O Nedlloyd Auckland/PDHW	38.2	61.5	210 / 37	1015.8
15 / 1800	Royal Princess/ GBRP	42.2	59.9	180 / 37	1017.9

miles west of the Azores. There were no reliable reports of tropical-storm-force winds from Lorenzo, and there were no reports of damages or casualties.

Hurricane Michelle: This classic late-season hurricane started as a broad low associated with a tropical wave in the southwestern Caribbean Sea on 27 October. It developed into a tropical depression on 29 October along the east coast of Nicaragua (Fig. 2). The depression then moved inland and meandered over northeastern Nicaragua for two days. Late on 31 October it moved into the northwestern Caribbean Sea and became Tropical Storm Michelle. The cyclone moved slowly north-northwestward for the next two days as it strengthened into a hurricane. The hurricane turned slowly northward on 3 November (Fig. 5), with an Air Force Reserve Hurricane Hunter aircraft measuring a central pressure of 933 hPa. Michelle turned northeastward on 4 November as maximum winds reached 120 kt. Later that day it hit western Cuba as a Category 4 hurricane on the Saffir-Simpson Hurricane Scale. A weakening Michelle continued northeastward through the Bahamas on 5 November and became extratropical over the southwestern Atlantic on 6 November. The system was absorbed by a cold front late that day.

Several ships encountered the large circulation of Michelle. The most significant observations were from the **Scan Partner** (call sign unknown) and the **ELWU7** (name unknown). The **Scan Partner** passed near the center of Michelle at 0730 UTC 2 November and reported 34-47 kt winds and a 988.0 mb pressure. The **ELWU7** reported 60-kt winds and a 995.0 mb pressure at 1200 UTC on 5 November. Other significant ship and buoy observations are included in Table 5.

Michelle was the strongest hurricane to hit Cuba since 1952 and left a trail of damage and death from Central America to the Bahamas. Cayo Largo, Cuba reported 108-kt sustained winds with gusts to 115 kt, along with a 9- to 10-ft storm surge that reportedly innudated the entire island. Nassau, Bahamas reported a peak gust of 89 kt. Winds of 35 to 45 kt occurred over portions of south Florida. In addition to the main storm surge, above normal tides and battering waves occurred in portions of Cuba, the Bahamas, the Cayman Islands, and south Florida. Seventeen deaths are associated with the hurricane, including 6 in Honduras, 5 in Cuba, 4 in Nicaragua, and 2 in Jamaica. Widespread severe damage occurred across western and central Cuba, with additional damage over portions of Central America, the Cayman Islands, Jamaica, and the Bahamas.

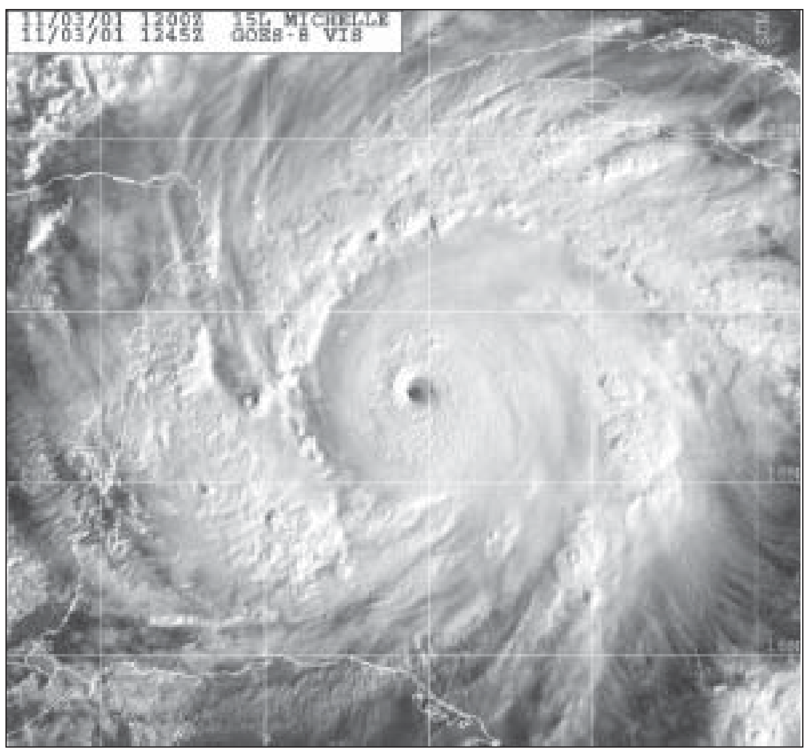


Figure 5 - GOES-8 visible image of Hurricane Michelle at 1245 UTC 3 November. Image courtesy of the Naval Research Laboratory, Monterey, CA.

Table 5 - Selected ship and buoy observations of 34 kt or greater winds for Hurricane Michelle, 29 October - 5 November, 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
01/1800	**Jo Cedar**/PFDI	18.2	81.6	100/37	1007.0
02/0730	**Scan Partner**/ (unknown)	17.5	84.1	See Note	988.0
04/0600	C6FN5	24.0	79.3	070/42	1006.0
04/0900	**Star Florida**/ LAVW4	24.2	81.5	060/37	1007.2
04/1500	**Nobel Star**/KRPP	24.1	83.6	050/39	1008.0
04/1800	**Emmagracht**/PDYX	23.6	81.1	080/39	1003.0
04/1800	C6QU3	18.0	81.1	240/34	1004.0
05/1200	ELWU7	25.3	75.9	050/60	995.0
05/1200	**Nedlloyd Van Nes**/ ELVG7	26.7	79.6	050/48	1003.5
05/1900	Drifting Buoy 41651	24.3	75.4	N/A	986.7
06/0200	ELWX5	20.3	68.0	190/38	1006.9
06/0600	**Washington Senator**/DEAZ	29.7	77.3	020/37	1011.8
06/0600	**Liberty Star**/WCBP	23.1	72.5	270/40	1003.2

Hurricane Noel: The story of Noel is found above. A few ships besides the **Tellus** encountered the storm, and their reports are included in Table 6. There were no reports of damages or casualties from Noel.

Hurricane Olga: Olga originated from yet another non-tropical low over the central Atlantic. The low formed on 22 November, and by 24 November it had sufficiently organized convection to be classified a subtropical storm about 780 nmi east-southeast of Bermuda (Fig. 2). The storm moved northwestward to westward for a day or so as it acquired full tropical characteristics. It became a hurricane about 435 nmi east of Bermuda on 26 November. Olga made two loops from 26 to 28 November, during which time maximum winds reached 80 kt. It then moved southwestward, weakening to a tropical storm on 29 November and a depression on 30 November. Olga turned northwestward late on 1 December. It then turned north-northwestward and regained tropical storm strength on 2 November. The cyclone turned eastward on 3 November and again weakened to a depression the next day. It dissipated later that day about 600 nmi east of Nassau.

Olga's extratropical origin resulted in a large wind field which affected many ships. Selected observations are given in Table 7. The most significant reports were from the sailing yacht **Manana Tres** (call sign unknown), which indicated the system had formed a strong inner core, and from the **Liberty Sun** (WCOB), which passed near the center just before Olga became a hurricane.

The only known damage from Olga was to the **Manana Tres**, which reported "lots of damage." Swells generated by Olga affected portions of the U. S. east coast, the Bahamas, and the northeastern Caribbean islands.

2. Eastern Pacific

Hurricane Gil and Tropical Storm Henriette: These two storms developed almost simultaneously and eventually interacted with each other. Gil formed from an area of disturbed weather associated with the southern portion of the tropical wave which spawned Dean in the Atlantic. The disturbance moved westward across Central America

Table 6 - Selected ship or buoy reports with winds of at least 34 kt for Hurricane Noel, 4-6 November 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
04/0000	Grafton/ZCBO5	31.8	47.1	150/35	1005.5
06/0000	**Polar Argentina**/ ELRT2	36.5	49.4	260/37	1005.0
06/0900	P6038	46.4	48.4	120/35	1010.2
06/1200	Buoy 44145	46.7	48.7	140/46	1008.4

Table 7 - Selected ship reports with winds of at least 34 kt for Hurricane Olga, 24 November - 4 December, 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
24/0600	Irving Primrose/ 8POI	34.2	52.2	040/45	1012.5
24/0900	Manana Tres	29.5	51.0		989.0
24/1200	Liberty Sun/WCOB	33.1	58.4	350/36	
24/1200	ELWZ7	26.3	54.2	320/43	1009.0
24/1200	Dorothea Schulte/ LAPP4	32.6	49.1	070/39	1005.0
24/1200	Irving Primrose/ 8POI	34.2	53.8	040/45	1013.5
25/0900	Lykes Liberator/ WGXN	37.4	52.7	050/47	1013.5
25/1800	Liberty Sun/WCOB	30.8	56.1	360/55	990.0
25/2100	Liberty Sun/WCOB	30.1	55.8	340/38	983.5
26/0000	Liberty Sun/WCOB	29.7	55.5	270/31	981.4
26/0600	Liberty Sun/WCOB	30.1	54.5	275/45	990.0
26/0900	Liberty Sun/WCOB	30.4	53.9	170/29	993.0
26/1200	Liberty Sun/WCOB	30.7	53.4	160/38	995.0
26/1200	Safmarine Infanta/ V7CN8	24.1	58.2	320/37	1004.0
26/1500	V7CR4	32.4	55.8	090/39	986.0
26/1800	V7CR4	32.6	56.3	090/39	985.5
29/1800	Sabina/HBEB	26.7	62.2	340/34	1001.2
29/1800	City of Alberni/8PNI	27.2	65.5	020/35	1008.0

on 24 August, but it did not become a tropical depression until 4 September when it was located about 850 nmi southwest of Cabo San Lucas, Mexico (Fig. 6). On the same day, early morning visible satellite images indicated that another circulation was organized enough to be classified as a tropical depression about 300 nmi west-southwest of Manzanillo, Mexico. This was about 765 nmi east of Gil. Gil reached hurricane intensity with maximum winds of 85 kt on 6 September, while Henriette strengthened to a peak of 55 kt on 7 September. Initially, Gil moved westward but Henriette moved faster and passed to the north of Gil. The two cyclones began to rotate around each other on 7 September. Henriette became absorbed by the circulation of Gil and dissipated on 8 September. However, its remnant disturbance made a counterclockwise loop of Gil over the ensuing 24 hours. Gil's circulation persisted a little bit longer but gradually weakened and dissipated on 9 September about 1150 miles east of the Hawaiian Islands.

The combination of Gil and Henriette created a large area of southwesterly and southerly winds to the east and southeast of the cyclones. The ship **Pacific Highway** reported 40 kt winds and 22 ft seas at 0000 UTC 7 September in this flow while about 205 nmi southeast of the center of Gil.

Tropical Storm Ivo: Ivo first formed about 100 nmi south-southwest of Acapulco on 10 September (Fig. 6). It moved slowly west-northwestward through its lifetime with its circulation hugging the coast. The cyclone became a tropical storm on 11 Septemberand reached a peak intensity of 45 kt on 12 September. It then weakened to a depression on 14 September and dissipated the next day about 300 nmi west of Baja California.

The ship **ZDEB2** (name unknown) reported 37 kt winds at 0600 UTC 12 September, which was the basis for upgrading Ivo to a tropical storm. Although tropical-storm force winds occurred along portions of the coast of Mexico, there were no reports of damages or casualties.

Hurricane Juliette: This large and powerful hurricane was the only eastern Pacific cyclone to make landfall during 2001. Juliette formed from the remnants of Atlantic Tropical Depression Nine, which entered the Pacific on 20 September. The system organized into a depression about 90 nmi south of the coast of Guatemala on 21 September and reached tropical storm strength later that day (Fig. 6). Juliette moved west-northwestward about 100-200 nmi from the coast of Mexico from 21 to 26 September. It became a hurricane on 23 September and reached a peak intensity of 125 kt on 25 September (Fig. 7). On that date, an Air Force Reserve Hurricane Hunter aircraft measured a central pressure of 923 hPa, the second lowest measured pressure of record in the eastern Pacific. Juliette turned northward and began to weaken on 26 September. It passed just west of Cabo San Lucas as a hurricane with 80 kt winds on 28 September and made landfall on the Baja California peninsula near San Carlos as a tropical storm with 35-kt winds on 30 September. Juliette continued slowly northward as a depression into the Gulf of California and eventually dissipated over the northern portion of the Gulf on 3 October.

The large circulation of Juliette affected several ships. Selected significant observations are shown in Table 8. The most significant observation was from the **Zim Atlantic** (4XFD), which reported 55-kt winds at 0600 UTC 28 September.

Table 8 - Selected ship reports with winds of at least 34 kt for Hurricane Juliette, 23-28 September 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
24/0000	**Nedlloyd Raleigh Bay**/PHKG	12.9	108.6	280/39	1007.0
24/0000	**Palmsatr Rose**/ C6JM8	12.7	103.9	270/40	1009.0
26/0000	**Ever Devote**/3FIF8	19.0	104.5	110/40	1007.5
26/0000	**Sealand Comet**/ V7AP3	11.5	107.0	210/34	1005.7
26/1200	CY414	11.4	111.9	240/36	1008.0
26/1200	**Sealand Comet**/ V7AP3	12.5	110.9	220/45	1007.0
27/0600	**Sirius Leader**/H3KF	17.0	110.9	240/36	1005.0
28/0000	**Providence Bay**/ MSTM6	22.9	111.5	030/45	988.3
28/0000	**Zim Atlantic**/4XFD	23.2	111.3	040/53	993.0
28/0600	**Zim Atlantic**/4XFD	22.7	112.7	320/55	997.0
29/1800	**Chiquita Frances**/ ZCBD9	19.9	112.7	270/37	1007.6

On shore, Cabo San Lucas reported sustained winds of 76 kt with a gust to 94 kt at 0000 UTC 30 September. Two deaths are attributed to Juliette: a fisherman near Acapulco whose boat capsized in high seas, and a surfer who drowned near the Baja California coast. According to Mexican news agency reports, Juliette "clobbered' the resort of Cabo San Lucas, isolating it for several days. Flooding in the state of Sonora drove more than 38,000 people from their homes. Moisture from Juliette produced thunderstorms in southern California on 30 September, knocking down trees and power lines across the Coachella Valley.

Hurricane Kiko: A portion of the tropical wave that spawned Atlantic Hurricane Felix likely spawned Kiko. The cyclone formed on 21 September about 550 nmi southwest of Cabo San Lucas (Fig. 6). Moving generally west-northwestward to westward, the cyclone became a tropical storm later that day and briefly became a hurricane with 65-kt

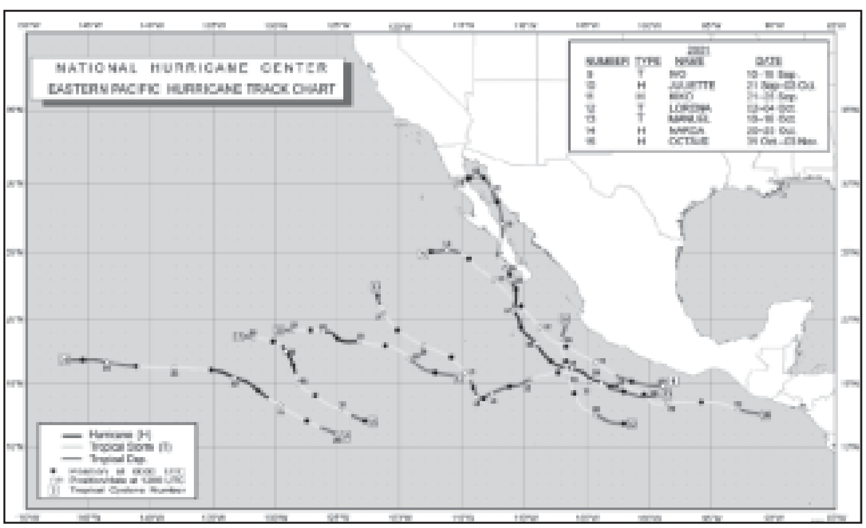


Figure 6 - Eastern North Pacific tropical storms and hurricanes of 2001.

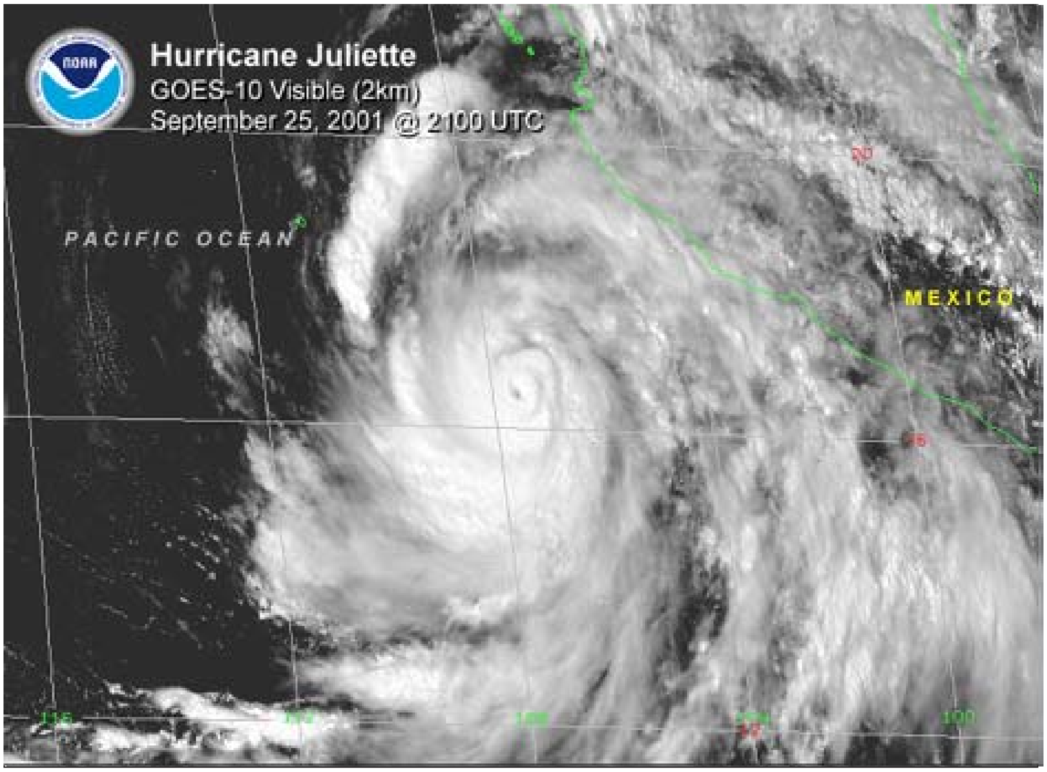


Figure 7 - GOES-10 visible image of Hurricane Juliette near peak intensity at 2100 UTC 25October 2001. Image courtesy of the National Climatic Data.

winds on 23 September. Kiko weakened to a depression on 25 September and degenerated into a low cloud swirl later that day near 19oN. 129oW. There were no reports of damages, casualties, or tropical-storm-force winds.

Tropical Storm Lorena: A tropical wave that crossed into the Pacific on 27 September organized into a tropical depression on 2 October about 300 nmi south of Acapulco, Mexico (Fig. 6). The cyclone moved west-northwestward and became Tropical Storm Lorena later that day. Lorena turned north-northwestward on 3 October as it reached a peak intensity of 50-kt winds. The storm appeared to be a threat to the coast of Mexico at that time; however, strong vertical shear caused rapid weakening, and Lorena became a weak low on 4 October about 120 nmi southwest of Puerto Vallarta, Mexico.

The ship **ELXX7** (name unknown) reported 35-kt winds at 1730 UTC 3 October, while an unidentified ship reported 35-kt winds a half-hour later. There were no reports of damages or casualties.

Tropical Depression Fourteen-E: This short-lived system formed on 3 October about 800 nmi southwest of Cabo San Lucas. Maximum winds reached 30 kt before the system dissipated the next day.

Tropical Storm Manuel: Manuel formed from the remnants of Atlantic Hurricane Iris. While Iris dissipated over Central America on 9 October, a new circulation center formed over the adjacent Pacific. This system became organized into a tropical depression on 10 October about 175 nmi south of Acapulco (Fig. 6). After becoming a tropical storm on 11 October, it moved westward to west-southwestward away from Mexico and weakened to a tropical depression on 12 October. Manuel then turned northwestward and regained tropical storm status on 15 October. It strengthened to its peak intensity of 50 kt on 16 October a little over 520 nmi south-southwest of Cabo San

Lucas. Weakening occurred thereafter, with Manuel becoming a depression again on 17October and dissipating about 660 nmi west-southwest of Cabo San Lucas the next day. There were no reports of damages, casualties, or tropical-storm force winds.

Hurricane Narda: Narda formed about 1150 nmi southwest of Cabo San Lucas on 20 October (Fig. 6). It became a tropical storm later that day and a hurricane with 75 kt winds on 22 October while moving west-northwestward. Narda then turned westward and weakened, becoming a tropical storm on 23 October and a depression on 24 October. Strong vertical wind shear caused the tropical cyclone to dissipate about 520 nmi east-southeast of the Hawaiian Islands on 25 October. There were no reports of damages, casualties, or tropical-storm-force winds.

Hurricane Octave: Octave developed from a large area of disturbed weather about 1000 nmi southwest of Cabo San Lucas on 31 October (Fig. 6). The west-northwestward moving cyclone became a tropical storm later that day and a hurricane on 1 November. Octave turned northwestward and reached a peak intensity of 75 kt on 2 November before weakening to a tropical storm later that day. On 3 November, the system turned westward and weakened to a depression, and it dissipated later that day about 1300 nmi west-southwest of Cabo San Lucas. There were no reports of damages, casualties, or tropical-storm-force winds.

B. Other Significant Events:

1. Atlantic, Caribbean and Gulf of Mexico

West Atlantic Gale 30 September: An early season cold front became stationary on 26 September from the western Atlantic across south central Florida to the Bay of Campeche. Winds increased late on 28 September across the Gulf of Mexico and western Atlantic as a low pressure center formed along the front just north of the Yucatan Peninsula. At 1200 UTC 29 September, a 1005 mb low was analyzed near the Dry Tortugas, Florida. The low moved northeastward across south Florida and by 0000 UTC 30 September was located just east of Palm Beach, Florida. It continued northeastward and produced a brief period of gales off the Georgia and north Florida coasts. The ship **A. V. Kastner** (ZCAM9) reported northeast winds of 35 kt at 0000 UTC 30 September. By 1200 UTC the low center was near 31°N. 70°W., and gales had moved north of 31°N. Since no QuikScat data were available due to the short duration of the event, the ship observations were extremely useful in determining the magnitude of the winds.

Northwest Caribbean Gale 29-31 October: A cold front that moved off the coast of Texas on 25 October reached the northwestern Caribbean on 27 October. The front moved slowly southeast across the Gulf on 26 October, and by 1200 UTC that day, a strong 1037 hPa high was located well northwest of the front over the central United States. Northeast winds increased to 20-25 kt across the northwest Caribbean behind the front. On 28 October, the front was stationary across the northwestern Caribbean while a broad low pressure area (the precursor of Hurricane Michelle) strengthened over the southwestern Caribbean Sea. By 1200 UTC on 29 October, winds increased to gale force from 16°N. to 20°N. between 78°W and 85°W. At that time the ship **Chiquita Schweiz** (C6KD9) reported 34-kt winds and 4-m (13-ft) seas near 18°N. 80°W. Later that day the broad low became a tropical depression (Fig. 2). Gale-force winds were associated with the stationary front located well north of the depression. QuikScat data from just before 0000 UTC 30 October indicated a large area of 30-40 kt winds over the northern Caribbean. The area of gale-force winds spread northeastward, and by 1200 UTC on 30 October covered the entire Caribbean north of 18°N. At that time **Chiquita Schweiz** again observed gale force winds of 40 kt near the Windward Passage. By 1200 UTC 31 October, the high pressure over the eastern United States began to weaken and move northeastward. This weakened the pressure gradient over the northwestern Caribbean and winds decreased below gale force.

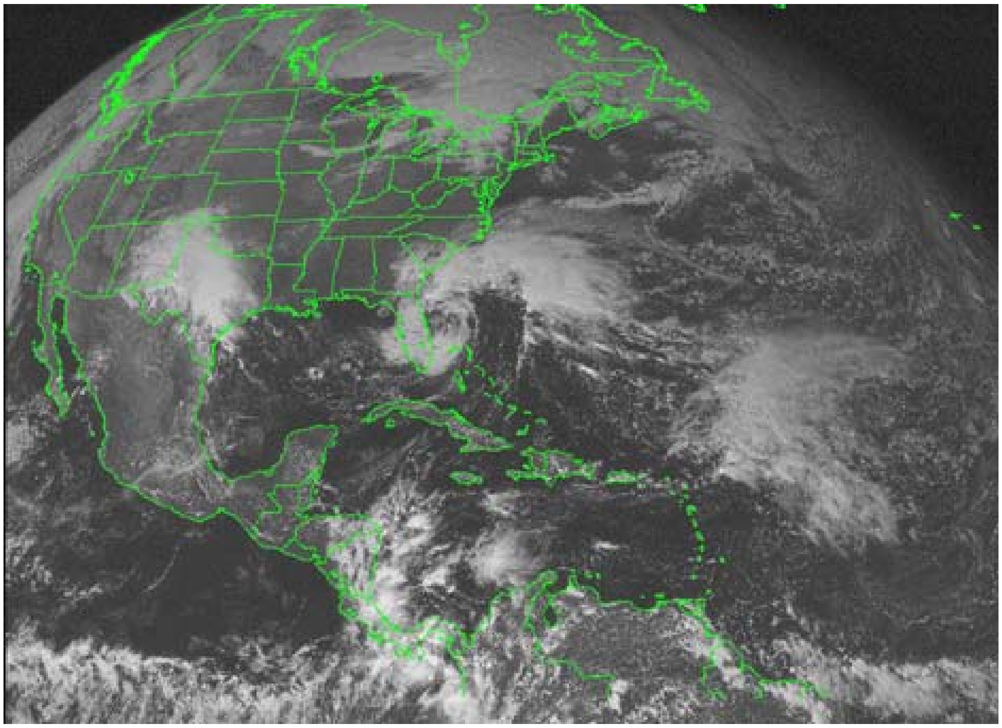


Figure 8 - GOES-8 visible image of western Atlantic gale at 1815 UTC 15 November 2001. Image courtesy of the National Climatic Data Center.

However, winds in that area soon increased with the approach of Michelle.

Central Atlantic Gale 3-4 November: This event was associated with the low that eventually became Hurricane Noel. As the low intensified just north of the TPC high seas forecast area on 2 November, the winds increased to gale force over the area north of 29°N. between 45°W. and 55°W. At 0600 UTC that day the ship **Chiquita Schweiz** again encountered gale force winds of 36 kt near 29°N. 53°W. This helped confirm QuikScat data a short time later. By 1800 UTC that day, the low had strengthened into a storm center near 33°N.44°W. At that time the ships **Chiquita Schweiz, Endurance** (WAUU), and **Grafton** (ZCBO5) observed northeast winds of 35 to 40 kt near 30°N. 50°W. The storm center moved northwestward on 3 November. A QuikScat pass from 2108 UTC that day detected 30-35-kt winds north of 30°N. between 48°W. and 57°W. Gales ended south of 31°N by 1800 UTC on 4 November as the system turned northward.

West Atlantic Gale: 15-16 November: A weakening stationary front extended east to west across the western Atlantic, while a strong high pressure center located along the mid-Atlantic coast produced strong northeast to east winds north of the front. A low started forming on the western end of the front late on 14 November just east of central Florida. The low quickly strengthened and became a 1006 hPa gale center near 28°N. 80°W. at 0600 UTC on 15 November. At 0600 UTC, the **Tellus** and the **Kent Sprint** (VGDX) observed 40-kt winds off the north Florida and Georgia coasts. The ship observations confirmed a 1023 UTC QuikScat pass which showed an area of 30-40-kt easterly winds from 30°N. to 33°N. west of 72°W. At 1200 UTC, the ship **Lykes Discoverer** (WGXO) encountered northeast winds of 37 kt, while an unidentified ship reported 40-kt winds near 31°N. 78.5°W. GOES-8 visible satellite imagery at 1815 UTC 15 November (Fig. 8) showed the well-defined low just off the east-central Florida coast. The gale center drifted northeastward and weakened while the high pressure center off the mid-Atlantic coast moved east into the central Atlantic. By 0600 UTC on 16 November, gale conditions ended south of 31°N. but continued over the Marine Prediction Center's area north of 31°N. At 1800 UTC, the gale center weakened to a low near 29°N. 76°W., which eventually dissipated northeast of Puerto Rico on 21 November.

Gulf of Mexico Cold Front 29-30 November: A slow-moving cold front moved off the coast of southeast Texas around 0000 UTC 28 November. Early on 29 November, the front accelerated southeastward as stronger high pressure moved southward across the central United States. By 0600 UTC, the front extended from just east of Lake Charles, Louisiana to the southwestern Bay of Campeche. At that time northwesterly gale force winds began over the southwest Gulf of Mexico in the area south of 25°N. west of the cold front. The ship **Koeln Express** (9VBL) observed 37-kt winds at 1200 UTC and 33-kt winds at 1800 UTC in the southwest Bay of Campeche. The short-lived gale event ended at 0000 UTC 30 November.

Central and East Atlantic Gales 17-18 December and 23-26 December: A predominant longwave trough was over the central and east Atlantic during the later half of December. Several fast-moving cold fronts and gale centers moved southeastward, then eastward just north of 31°N., producing periods of gale force winds over the eastern portion of the TPC forecast area. Gales associated with the first system began at 0600 UTC 17 December. Gale conditions and seas of 4.5 to 6 m (15-20 ft) occurred over the TPC forecast area north of 29°N. east of 50°W. At 0600 UTC and 1200 UTC 17 December the ship **Chiquita Nederland** (C6KD6) encountered west to northwest 35 to 40-kt winds near 30°N. 45°W. A day later the ship **Coral Reef** (C6RO6) and the ship **C6RO2** (name unknown) experienced westerly gale force winds of 35-40 kt near 30°N. 45°W. at 0600 UTC and 1200 UTC. By 0000 UTC 19 December, gale conditions ended south of 31°N.; however, swells of 3.5-5.5 m (12-18 ft) continued north of 25°N. east of 55°W. through the rest of that day.

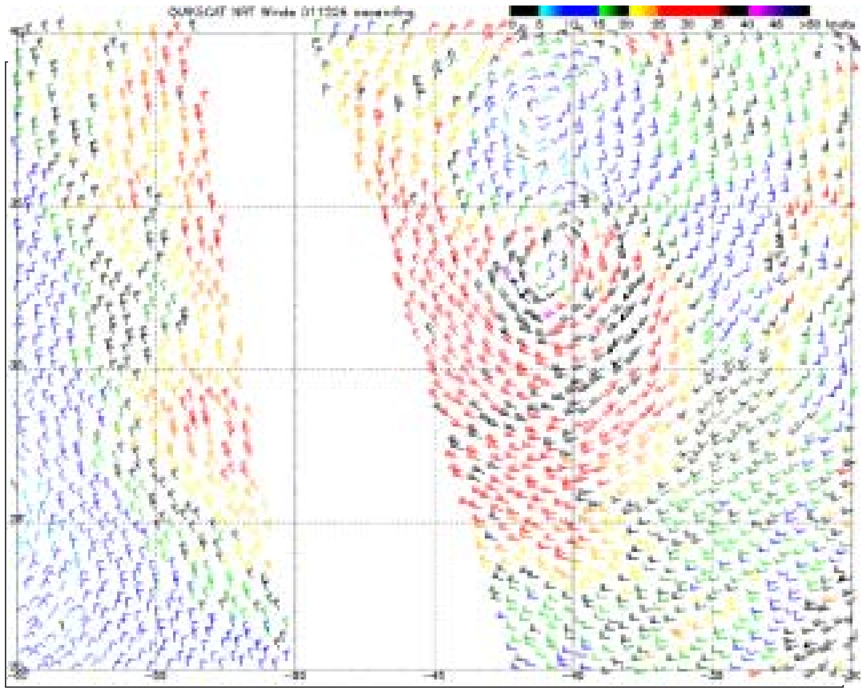


Figure 9 - QuikSCAT data at 0755 UTC 26 December 2001. Image courtesy of the National Environmental Satellite, Data, and Information Service.

The next cold front began producing gales along 31°N. shortly before 1200 UTC 23 December. At that time this fast-moving front extend through 31°N. 42°W. - 21°N. 55°W. to near Puerto Rico. QuikScat data at 2134 UTC that day showed a large area of 30 to35-kt winds north of 29°N. between 45°W. and 55°W. On 24 December at 0000 UTC, the ship **Licorne Pacifique** (J8CV5) reported northwest winds of 35 kt near 29°N. 53°W. By 0000 UTC on 25 December, the cold front reached from 31°N. 31°W. -19°N. 40°W. to near 15°N. 58°W. At that time gale conditions covered the area

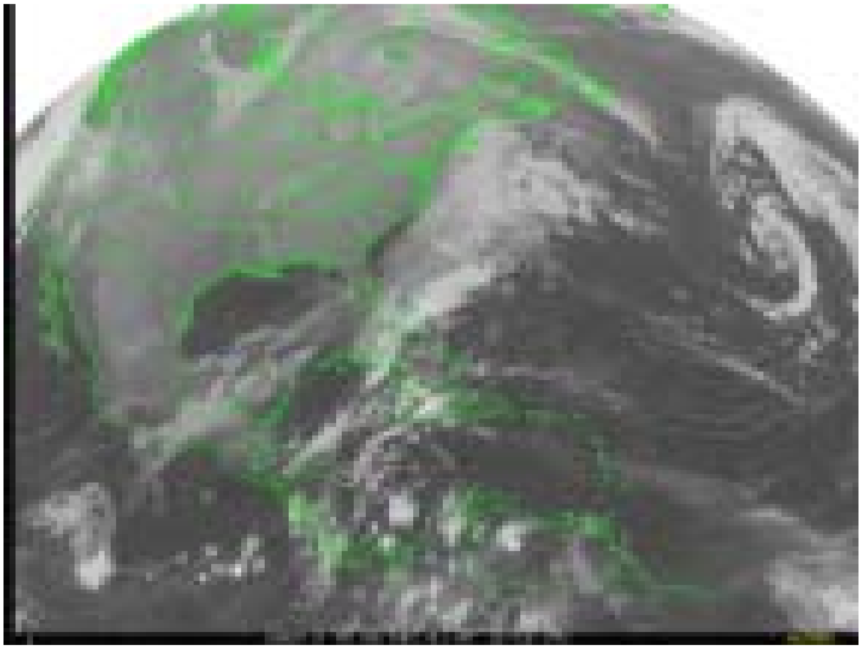


Figure 10 - GOES-8 visible image of eastern Atlantic gale at 1215 UTC 26 December 2001. Image courtesy of the National Climatic Data Center.

north of 27°N. east of 53°W. On 25-26 December a fast-moving storm center moved southeastward and then eastward just north of 31°N. This caused winds to increase 30-40 kt over the TPC forecast area. At 0600 UTC on the 26th, the 988-hPa storm was centered near 33°N. 42°W. At that time the ship **Chiquita Rostock** (ZCBD2) experienced west winds of 40 kt near 29°N. 42°W. QuikScat detected 40 to 50 kt winds just southwest of the storm center and 30 to 40-kt winds south of 31°N. at 0755 UTC that day (Fig. 9). GOES-8 satellite imagery at 1215 UTC 26 December (Fig. 10) clearly detected the well-defined storm. By 0000 UTC on 27 December, the storm weakened and moved northeastward away from the TPC forecast area, and gale conditions moved north of 31°N. However, northwest winds of 25-30 kt and seas of 3.5-5.5 m (12-18 ft) continued north of 25°N. east of 50°W. until 28 December.

2. Eastern Pacific

Six Gulf of Tehuantepec gale events occurred during the period beginning in the middle of October, with the estimated beginning and ending times given in Table 9. These events were documented by QuikScat data or occasionally by reliable ship observations.

The first event occurred between 17-19 October. A strong cold front moved southeastward across the Gulf of Mexico on the 16-17 October, and a 1030 hPa high pressure center moved southward to eastern Texas by 0600 UTC on the 17th. At that time gales began over the Gulf of Tehuantepec. There were no ship observations of gale force winds during the event; however, QuikScat data detected 30 to35-kt winds during the event, which ended at 1200 UTC 19 October.

The second event, beginning at 0600 UTC 28 October, was more prolonged. Two ships reported gale force winds - the **Chiquita Joy** (ZCBC2), which observed north winds of 37 kt at 1800 UTC 28 October and 38 kt at 0000 UTC 29 October, and the **Marine Chemist** (KMCB), which reported 35-kt winds at 0000 UTC on 29 October. Several QuikScat passes during the event showed gales with winds as high as 40 kt at 1232 UTC on 29 October. Subsequent QuikScat passes on 30-31 October showed 30-35 kt winds. The event ended at 1200 UTC 1 November.

The next event began just before 1200 UTC 5 November and was observed by several ships. The ship **Tristan** (SKWI) encountered winds of 37 kt and 38 kt at 1200 and 1800 UTC, respectively. Other ships including the **Saloma** (VRVT2), **Leverkusen Express** (DEHY), **Overseas New Orleans** (WFKW), and the ship **30111** (name unknown) observed winds of 35-40 kt between 1800 UTC on 5 November and 1800 UTC on 6 November. It is unusual to receive so many ships'

Table 9 - Gulf of Tehuantepec Gale Events (October - December 2001).

Event	Beginning	End
1	0600 UTC 17 October	1200 UTC 19 October
2	0600 UTC 28 October	1200 UTC 1 November
3	1030 UTC 5 November	1800 UTC 7 November
4	2230 UTC 10 November	0600 UTC 12 November
5	0000 UTC 10 December	0000 UTC 11 December
6	1030 UTC 20 December	1030 UTC 22 December

observations of gale force winds during a single Tehuantepec event. These observations were very useful, as QuikScat data only detected 30 to35-kt winds. The event ended at 1800 UTC 7 November.

The fourth event began a few days later, just before 0000 UTC 10 November. During the event there were no ship observations of gale force winds; however the ship **Zim Asia** (4XFB) observed 32-kt winds at 0600 UTC on 11 November. Another ship, the **Bosporus Bridge** (3FMV3), encountered 33-kt winds well south of the Gulf of Tehuantepec six hours later. Therefore, it is likely that gale-force winds occurred over the Gulf of Tehuantepec. Winds decreased below gale force at 0600 UTC 12 November.

The next event lasted only 24 hours. Gales began just before 0000 UTC 10 December. High-resolution QuikScat data indicated 35 to 40-kt winds near that time; however, no ship observations of gales were received. The event ended by 0000 UTC 11 December.

The sixth event of the period began just before 1200 UTC 20 December. QuikScat data from 1208 UTC 20 December indicated 35-kt winds over the Gulf. Two subsequent QuikScat passes near 0000 UTC and 1200 UTC on 21 December showed winds of 35-40 kt.

There were no ship observations of gale-force winds during the event, but the ship **Pearl Ace** (VRUN4) observed 30-kt winds at 0600 UTC on 22 December. Gale conditions ended shortly before 1200 UTC that day. ⚓

New Great Lakes Weather Station Gives Forecasters and Mariners Crucial Data

By David Gilhousen
National Data Buoy Center

In November 2001, the National Data Buoy Center (NDBC) installed a new automatic weather station atop the Lake St. Clair Lighthouse near Detroit. The station, identified as LSCM4, is the 57th station in NDBC's Coastal-Marine Automated Network (C-MAN). On April 11, 2002, a buoy (station 45012) was deployed in the middle of Lake Ontario, expanding its present network to approximately 70 moored buoy stations. Station 45012 is located near Rochester, NY at approximately 43° 37' N., 77° 24' W.

The C-MAN station at Lake St. Clair Lighthouse is funded through Michigan's Department of Environmental Quality (DEQ) with support from the U.S. Geological Survey (USGS.) and the Detroit Water and Sewerage Department. Lake St. Clair is a large source of drinking water for the Detroit area, and the USGS. is conducting modeling of lake currents in order to better assess the effect of pollutants on the lake. The USGS needed a high quality, year-round wind measurement for its computer model and worked with the DEQ to fund the C-MAN station. In addition to the winds, the C-MAN station also measures air temperature, water temperature, dew point, and sea level pressure.

"Though there are weather-reporting data buoys in the lake, they are retrieved by the middle of November and not re-deployed until April," said Greg Mann of the National Weather Service Office in Detroit. "We produce marine forecasts year-round for Lake St. Clair, and the worst storms usually occur in late fall or early spring." Lake St. Clair is a popular location for recreational boaters and ice fishermen. The weather reporting buoys are operated by the University of Michigan and the Meteorological Service of Canada.

(Photo used by permission of Don Carter)

The buoy in Lake Ontario will serve as a replacement for our C-MAN station at Galloo Island, NY (GLLN6). The Canadian Coast Guard will be used to deploy and retrieve the buoy, since the U.S. Coast Guard has no buoy tenders in Lake Ontario and maintains Aids-to-Navigation buoys via an agreement with the Canadians.

The C-MAN equipment will be removed from GLLN6 because the lighthouse (where the equipment is located), is in disrepair, and the Coast Guard facility has been sold to a private party. A Canadian weather buoy station, 45135, located about 20 miles southwest of GLLN6, provides representative observations for Eastern Lake Ontario, and the National Weather Service's Eastern Region has determined a greater need for observations in central Lake Ontario. The Meteorological Service of Canada is also aiding in this effort by providing buoy winter storage and dock space at their facilities in Hamilton, Ontario.

In addition to wave height and period, the buoy will measure winds, air temperature, water temperature, and sea level pressure. In a 2000 survey conducted by WFO Buffalo of NOAA Weather Radio users, the lack of wave measurements was identified as the single most important deficiency in weather information. The observations provided by 45012 should help fill this void.

Observations from both stations can be obtained through NOAA Weather Radio, the Dial-A-Buoy line (228-688-1948), or by accessing NDBC's Web site, www.ndbc.noaa.gov. ⚓

Alaskan Waters: Collecting Ships Observations

Rich Courtney
PMO WSO Kodiak, Alaska

Another pair of eyes is always advantageous. It is the main reason why many police officers work in pairs, airliners have two pilots, and indeed, many vessels double the watch for conducting hazardous evolutions such as entering port or restricted waters. So too, lies the relationship between the vessel crews and meteorologists. A second set of eyes measure the effectiveness of computer models in rapidly changing dynamic weather patterns. Masters, mates and seamen all assist in the forecast process by providing the "ground truth" that is vital to a good forecast. Meteorologists keep the forecast on track with the help of the vessel crews. Recruitment of these eyes has a very high priority within the various offices in the Alaskan Region.

Alaska has the largest coastline of any U.S. state with numerous bays, passes and channels. Forecasting correct weather conditions is challenging at best. There are very few shipping lanes into the region, and this has led to very sparse weather observations in the past. However, there is a large amount of coastal traffic in the form of tugs, cruise ships, ferries, oil/gas platforms and fishing vessels. These numerous "second set" of eyes are used to keep the forecasts current and on track. Most observations are collected via High Frequency Single Side Band Radio, SEAS software, e-mail or by telephone.

Alaska Region has three, part-time Port Meteorological Officers located in Anchorage, Kodiak and Valdez. The responsibilities of these offices include recruiting and training ship's personnel in reporting weather observations, principally with the SEAS software systems. More than 200 ship visits were made in pursuit of these duties during 2001. In addition, Alaska has three forecast offices, in Anchorage, Juneau and Fairbanks, and ten Weather Service Offices. Forecast Offices issue warnings and forecasts twice daily with updates. Meteorologists occasionally ride ships to familiarize themselves with ship operations in sea conditions. The Weather Service Offices located in Annette Island; Barrow; Bethel; Cold Bay; King Salmon; Kotzebue; McGrath; Nome; St. Paul and Yakutat also visit ships, collect weather observations, furnish training, and provide barometer calibration services. These offices conducted another 100 visits in an effort to reach our "at-sea" customer base.

Efforts by the Region to recruit ships began in the mid 1970's. Ms. Peggy Dyson of Kodiak had an informal grapevine that was used to pass forecats over HF/SSB radio and collect reports with at sea conditions. Afterward, she would type the observations and send them over landlines to the Forecast offices. Later, this effort was expanded to other National Weather Service Offices. In 1999, tests were conducted by Weather Service Office Kodiak to report limited amounts of data in the ship's synoptic code. The shift to use the synoptic code was needed to modernize the reporting process. It allowed this valuable source of information directly into model analyses and integrated into the various office display equipment used in the NWS Forecast Offices. Initially, the vessels only called on data for pressure, wind, sea height and air temperature. The result was a resounding success, with the Marine Prediction Center and World Meteorological Organization getting approximately 3000 ship observations in a region normally void of reports. In 2000, efforts were sought by the Alaska Marine Program Manager, Mr. Greg Matzen, to secure a programmer to help automate the reporting process. Ms. Rose Cunningham, a programmer in the Alaskan Region

HQ, was assigned the task of developing a software program that would encode data reported in a limited format. The task received technical assistance in scope and design from the author in Kodiak. While the SEAS software was designed for use by one vessel and report via Satellite, the BBXX encoder was designed to report multiple ship reports through landlines. During 2000 and 2001, some 9500 and 12,000 ship observations were encoded and transmitted to the Marine Prediction Center respectively. These observations ranged from SE Alaska's inner channels to the Bering Sea and across the north slope of Alaska in the Beaufort Sea.

With the advent of the SEAS 2000 software, an effort was started to collect ship observations directly from the vessels involved with reporting the weather. Smaller vessels, such as tugs and fishing vessels are equipped with an e-mail capability that allows messages to be sent via Inmarsat-C. However, the message has to be in ASCII text. The new SEAS software has this capability incorporated into this. To exploit this capability, an e-mail address was established in Alaska Region HQ to accept the reports. They are then sent to Marine Prediction Center via landline. In May 2001 Mr. Michael Daigler, Chief Mate aboard the tug **Northern Spirit**, and the author discussed a variety of ways to increase the number of reports directly to forecasters in Alaskan waters. The new SEAS software was mentioned, including the fact that the NWS was looking for a tug to test this capability. Michael asked to have the software sent to him on a CD, along with the accompanying text for taking observations. Installation and training was conducted over the phone and placed on Michael's personal laptop. Observations were taken, encoded and sent through Inmarsat-C using the ship's account with Stratosmobile. Mr. Daigler continued sending one observation a day for the remainder of the month, giving him a direct communication with the forecasters in the Juneau Forecast Office. **Northern Spirit**'s observations took on a great deal of importance, as the tug spends nearly all it's time in the inner channels of Southeast Alaska, from Ketchikan to Haines. In these tight and congested waters, the topography of the land greatly influences the weather conditions, especially the wind direction and speed as well as sea conditions. The following month Mr. Bernie Meier, Master of the Crowley Marine Services tug **Sinuk**, was headed to the northern coast of Alaska in support of the resupply effort of the oil industry. **Sinuk** and several more Crowley tugs provided a constant stream of data of North Slope weather conditions.

Northern Spirit receives award - Superior VOS Performance.

Observations from smaller coastal craft have also provided many benefits. The smaller craft tend to move outside the shipping lanes providing valuable data in these isolated coastal areas. These vessels tend to be located within 30 feet of the water's

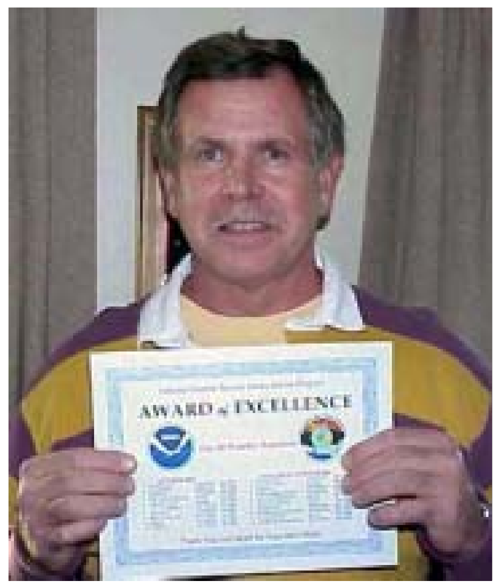
Tug SINUK

surface and provide a closer view of the sea and swell heights. Working in the near coastal zone also provides valuable information on the topographic effects that terrain has on the weather conditions.

As the saying goes, “You can’t do much about the weather except talk about it” and that’s just what the coastal shipping in Alaska is doing. Plans for the future include additional vessels from the towing, ferry, fishing industries and oil and gas platforms to keep an eye on the Alaskan weather. ⚓

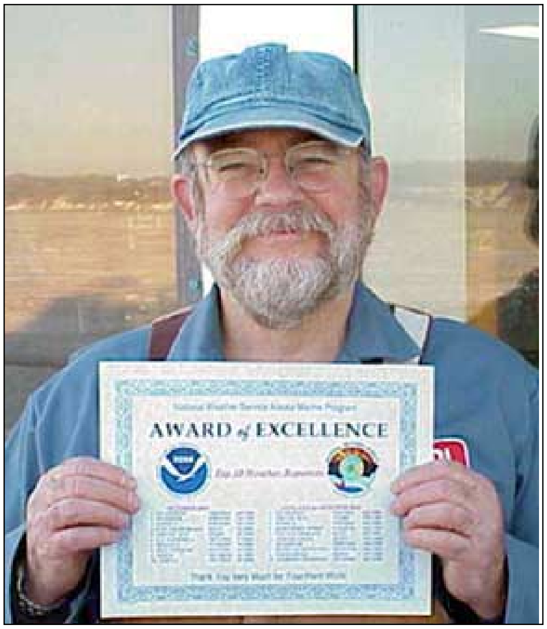
Northern Spirit

The crew of the CSX *Anchorage* was presented with an Award of Excellence while in the port of Anchorage, Alaska on November 6, 2001. Pictured from left to right are: Cadet Jim Carmany III, 3rd Mate Fred Koster, and 2nd Mate William Johnson.

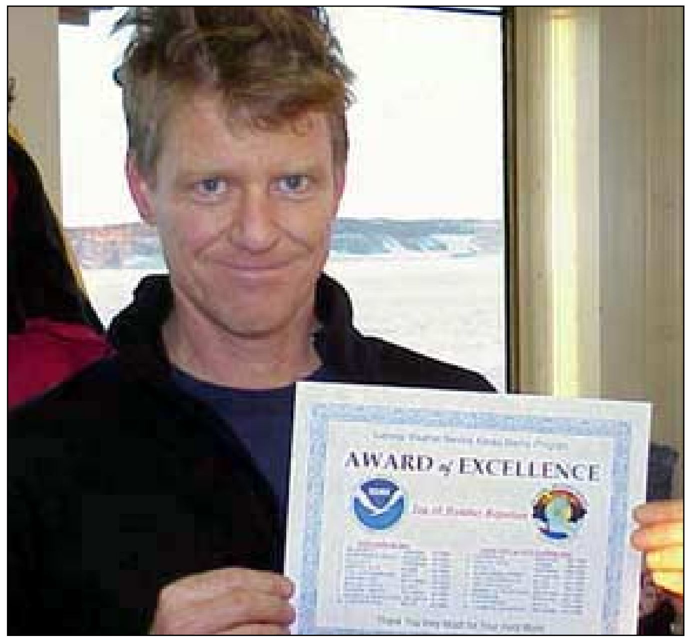


Captain Douglas Lefebvre of the CSX *Anchorage* received the Alaska Marine Program Award of Excellence while at the Port of Anchorage on November 27, 2001. The CSX *Anchorage* is a Top 10 ship. They have made the 4th highest total of observations in Alaskan waters for both October with 92,and for the first 10 months of 2001 with 565.

Captain Richard Swain (left) and Chief Mate Steve Iltich (right) of the Crowley Tug *Warrior* while at the Port of Anchorage on November 21, 2001.



3rd Mate Jack Worman (left) while in the Port of Anchorage on December 4, 2001, and 2nd Mate Brad Goodwin (below) of the CSX *Kodiak.* The *Kodiak* received the Alaska Marine Program Award of Excellence for November 2001. It was in the Top 10 again in Alaskan waters for ship observations and has taken 478 so far this year.



Captain John Strong from the SeaCoast Tug *Public Pride* receiving the Alaskan Marine Program Award of Excellence for being one of the top weather reporting vessels in Alaskan waters for May 2001. The *Pacific Pride* was visiting the Port of Anchorage on July 27, 2001.

2nd Mate Don Antonio Scichili (left), Captain Domenico Aiello (center) and 2nd Mate Francesco Caccamo (right) of the LNG Tanker *Polar Eagle* as received the Alaska Marine Award of Excellence while in Nikiski, Alaska on December 19, 2001.

Captain Larry Thormahlen (left), Chief Mate George Nielsen (center) and 2nd Mate Mark Irish (right) of the Tug *Malolo* while at the Port of Anchorage on December 3, 2001. The *Malolo* was on of the Top 10 weather reporting vessels in Alaskan water for the month of October 2001. They began using and enjoying the new Windows SEAS 5.22 software this summer.

National Weather Service Voluntary Observing Ship Program

New Recruits from 1 Nov 2001 to 30 Apr 2002

NAME OF SHIP	CALL SIGN	AGENT NAME	RECRUITING PMO
ALASKA SPIRIT	WCC5414	ALASKA SPIRIT	KODIAK, AK
APOLLO	WDA2886	SAUSE BROS TOWING	KODIAK, AK
BOWFIN	WSX7318	WESTERN PIONEER	KODIAK, AK
BRUCE	WWU8	UNOCAL OIL & GAS	ANCHORAGE, AK
BUFFALO SOLDIER	WWXB	MAR-TEX SHIPPING & CHARTERING	HOUSTON, TX
CALIFORNIA LUNA	S6CM	G-ACE PTE LTD	SEATTLE, WA
CAPT LES EASON	WTT8587	SAUSE BROS TOWING	KODIAK, AK
CARNIVAL PRIDE	H3VU	CARNIVAL CRUISE LINE	MIAMI, FL
CARNIVAL TRIUMPH	C6FN5	CARNIVAL CRUISE LINE	MIAMI, FL
CMA CGM MANET	C6RW6	INCHCAPE SHIPPING SERVICES	NORFOLK, VA
COCHISE	WAW9233	SAUSE BROS TOWING	KODIAK, AK
DEEPWATER MILLENNUM	3FJA9	TRANSOCEAN SEDCOFOREX	HOUSTON, TX
DOUBLE EAGLE	WYE6617	B & V NAVIGATION	KODIAK, AK
EAGLE CHARLOTTE	S60F	RILEY SHERMAN SHIPPING AGENCY	HOUSTON, TX
ENDURANCE	WDA3359	CROWLEY MARINE	ANCHORAGE, AK
GEMINI	V7BW9	PRONAV SHIP MANAGEMENT	KODIAK, AK
GUARD	WCY2823	CROWLEY MARINE	ANCHORAGE, AK
HENRY SAUSE	WTW9259	SAUSE BROS TOWING	KODIAK, AK
HUAL TRITON	C6QA4		BALTIMORE, MD
LYKES AMBASSADOR	ELVR4	STRACHAN SHIPPING CO	HOUSTON, TX
MASTER	WCD7879	B & V NAVIGATION	KODIAK, AK
MAUNA LOA	WCY8398	SAUSE BROS TOWING	KODIAK, AK
MI-OI	WTT3606	SAUSE BROS TOWING	KODIAK, AK
MILLENIUM	ELXQ3	CELEBRITY CRUISE LINE	MIAMI, FL
MOL THAMES	3EFV8	INCHCAPE SHIPPING	NORFOLK, VA
OCEAN HARMONY	3FRX 6	MK SHIP MANAGEMENT	SEATTLE, WA
ORIENTE SHINE	H9AL	RAINBOW MARITIME CO., LTD	SEATTLE, WA
P&O NEDLLOYD YANTIAN	ELYD5	INCHCAPE SHIPPING	LOS ANGELES, CA
PANDALUS	WAV7611	PANDALUS ALASKA DEPT. FISH & GAME	ANCHORAGE, AK
PHYLLIS DUNLAP	WDA6522	DUNLAP TOWING	KODIAK, AK
SALISHAN	WUT4384	SAUSE BROS TOWING	KODIAK, AK
SUNBELT SPIRIT	V7DK4	REEFER EXPRESS LINES	NEW YORK, NY
TAKU	WI9491	ALASKA MARINE HIGHWAY	KODIAK, AK
TIGER	WCE2134	SEACOAST TOWING	KODIAK, AK
TMM CAMPECHE	ELZ12	STRACHAN SHIPPING CO	HOUSTON, TX
TYCOM RELIANCE	V7CZ2	GENERAL STEAMSHIP CORP	SEATTLE, WA
TYONEK	WMH8	TYONEK PLATFORM	ANCHORAGE, AK
USCGC RUSH	NLVS		KODIAK, AK
USCGC SPAR	NJAR	USCGC SPAR WLB206 CMDG OFFICER	KODIAK, AK

VOS award recipients aboard the *Norway,* from left to right: Kjell Peterson, 2ND Officer, TrondClar Hauge, and Mariven Castro, 3RD Officer.

Jim Nelson, PMO Houston/Galveston (on right) presents award to Captain William L. Miles (on left) of the Lykes *Discoverer* (WGXO). Lykes *Discoverer* provided our forecasters with 756 weather observations in 2000. This is Captain Miles' second year in a row on two different ships receiving our annual award. When Captain Miles is off, Captain David S. Putty is Master. The National Weather Service and NOAA extend their thanks to both Masters for their great support.

Receiving a SEAS award for the NOAA ship *Albatross* are (from right to left): ENS Sean Suk, Junior Officer; ENS John Crofts, Junior Officer; CDR Michael Abbott, Commanding Officer; Stephen Wagner, Operations Officer; and ENS Jeff Taylor, Navigation Officer.

PMO Jack Warrelmann presents VOS award to CAPT Satish L. Hardas and First Officer Girish C. Lele of the M/V *Bernardo Quintana A*. Shown right to left are: First Officer Lele, CAPT Hardas, and PMO Warrelmann.

1st Officer ODD Toedegaard of the *Marit Maersk.*

PMO Jack Warrelmann presents VOS award to the NOAA ship *Gordon Gunter*. Shown right to left are: PMO Jack Warrelmann, LT JG Thomas J. Peltzer (NAV O), ENS Andrew A. Hall (OPS O), and ENS Sean D. Cimilluca.

PMO Jack Warrelmann presents VOS award to the NOAA ship *Oregon II*. Pictured right to left are: ENS Nick Toth, Master James C. Rowe, PMO Jack Warrelmann, 3rd Mate Dave Nelson and LT. CDR Ray Slagle.

The *Shiraoi Maru* was selected by Pat Brandow, PMO Seattle, as one of the top performers of 2000. A VOS plaque was presented to the crew. Pictured left to right are: Wei Shu Jiang, Chief Officer; Zhao Ki Jun, Captain; and Wang Hui Dong, 3rd Mate.

VOS award presented to the *Delaware Bay*. Pictured from left to right are: Jim Farrington (Northeast Atlantic SEAS Representative), AB Al Shurtleff and Captain G. Gregorek. Not shown: Chief Mate - J. Bartek, 2nd Mate K. Quinn, 3rd Mate G. Tarzetti and AB J. Forester.

Pictured left to right are: Seaman Surveyor Bernard Pooser, Surveyor, Navigational Officer LTJG Jon Neuhaus, and Seaman Surveyor Cleo Lewis of the NOAA ship *Whiting*.

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