Mariners Weather Log

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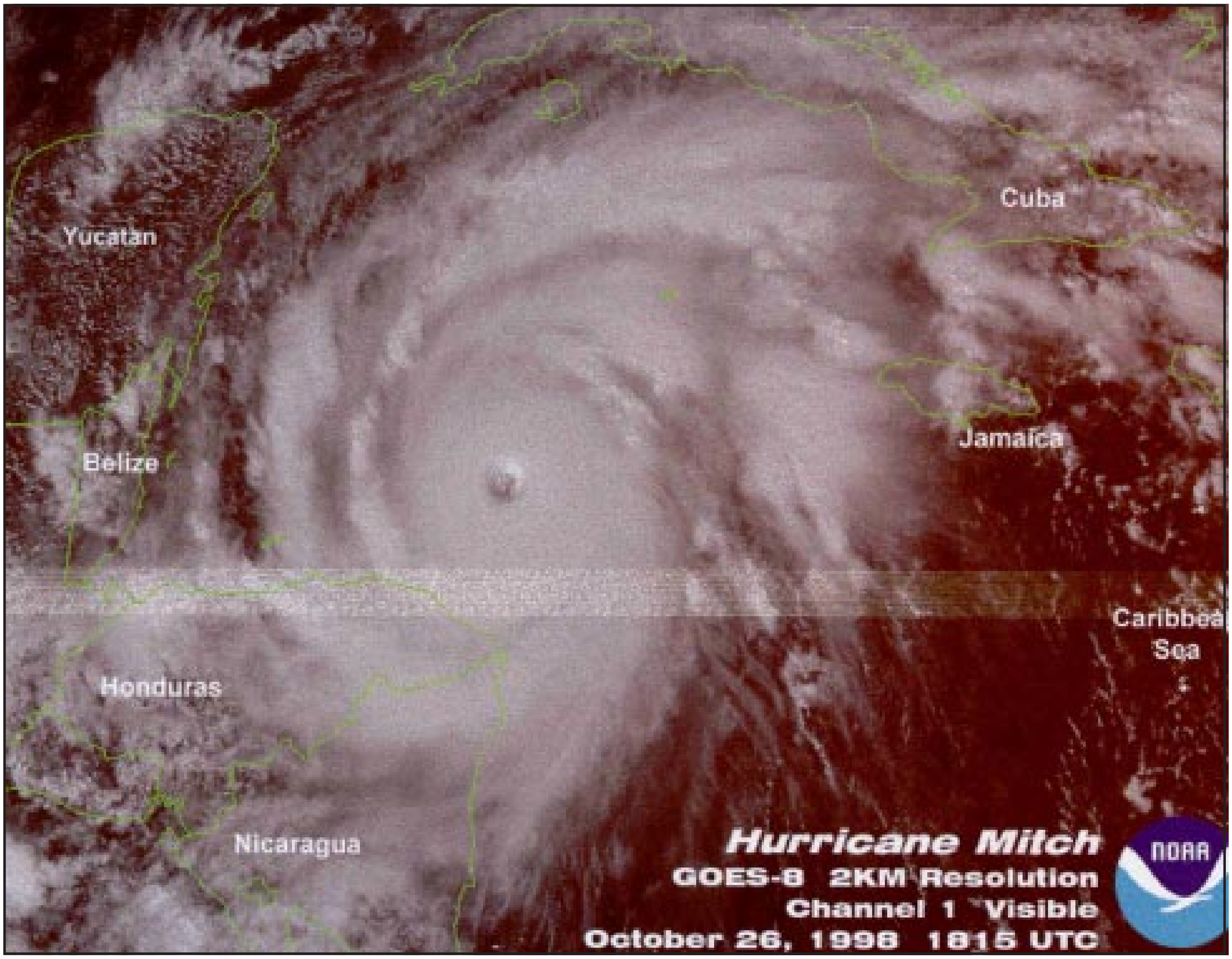

Hurricane Mitch

GOES-8 2KM Resolution

Channel 1 Visible

October 26, 1998 1815 UTC

Hurricane Mitch, one of the deadliest Atlantic hurricanes in history, as sea level pressure dropped to 905 Hp 35 nm southeast of Swan Island. This was the lowest sea level pressure ever observed in an October hurricane in the Atlantic basin and the fourth lowest pressure ever observed in an Atlantic hurricane (tied with Camille in 1969). See page 4.

Mariners Weather Log

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From the Editorial Supervisor

Due to increased printing costs, the annual subscription price of the Mariners Weather Log is now $12.00 (domestic) and $15.00 (foreign). Please see the inside back cover for the ordering form and more information.

We thank those free subscribers who filled out and returned the questionnaires to us. However, some questionnaires have not yet been returned. If your vessel has changed crews, or has been in the yard for service, the questionnaire may be aboard without your knowledege (it's a white card, folded size 5.5 x 8.5 inches). Please make every effort to complete and return these to us. You must do so to remain a free subscriber.

This issue features an article on the endangered right whales in the North Atlantic. Effective July 1, 1999, vessels of 300 gross tons or greater are required to report data such as position, course, and speed when entering two right whale aggregation areas: one off Massachusettes and one off Georgia and Florida, as part of an International Maritime Organization approved effort to save this endangered species. Please see the article for details.

For Voluntary Observing Ships, development of SEAS 2000 has begun. This is a new Windows-based program to facilitate reporting of meteorological observations. The projected release date is early 2000. I reviewed a pre-production version and was very impressed. Three NOAA line offices are collaborating in this effort. It's being lead by the Office of Atmospheric Research, Global Ocean Observing System (GOOS) Operations Center, with the office of NOAA Corps Operations writing the software, in cooperation with the National Weather Service. Prior to release of this new software, we recommend use of SEAS version 4.52, which is alsoY2K compliant, available from PMOs, SEAS Field Representantives, or the SEAS webpage at: http://seas.nos.noaa.gov/seas/.

Martin S. Baron⚓

Some Important Webpage Addresses

NOAA	http://www.noaa.gov
National Weather Service	http://www.nws.noaa.gov
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

See these webpages for further links.

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Hurricane Mitch—

One of the Deadliest Atlantic Hurricanes in History

John L. Guiney and Richard J. Pasch
Tropical Prediction Center
National Hurricane Center
Miami, Florida

Hurricane Mitch, the strongest October hurricane ever recorded, formed in the southwest Caribbean Sea from a tropical wave about 440 miles south of Kingston, Jamaica late on October 21, 1998. The system initially moved slowly westward and intensified into a tropical storm on October 22, while located about 260 miles east-southeast of San Andres Island. Mitch then moved slowly northward, and then north-northwestward on the 23rd and 24th while gradually gaining strength. Early on October 24, Mitch became a hurricane and was centered about 350 miles east-southeast of Cabo Gracias a Dios, Nicaragua. Later that day, as it turned toward the west, Mitch began to intensify rapidly. In about 24 hours its central pressure dropped 52 mb, to 924 mb, by the afternoon of October 25. Further strengthening took place and the central pressure reached a minimum of 905 mb on the afternoon of October 26, while the hurricane was centered about 35 nm southeast of Swan Island (see cover photograph). This pressure is the fourth lowest pressure ever measured in an Atlantic hurricane (tied with Hurricane Camille in 1969). This is also the lowest pressure ever observed in an October hurricane in the Atlantic basin. At its peak on the 26th, Mitch's maximum winds were estimated to be 155 knots, making it a category five hurricane on the Saffir/Simpson Hurricane Scale.

After passing over Swan Island, Mitch began to gradually weaken on October 27 while moving slowly west. It then turned southwestward and southward toward the Bay Islands off the coast of Honduras. The center passed very near the Island of Guanaja as a category four hurricane, wreaking

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Hurricane Mitch

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havoc there. Mitch slowly weakened as its circulation interacted with the land mass of Honduras. From mid-day on the 27th to early on the 29th, the central pressure rose 59 mb. The center of the hurricane meandered near the north coast of Honduras from late on the 27th through the 28th, before making landfall during the morning of the 29th about 60 nm east of La Ceiba with 85-knot winds. Mitch moved southward over Honduras, weakening to a tropical storm early on the 30th. The cyclone moved slowly over Honduras and Guatemala on October 30-31, gradually weakening to a tropical depression. Mitch generated torrential rains over portions of Honduras and Nicaragua, where the associated floods and mud slides were devastating. The highest rainfall total reported by the Honduras Weather Service was 35.89 inches in Choluteca, located in the southernmost portion of the country. Even higher values may have gone unobserved. Some heavy rains also occurred in neighboring countries.

Although Mitch's surface circulation center dissipated near the Guatemala/southeast Mexico border on November 1, the remnant circulation aloft continued to produce locally heavy rainfall over portions of central America and eastern Mexico for the next couple of days. On November 3, a low-level circulation became evident in the eastern Bay of Campeche and the system regenerated into a tropical storm while located about 150 miles southwest of Merida, Mexico. Mitch moved northeastward and weakened to a depression early on the 4th as it moved inland over the northwest Yucatan peninsula. The center re-emerged over the south-central Gulf of Mexico by mid-morning on the 4th, and Mitch regained tropical storm strength. The storm began to accelerate northeastward as it became involved with a frontal zone moving through the eastern Gulf. Mitch made landfall on the morning of November 5 in southwest Florida near Naples, with maximum sustained winds near 55 knots. By mid-afternoon of the 5th, Mitch moved offshore of south Florida, and became extratropical.

Most ships heeded the marine forecasts and only 30 ships reported wind of 34 knots or greater during hurricane Mitch. Table 1 lists these reports along with the pressure and significant wave height. The highest wind was 54 knots reported by ship C6HH3 (16.2N, 87.6W) at 1500 UTC on 31 October.

It has been estimated that there was a 50 percent loss to Honduras' agricultural crops. At least 70,000 houses were damaged and more than 92 bridges were damaged or destroyed. There was severe damage to the infrastructure of Honduras and entire communities were isolated from outside assistance. To a lesser extent, damage was similar in Nicaragua, where a large mudslide inundated ten communities situated at the base of La Casitas Volcano. Guatemala and El Salvador also suffered from flash floods which destroyed thousands of homes, along with bridges and roads.

The estimated death toll from Mitch (as of February 1,1999) stands at 9,086, with a comparable number of missing persons. The greatest losses of life occurred in Honduras and Nicaragua—5,677 and 2,836, respectively. The death toll also includes 31 fatalities associated with the loss of the schooner FANTOME. The exact number of deaths caused by Mitch will probably never be known. However, this was one of the deadliest Atlantic tropical cyclones in history, ranking below only the 1780 "Great Hurricane" in the Lesser Antilles, but comparable to the Galveston hurricane of 1900, and Hurricane Fifi of 1974, the latter also striking Honduras. Most of the U.S. damage from Mitch was caused by tornadoes in the Florida Keys which injured 65 people, damaged or destroyed 645 homes, and caused an estimated $40 million in damages.⚓

Table 1. Hurricane Mitch Ship Reports ≥ 34 Knots

Location	Press (mb)	Date/ Time (UTC)	Sust. Wind (kts)	Max. Significant Wave Height (FT)
PFRO (14.4N 77.0W)	1010.2	22/1200	37	2.0
ZCBN5 (11.8N 78.3W)	1006.0	23/2100	38	2.0
ZCBN5 (12.5N 77.6W)	1005.2	24/0000	37	2.0
ZCBN5 (13.4N 77.1W)	1005.3	24/0300	40	MM
ZCBN5 (14.2N 76.7W)	1006.1	24/0600	39	MM
PEXV (19.7N 81.3W)	1009.1	25/2100	43	2.0
PDWT (20.2N 84.3W)	1008.0	27/0000	37	3.0
KGDF (21.5N 76.5W)	1012.0	27/0000	35	3.0
3FKZ3 (22.1N 73.1W)	1016.0	27/0000	36	3.0
PDWT (20.4N 83.9W)	1009.5	27/0300	39	7.0
PDWT (20.6N 83.5W)	1009.5	27/0600	39	MM
PDWT (20.7N 83.0W)	1009.0	27/0900	45	MM
PJAG (9.6N 85.5W)	1011.0	27/1200	39	2.0
PDWT (20.8N 82.5W)	1012.0	27/1200	37	4.0
ELRU3 (21.1N 85.5W)	1010.0	27/1200	37	MM
C6YC (21.3N 83.2W)	1010.0	27/1800	40	2.0
C6YC (20.9N 82.6W)	1009.5	27/2100	45	3.0
C6KU7 (18.6N 86.6W)	1005.1	28/1200	40	3.0
PJAG (14.4N 77.3W)	1010.0	31/1200	35	2.0
C6YE (17.7N 87.2W)	1008.0	31/1200	38	3.0
C6HH3 (16.2N 87.6W)	1007.8	31/1500	54	MM
WLDF (23.9N 86.9W)	1003.7	04/0600	40	4.0
3FKZ3 (20.3N 85.4W)	999.0	04/1200	48	MM
WLDF (24.7N 84.9W)	1003.0	04/1200	39	2.0
3FKZ3 (20.0N 84.9W)	1000.0	04/1500	48	5.0
3FKZ3 (19.5N 82.8W)	1001.0	05/0000	36	4.0
ELFT8 (23.2N 86.6W)	998.0	05/0000	38	2.0
C6KY3 (22.7N 86.3W)	997.0	05/0300	40	3.0
SHIP (25.1N 85.2W)	1000.5	05/0600	36	6.0
KXDB (24.9N 80.3W)	996.1	05/1200	45	3.0
C6KU7 (25.9N 77.5W)	1000.0	05/1500	35	3.0
3EZK9 (25.1N 75.6W)	1001.0	05/1800	37	10.0
ELUA5 (26.0N 75.4W)	1000.0	05/1800	38	4.0

Note: Observed wind speeds and wave heights were relatively low because vessels heeded warnings and fled the area where the higher values would have been observed.

Civil War Naval Scenes of Xanthus Smith

Liz Barszczewski and Ed Lynch
Independence Seaport Museum
Philadelphia, Pennsylvania

Editors Note: The exhibit of Civil War Naval Scenes was on display at the Independence Seaport Museum in Philadelphia, Pennsylvania, through May 30, 1999.

It is often said that the Civil War was fought on land, but won at sea. While this theory is true to a large extent, the prominent role that both the Union and Confederate navies played during this period in history is not nearly as well known as many of the more famous Civil War land battles such as Vicksburg and Gettysburg. Indeed, some of the most important conflicts occurred not only along the United States' coastline, rivers, and inlets, but also on the high seas.

Xanthus Smith was born on February 26, 1839, on Locust Street in Philadelphia, to Russell Smith, a renowned 19th-century theater curtain and scenery painter, and his wife, Mary Smith, a well-known naturalist who worked in watercolors. At a young age, Smith expressed an interest in the sea through his sketches and watercolors. After touring Europe in the 1850s, he returned to study drawing at The Pennsylvania Academy of the Fine Arts in Philadelphia.

With the outbreak of the Civil War, Smith enlisted in the Navy and was stationed at Port Royal, South Carolina, aboard the U.S.S. WABASH, Rear Admiral Samuel Francis DuPont's flagship of the South Atlantic Blockading Squadron. It was during this assignment that Smith was encouraged by Rear Admiral DuPont and other superior officers to sketch and paint in detail several vessels in the squadron.

In the latter part of 1864, Smith was forced to resign his commission and return home due to his

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Independence Seaport Museum

Farragut passing the forts below New Orleans. Xanthus Smith, 1872, oil on canvas.
Courtesy Philadelphia Independence Seaport Museum (loan from Atwater Kent Museum).

Xanthus Smith

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father's poor health. However, he continued to create ship portraits similar to the ones he painted while stationed at Port Royal. These paintings led to the development of his studied and accurate approach to well-known Civil War naval battles including the clash between MONITOR and MERRIMACK at Hampton Roads, South Carolina, and the battles of New Orleans and Mobile Bay.

While Smith's work focused on and represented individual battles, it also documented and conveyed important technological developments of the War. One of the most important developments reflected in his work was the emergence of an ironclad navy. It was the Confederates who first began ironclad construction with the conversion of U.S.S. MERRIMACK into the ironclad steamer C.S.S. VIRGINIA. Eventually, Union forces saw the need for an ironclad navy and began to work on the design and implementation of such vessels. Three very different designs were submitted to the Union Navy and approved for construction. Two of the three came from designer John Ericsson and shipbuilder Merrick and Sons', both of Philadelphia. Ericsson's design for the MONITOR and Merrick and Sons' design for the hull which would later to be known as NEW IRONSIDES, were quickly put into production. This commitment to new technology had an invaluable impact on the future of the U.S. Navy and resulted in the construction of 40 Monitors by the end of the war. Eventually, Merrick and Sons' NEW IRONSIDES emerged as the prototype of the modern day navy vessel.

Much of Smith's most famous and dramatic work recorded the frequent skirmishes with blockade runners along U.S. waterways. As a means of applying economic pressure on the South and attempting to stop their trading with Europe, President Lincoln announced the implementation of a Union blockade in April 1861, which ran from Alexandria, Virginia, to the Rio Grande River. Confederate "runners" were employed to break through the Union blockade and smuggle goods in and out of the South. The tantalizing lure of immense profits attracted men from all over the globe to the dangerous job of blockade running. As the Union blockade became more efficient, the profits from blockade running soared, as did the increased risks.

Smith's work also detailed the international aspects of the Civil War. One of the most famous battles in international waters he depicted was that of U.S.S. KEARSARGE and C.S.S. ALABAMA on June 19, 1864. ALABAMA had been traveling the globe attacking northern merchant ships and KEARSARGE had been searching for her along the northern European coast to the Canaries, Madeira, and into the Western Islands since March 1863. The two finally met in the waters off Cherbourg, France. ALABAMA opened fire first. KEARSARGE held steady and closed the distance between the two ships to less than 1,000 yards before opening fire. Within the hour, ALABAMA was forced to strike her colors and admit defeat. She appealed for assistance from KEARSARGE, which rescued the majority of her crew.

Throughout his life, Smith continued to paint numerous Civil War naval battles, some of which were unfamiliar to him. For these particular paintings he often consulted with officers who had participated in an attempt to maintain historical accuracy. He maintained a studio on Chestnut Street in Philadelphia, where he continued to paint as the last surviving artist with Civil War service until his death on December 2, 1929. Smith's legacy continues today through his numerous paintings and sketches, significant not only because of the bold brush strokes and vibrant colors used to bring them to life, but for his ability to capture important historical moments in time with an awe-inspiring accuracy.⚓

The Saffir/Simpson Hurricane Scale:

An Interview with Dr. Robert Simpson

Debi Iacovelli
Tropical Weather Specialist
Cape Coral, Florida

Editor's Note: The Saffir/Simpson Hurricane Scale was first proposed in 1971 by Robert Simpson and Herbert Saffir, and is now widely used. This interview was conducted in 1991.

"Hurricane Hugo is now a Category 4 on the Saffir/Simpson Scale…" We hear the expression so often during the hurricane season, the "Saffir/Simpson Scale." But where did it originate and who was the creator of it? In this exclusive interview, Dr. Robert Simpson gives us some background about the scale and his personal feelings on the way it has been used in the discussion of hurricanes.

Space will not permit me to do justice to the lengthy career of Dr. Robert Simpson. He and his wife, Dr. Joanne Simpson, are both fellows of the American Meteorological Society. He is a former director of the National Hurricane Center (1967-1974) and is an accomplished writer of tropical meteorological books and articles. In 1991 he was awarded the "Cleveland Abbe Award for distinguished Service to Atmospheric Sciences by an Individual" for "pioneering work in storm research and for outstanding leadership in planning and implementing complex operational programs over a span of decades." He now operates a consulting meteorological firm in Charlottesville, Virginia, called "Simpson Weather Associates, Inc." Needless to say, Dr. Simpson and his wife are truly among the pioneers in hurricane research.

DI: When did you first start working with hurricanes, Dr. Simpson?

RS: I got interested in hurricanes ever since I almost drowned in one in Corpus Christy (Texas) in 1919, but my first actual flight into a hurricane was in 1945. And then I flew with the Air Force in their early reconnaissances from 1945 through 1954 as a guest to get research data after they got their operational data. Based upon that then, when we were able to get the money in 1954 to establish a full-time, around the year, research on hurricanes, I was asked to be the first director of it. We established that at West Palm Beach, Florida. We had three planes dedicated to research there, and by the Air Force, but they only did our hurricane research for us, we didn't get any operational information, just research. So that was the beginning of organized hurricane research itself. A lot of

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The Saffir/Simpson Scale

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people, both on the outside, in Universities as well as from within the Weather Services and NOAA, participated in the research, both on the data we got on the aircraft, and theoretical research.

DI: Dr. Simpson, why don't you give us a bit of background on the development of the Saffir/ Simpson hurricane scale?

RS: The problem of evacuating people and getting warnings out that are understood and which will evoke a response in the people who need to move has always been a difficult one. When I first came down to the Hurricane Center in 1967, I tried to come to grips with how we could do a better job of communicating. And that's very difficult; scientists communicate with each other very easily, but a scientist trying to communicate with a person who is a non-scientist on a technical problem is very difficult at times.

So it occurred to me if we could find some means of expressing the gradations of risks that people have in a hurricane, it would help people like the American Red Cross and the Emergency Management people to decide how best to make their decisions and to deal with the people they were responsible to. So I was talking to Herb Saffir (in 1968) about work that he had been doing and had just completed for the United Nations. He had completed something in the way of a summary of what you could expect in the way of ornamental damage and basic damage to structures with winds of different strengths. I said this is probably, put in a different suit of clothing, exactly the type of thing we need but we'll have to add the storm surge to it and a few other things. So I took on the job of working with him to get this thing put up in a new suit of clothing that we could then distribute to people, like the American Red Cross, who have to provide disaster relief when it's all over.

It was used that way for a couple of years before I left the Hurricane Center in 1974. Then the year after that when Neil Frank became the director, the pressure was put on him to distribute this to the public. I often felt that it was a little bit premature to put the scale out without perhaps improving it a little bit, and at least educating the people as to what it meant a little bit more. But politics and the situation was such that when people want something they want something, they're going to get it whether they know how to use it or not. So, I think that through the years it served a very good purpose for a lot of people. It's been misinterpreted, misused in a lot of places, but almost any device which is technical is. And the main difference in making it a equally useful thing to everybody is education, and telling them what it amounts to.

The scale as devised, expresses what the extreme conditions can be expected from a hurricane of a certain type and a certain category. It doesn't mean that everyone that a hurricane moves over, and the worst part of that hurricane, is going to receive that kind of damage or that kind of hazard. In other words, it's a study in probabilities—the probability of being hurt. And why is that? It's a great big storm, why isn't there a uniform amount of damage that you get? And if you've ever surveyed damage after a hurricane you know that one block of houses may be almost totally destroyed, and two blocks to either side there will be little damage at all.

It's almost like a tornado. It's not a tornado, but what is happening is it's not a uniform bowl of pudding that's circulating around here. It's something that has lots of streaks in it, and the streaks are made by the cumulus clouds that are embedded in this great big storm. And as these cumulus clouds circulate around, they're relatively small. Some of them are no more than a couple of kilometers across and maybe four of five kilometers long. That means that just a few blocks to one side or to the other side of where this cumulus cloud is providing the extreme wind, you have much less than the extreme, and therefore get no damage at all that's comparable on either side of it. So, there's several problems. The problem is first, expressing to the people who have to leave that it's a matter of probabilities, but if they don't believe that they're going to be in the worst sector and receive the worst damage or hazard, then they're playing Russian Roulette. They have to assume the worst and act accord-

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The Saffir/Simpson Scale

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ingly. Others are engineers who brag about the fact that the house or building that they engineered received no damage, and another engineer whose building received a lot of damage tries to explain why it did, because he knows he engineered it right. There isn't that understanding, and it's difficult to understand that it's the difference in the hurricane, not the difference in the engineering that caused the difference in the amount of damage received.

DI: Dr. Simpson, in your opinion, since the Saffir/Simpson scale is an open ended scale, do you think that hurricane windspeeds could become a category 6 or 7?

RS: I think it's immaterial. Because when you get up into winds in excess of 155 miles per hour you have enough damage if that extreme wind sustains itself for as much as six seconds on a building it's going to cause rupturing damages that are serious no matter how well it's engineered. It may only blow the windows out, but on the other hand, it can actually rupture the stairwells, the elevator wells and twist them, and it's happened in many buildings so that you can't even use the elevators after they've experienced this. So I think that it's immaterial what will happen with winds stronger than 156 miles per hour. That's the reason why we didn't try to go any higher than that anyway.⚓

Saffir/Simpson Hurricane Scale*

Category	Definition/Likely Effects
ONE	**Winds 75-95 mph (65-82 kts)**: No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage.
TWO	**Winds 96-110 mph (83-95 kts)**: Some roofing material, door, and window damage of buildings. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected anchorages break moorings.
THREE	**Winds 111-130 mph (96-113 kts)**: Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys small structures with larger structures damaged by floating debris. Terrain may be flooded well inland.
FOUR	**Winds 131-155 mph (114-135 kts)**: More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.
FIVE	**Winds greater than 155 mph (greater than 135 kts)**: Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required.

NOTE: A "major" hurricane is one that is classified as a Category 3 or higher.

* In operational use, the scale corresponds to the one-minute average sustained wind speed as opposed to gusts which could be 20 percent higher or more.

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- The AMVER center cannot acknowledge receipt of your transmission (no outgoing communications capability).
- AMVER reports satisfy the 24-hour notice of arrival required under 33 CFR 160.207 and 160.209.
- AMVER information is protected and released only to search and rescue authorities, and only in a bonafide emergency.
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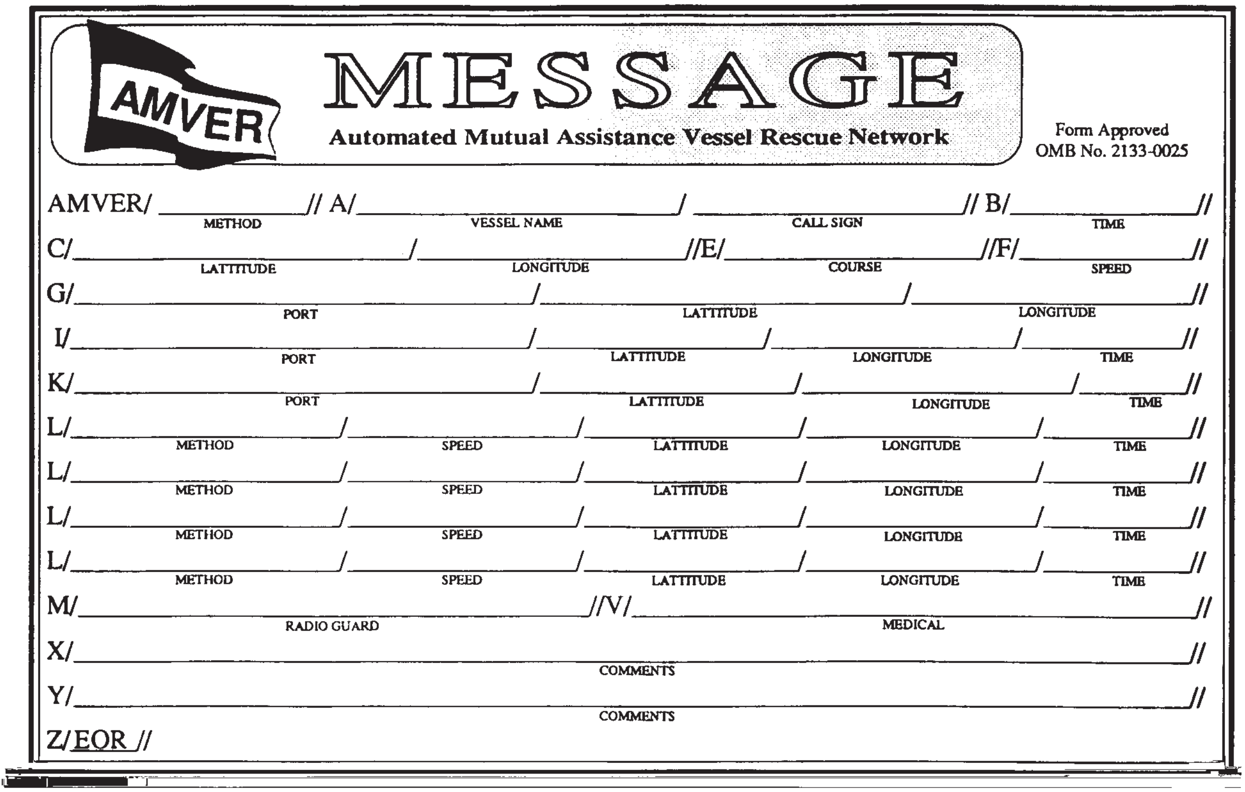

MESSAGE

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METHOD — VESSEL NAME — CALL SIGN — TIME

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G/ ________ / ________ / ________ //
PORT — LATTITUDE — LONGITUDE

I/ ________ / ________ / ________ / ________ //
PORT — LATTITUDE — LONGITUDE — TIME

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PORT — LATTITUDE — LONGITUDE — TIME

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L/ ________ / ________ / ________ / ________ / ________ //
METHOD — SPEED — LATTITUDE — LONGITUDE — TIME

M/ ________ //V/ ________ //
RADIO GUARD — MEDICAL

X/ ________ //
COMMENTS

Y/ ________ //
COMMENTS

Z/EOR //

LIST OF REQUIRED AND OPTIONAL LINE ENTRIES

SAILING PLAN REPORT
Required: AMVER/SP A/B/G/I/L/Z/
Optional: E/F/M/U/X/Y/

DEPARTURE REPORT
Required: AMVER/PR A/B/G/Z/
Optional: E/F/I/L/M/V/X/Y/

ARRIVAL REPORT
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Optional: X/Y/

POSITION REPORT
Required: AMVER/PR A/B/C/I/Z/
Optional: E/F/M/X/Y/

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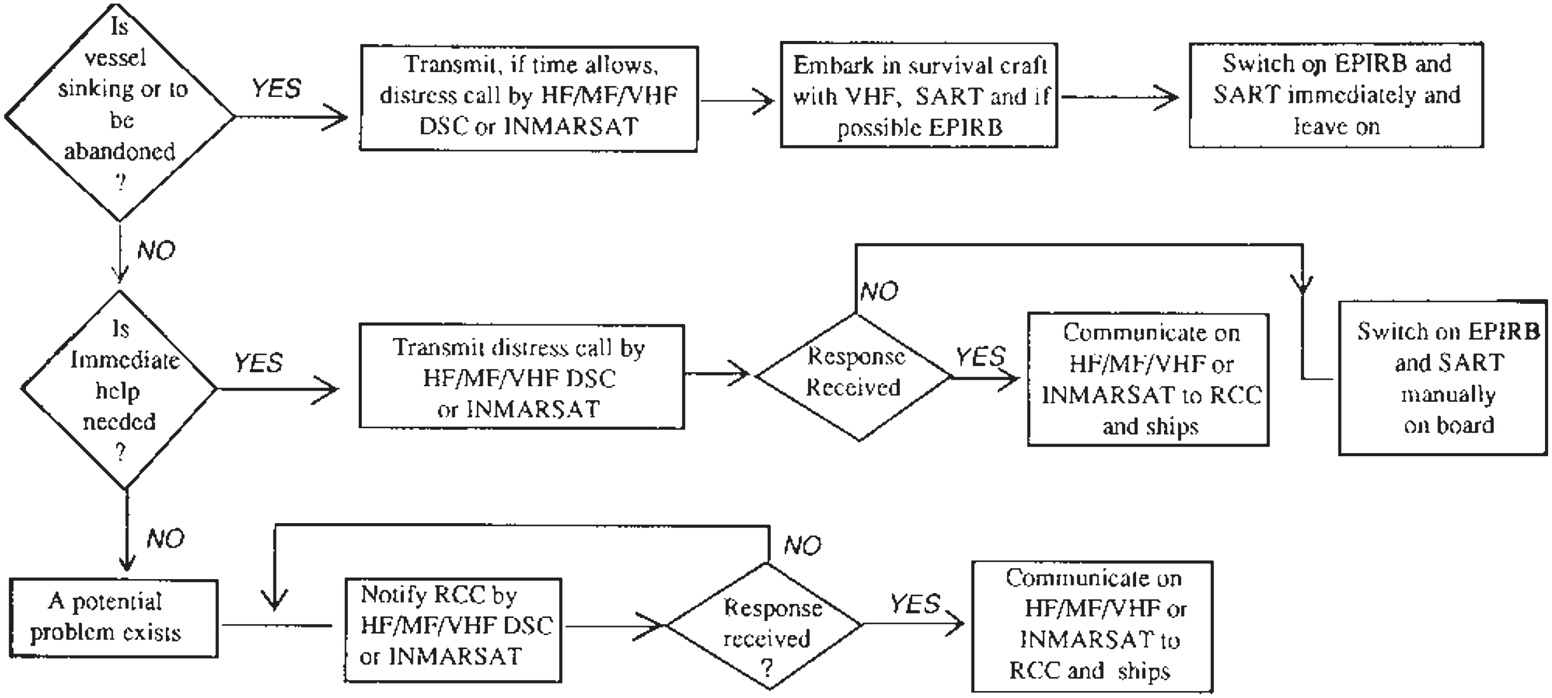
GMDSS Operating Guidance for Masters of Ships in Distress Situations



1. EPIRB should float-free and activate automatically if it cannot be taken into survival craft.
2. Where necessary, ships should use any appropriate means to alert other ships.
3. Nothing above is intended to preclude the use of any and all available means of distress alerting.

Radio Distress Communications

	Digital Selective Calling (DSC)	Radiotelephone	Radiotelex
VHF	Channel 70	Channel 16	
MF	2187.5KHz	2182KHz	2174.5KHz
HF4	4207.5Khz	4125KHz	4177.5KHz
HF6	6312KHz	6215KHz	6268KHz
HF8	8414.5KHz	8291KHz	8376.5KHz
HF12	12577KHz	12290KHz	12520KHz
HF16	16804.5KHz	16420KHz	16695KHz

1998 AMVER BUSINESS REPORT

IT WAS A VERY GOOD YEAR!

RECORDS BROKEN:

NUMBER OF SURVIVORS RESCUED: 238
NUMBER OF SHIPS ON AVERAGE DAILY PLOT: 2,776
ANNUAL PARTICIPATION GROWTH: 3.5%
SHIPS RECEIVING PARTICIPATION AWARDS: 4,095
DAILY PLOT ABOVE RECORD 2900 MARK: 8 Days

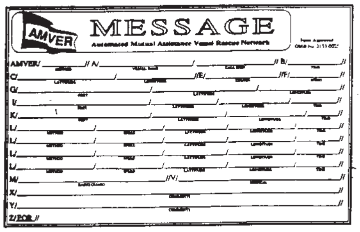
RESPONSE: **189 SHIPS FROM 38 COUNTRIES DIVERTED TO ASSIST!**

Top Five Nations: United States (37) Japan (23) Norway (15) Greece (14) Hong Kong (10)

36 SHIPS FROM 15 COUNTRIES MADE RESCUES!

Owner Countries: United States (8) Greece (8) Norway (6) Japan (2) Hong Kong (2) Australia (2) Belgium (1) Canada (1) Denmark (1) Germany (1) Italy (1) Morocco (1) Netherlands (1) South Africa (1) Taiwan (1)

Ships: Probo Bani, Cornucopia, New Endeavor, Francis L, Solaro, Bow Heron, Hood Island, Peramos I, Flinders, Taiko, Strong Texan, Tokyo Highway, Tycho Brahe, Maasstroom L, Monarch Of The Seas, Seaguardian, Solar Wind, Direct Falcon, Seaboard Universe, Independent Spirit, Sea-Land Hawaii, Sea-Land Initiative, Yaya, Geirgios D, Majesty Of The Seas, Sun Princess, Antonio D'Alesio, National Prestige, Starman, Settsu, Petersfield, President Polk, Rosita, Kavo Delfini, Faro I, Cape Banet



MESSAGE
Automated Mutual Assistance Vessel Rescue Network
AMVER/ // A/ / // B/ //
C/ / //E/ //F/ //
G/ / / //
I/ / / / //
K/ / / / //
L/ / / / / //
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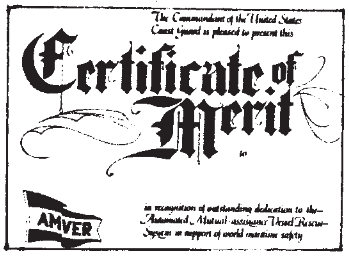
L/ / / / / //
L/ / / / / //
M/ //N/ //
X/ //
Y/ //
Z/EOR //

ALERTS:

406 MHz EPIRB ALERTS INITIATED 23% OF AMVER CASES
121.5 MHz EPIRB ALERTS INITIATED 22% OF AMVER CASES
DIGITAL SELECT CALL (DSC) / INMARSAT-C = 7% OF CASES

INCIDENTS:

VESSELS DISABLED OR ADRIFT: 33 Cases
VESSELS TAKING ON WATER: 12 Cases
MEDICAL EVACUATIONS: 12 Cases
MAN OVERBOARD: 10 Cases
VESSEL SINKINGS: 8 Cases



The Commandant of the United States Coast Guard is pleased to present this
Certificate of Merit
to
in recognition of outstanding dedication to the Automated Mutual-assistance Vessel Rescue System in support of world maritime safety

NOMINATIONS: **10 VESSELS NOMINATED FOR SPECIAL AWARDS:**

M/V BOW HERON (NO) M/V HOOD ISLAND (BE) M/V FLINDERS (AS)
M/V MAASSTROOM L (GR) M/V SEAGUARDIAN (GR) M/V NATIONAL PRESTIGE (TW)
M/V STARMAN (GR) M/V PRESIDENT POLK (US) M/V SIENKIEWICZ (PO) M/V ROSITA (NO)

How Does the Wind Generate Waves?

Bruce Parker

Dr. Parker is Chief of the Coast Survey Development Laboratory in the National Ocean Service, NOAA.

Nothing embodies the drama of the sea more than waves. To the average person, the images evoked are probably those of huge waves crashing onto a beach during a storm. To the recreational boater, it may be remembering the jarring rhythm of the boat's bow banging down onto the next set of wave crests and the resulting spray as you headed for the comfort and dryness of the dock. To the mariner, it may be the memory of tons of water crashing onto the deck of the cargo ship, and perhaps of fear as the captain kept changing course and speed in an effort to keep the vessel in a position where a huge wave could not turn it over or break it in two.

Though it has always been obvious that waves were caused by the wind, it may be surprising to learn that we still do not completely understand how the wind blowing over a smooth flat water surface can generate waves and how these waves can sometimes grow to heights of 50 or even 100 feet. When oceanographers say something is "not completely understood," what they really mean is that they don't yet have a reliable mathematical model that can accurately predict what will happen in the real world for all conditions. Even when a mathematical model does work well, it may not be easy to translate the mathematics of the model into physical terms that are easily described and understood. That being said, in this column we will try to explain how the wind generates waves, hopefully in physical terms that make sense.

Let's start with the most basic idea, i.e., the idea of a *wave*. In previous columns we have talked about an *oscillation*, such as a pendulum oscillating back and forth. A wave is merely an oscillation that does not stay in one place, but moves along or through some medium—for example, along a string, through the air, or

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How Wind Generates Waves

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along the water's surface (there are many kinds of waves in nature). If a taut string is plucked, and a point on that string moves up and down, that point is oscillating, but if the up and down motion moves along the string away from the point where it was plucked, that is a wave.

For an oscillation or a wave to occur there must be a motionless at-rest position where all the forces are in balance (in *equilibrium*), and, when we upset this balance, there must be a *restoring force* that will try to bring it back to the equilibrium position. Suppose we have a ball attached to a string hanging motionless (i.e., a pendulum). We hit the ball to the left, and its inertia carries the ball further to the left and the string forces it to move upward against the force of gravity (Figure 1). Gravity, the restoring force, eventually slows the ball down until it stops at the maximum height of its swing, and then pulls it downward again. The ball moves back to the right toward the original point of equilibrium (the point where it was when originally motionless). However, with little friction to stop it, the ball's inertia carries it right past this equilibrium point, moving to the right and once again upward against the force of gravity, which again slows it down and pulls it down and back to the left. Because there is very little friction in this system (mostly the friction of the air on the ball moving through it), the ball comes to a complete stop at the equilibrium position only after many oscillations.

Water sitting in a tank (or in an ocean basin) with no external forces pushing on its surface, will also be in an equilibrium position, i.e., motionless with a flat surface. If something moves the water away from this flat equilibrium position, there are two restoring forces that will work to make the water surface flat again: *surface tension* and *gravity*. If only a very small part of the water surface (less than an inch) is bent (and stretched), then it will be flattened out again by the water's surface tension (due to the attraction of the water molecules for each other). If a larger portion of the water surface is bent, and a portion of water is moved vertically above the equilibrium level (above the original flat surface), gravity will pull the water back down. If the water is pushed down below the equilibrium level, causing a depression in the surface, then water pressure will force it back up. This water pressure is due to the gravity pulling down on the water around the depression. In all these cases, once the water starts moving back toward the equilibrium position, the inertia of the water will carry the surface past the equilibrium level, there being little friction to slow it down right away.

But in this case, the water surface does not just go up and down at that one location. This up and

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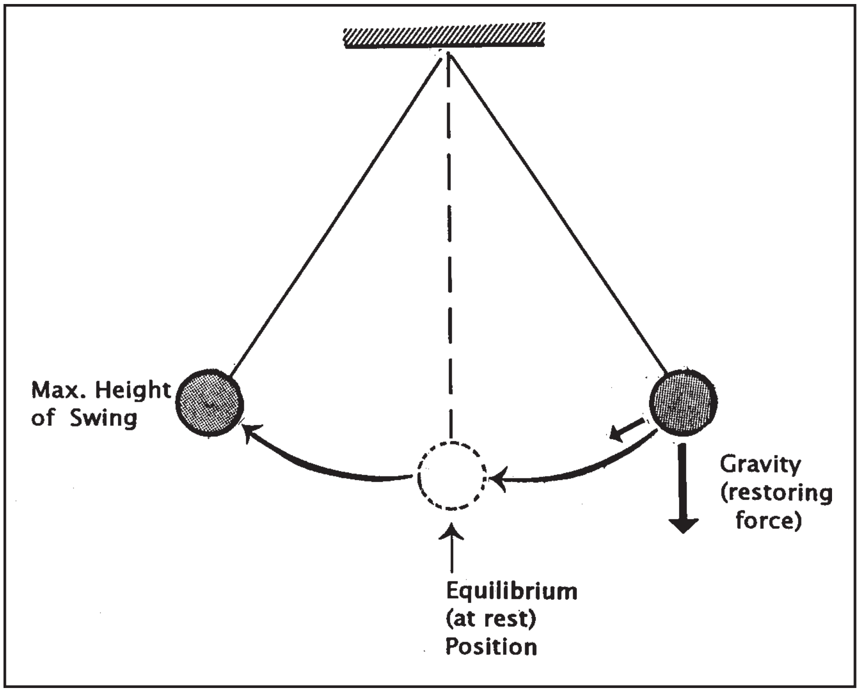

Figure 1. A simple oscillating pendulum. See text for explanation.

How Wind Generates Waves

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down motion of the surface propagates as a wave away from that location. The reason the change in shape of the water surface (i.e., the wave) moves along the water surface away from the location where the original disturbance took place, is that water particles were also pushed horizontally, in addition to vertically, forward and then backward. Individual water particles oscillate about their own equilibrium positions. As they interact with their neighboring particles they transfer some energy to them. Those particles in turn interact with other neighboring particles and transfer energy to them, and so on (Figure 2). In fact, these water particles actually oscillate in two dimensions, moving in (almost) perfect vertical circles (usually referred to as *particle orbits*). After a complete cycle of the wave, each particle comes back to (almost) where it started one cycle earlier. This is clear when a float is on the water surface. When a wave goes by, the float moves forward as it moves upward, and then it moves backward as it moves downward. One also notes in Figure 2 that the wave has an effect on the water column below it. The circular particle orbits become smaller as one goes deeper, disappearing at a location of no wave motion at a depth equal to approximately half the wavelength. (If the water is too shallow for a location of no wave motion to occur, this *shallow-water wave* will have elliptical particle orbits, as well as other different characteristics, which we will look at in a later Physical Oceanography column.)

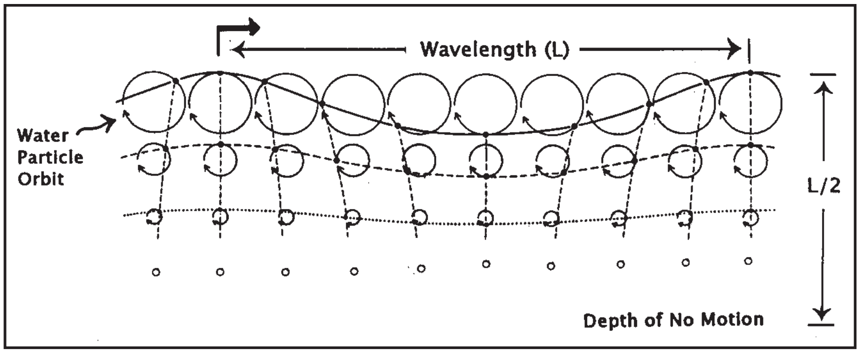

Figure 2. A simple propagating water wave with the water particle orbits shown.

A key point to remember is that it is the *shape* of the water surface (and the energy) that is propagating away, not the water particles themselves. [“(almost)” was used twice in the previous paragraph because, to be very precise, there is a very, very small transport of water forward with each wave cycle, but this is insignificantly small compared with the speed of the propagating shape of the surface.]

At this point we should define some terms related to waves (some of which you probably have already seen before), which are illustrated in Figure 3. Note, however, that the wave shown in Figure 3 is an idealized wave (or one component making up a wave). The highest point that the water surface reaches is the *crest* of the wave; the lowest point is the *trough*. The difference from trough to crest is the *wave height*. The distance from one crest to the next crest, or from one trough to the next trough, is the *wavelength*.

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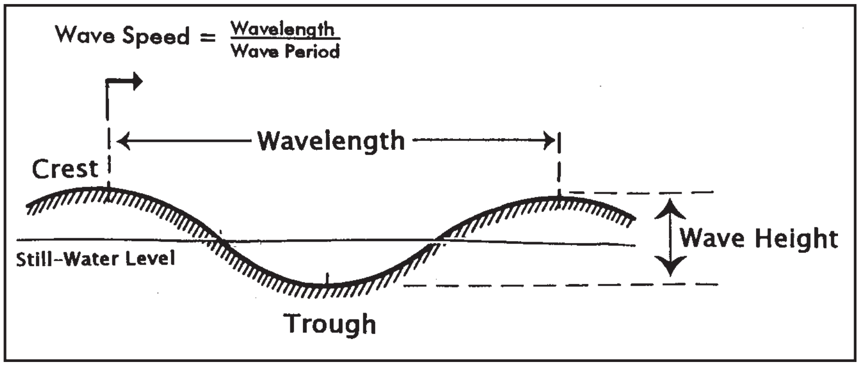

Figure 3. Terms describing a simple water wave. The *wave period* is the time is takes for one complete wave cycle to pass by a point.

How Wind Generates Waves

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As the wave propagates by a point, the time it takes one wave cycle to pass by that point (i.e., the time it takes between the first crest passing the point and the second crest passing that point) is called the *wave period*. The inverse of the period is the *frequency* of the wave, i.e. how many cycles of this wave pass by in a second. The speed at which a wave travels, its *wave speed* or *celerity*, is equal to its wavelength divided by the wave period. This is different from, and much greater than, the speed of individual water particles.

So how does the wind generate waves and make them grow? It's obvious how the wind pushes on the sails of a sailboat. But what can the wind do to a glassy-calm flat sea surface? How can the wind move the water surface and change its shape? There are two possible ways. The first is through the friction of the horizontally-flowing air particles in the wind *rubbing against* the water particles in the water surface (this *wind stress* is a force tangential to the surface). However, when the wind blows over any surface, including water, the movement of the air particles is not simply parallel to the surface. The flow of air is turbulent, meaning that there are swirling eddies of various sizes and thus chaotic vertical movements of the air particles (which produce a force *perpendicular* to the water surface). The second way that the air can move the water surface is through the vertical pressure of the air particles, either moving downward (pushing on and lowering the water surface) or moving upward (creating a reduced pressure that lifts the water surface). The question then is what role does either the frictional stress or the pressure (or both) play, first in generating waves and second in making them grow?

When the wind speed is low (less than a few knots) over a flat water surface, the air flow is less turbulent and has only very small eddies. As a result of the vertical motion from these small eddies (less than an inch in size), there are increased pressures pushing the water down in some places and decreased pressures, allowing the water to rise in other places. Surface tension provides the restoring force for the resulting *capillary waves* or *ripples* (also called "*cat's paws*," especially when momentarily propagating across the water surface during a light wind gust) . These very small waves disappear almost immediately when the wind stops. While they exist, however, they add roughness to the water's surface that allows the wind to have a greater effect.

For higher wind speeds, which are accompanied by larger eddies and larger pressure pulses, the elevations and depressions on the water surface are large enough for gravity to be the restoring force. The gravity waves do not disappear as quickly as the capillary waves. However, the key to the generation of significant waves seems to be a *resonant* mechanism between the pressure pulses in the wind and the underlying gravity waves. This resonance occurs when the water waves propagate at the same speed as the wind component in the direction of wave propagation. When this happens, the wind can keep imparting energy to the waves because the wind pressure is greatest at the wave troughs (pushing down on the water surface *at the same time* as when the wave is already moving downward) and least at the wave crests (pulling up on the water surface *at the same time* as when the wave is already moving upward). When the vertical wind particle oscillations are *in phase* with the vertical water particle oscillations, more energy goes from the wind to the waves, and the waves grow.

Once the water surface has become wavy, this wavy surface has an effect on the wind field, which leads to further wave growth. This is because now the wind has something it can *push* forward, applying pressure to the wave's backside (windward side) and giving the wave more energy. In addition, the wave has a *sheltering effect* which allows the formation of an eddy in the air on its leeward side (the front side) (see Figure 4). This eddy results in reduced pressure on the leeward side, that helps the wave grow. (On both sides of the wave there is also an upward tangential wind

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How Wind Generates Waves

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stress effect on the surface). As waves get larger, there is more windward surface for the wind to push on and also larger leeward eddies, and a feedback mechanism results which can make the waves grow quickly.

While the wind is still blowing and the waves are still growing, three factors determine how large the waves can grow. The greater the *wind speed*, the longer the wind blows (its *duration*), and the longer the length of water it blows over (the *fetch*), the greater the height of the waves will be. When the waves have gotten as large as they can for a particular wind speed, duration, and fetch, it is referred to as a *fully developed sea*. When the waves reach a *steepness* where the wave height is approximately 1/7th of the wavelength, they become unstable and begin to break (producing *white caps)*.

A description of wave generation is complex because many different waves are produced at the same time by the wind (especially in a storm) with many different wavelengths and periods, traveling in many different directions. At any one location at any given moment, the wavy surface will be a combination of all the waves passing by that location at that moment. Thus, the surface over an area looks very irregular (called a *confused sea*) and changes continuously, so much so that one cannot even pick one wave crest and follow its movement for any distance, because at some point it will disappear (at the point where the wave components at that moment happen to cancel each other out, instead of adding together). When many waves with different wavelengths add together positively, the steepness easily can increase beyond 1/7 and cause white caps. The irregular, ever-changing water surface makes it difficult to determine visually the average wave height of a confused sea, and the visually reported value (when compared to instrument measurements) usually turns out to be the average of the highest one-third of the waves (which has become a standard wave term called the *significant wave height*). The irregular surface is the reason why wave forecast models must deal with complex statistics. The easiest way for an oceanographer to describe all the waves in an area of the sea is in terms of its *spectrum*, which is merely a way of graphically showing how much energy there is at different wave periods (or, at different frequencies).

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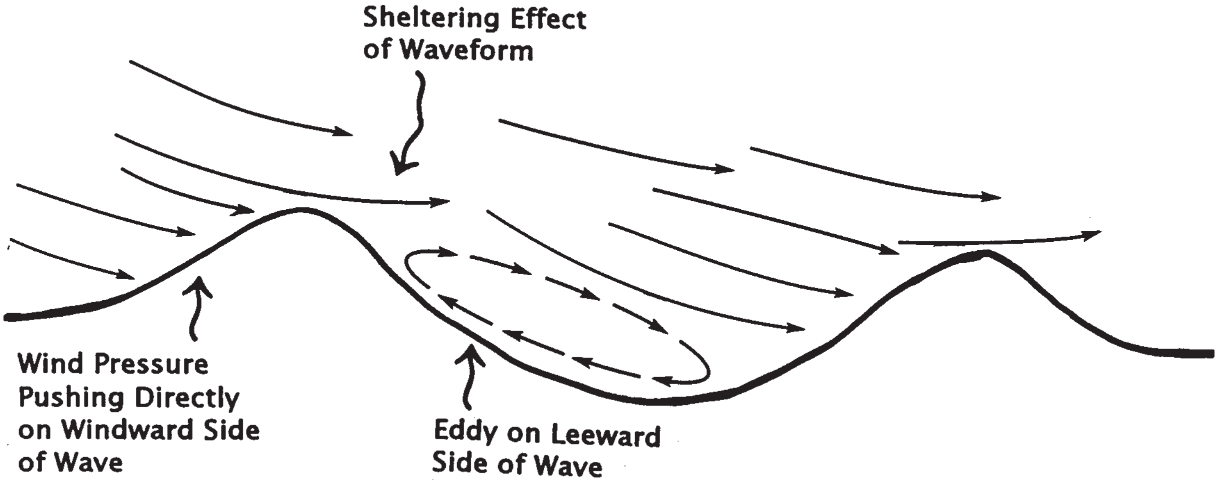

Figure 4. The effect of a wavy surface on the air flow and the further growth of the waves. See text for explanation.

How Wind Generates Waves

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When waves propagate away from the storm (or when the storm dies out) the situation changes. When the wind was still blowing the waves were *forced* waves, meaning that energy was still being imparted to them by the wind. When the wind stops, these waves continue to propagate as *free* waves called *swell*. Swell is made up of longer, lower, rounder waves. This is because the various component waves of different wavelengths no longer stay together. In deep water the wave propagation speed depends only on the wavelength of the wave. Thus, waves with longer wavelengths travel faster than waves with shorter wavelengths, and therefore the waves tend to sort themselves out, the longer waves leaving the shorter waves behind. This is called *dispersion*. A distant storm at sea first makes its presence known by the long-wavelength swell coming from that direction. As swell travels, the shorter wavelength waves tend to decrease their wave heights much sooner than do the longer wavelength waves. In addition, the longer waves slowly increase in wavelength and period as they travel. Because of the very little frictional dissipation involved, these long, low, and rounded waves can travel hundreds and even thousands of miles over the ocean's surface (or until they hit a coast).

What does it take for a wave to reach 50 feet in height or the occasionally reported 100 feet in height? Winds blowing at Beaufort force 8 (34-40 knots) for a couple of days over a fetch of 500 nautical miles can produce waves with significant wave heights of 25 feet and occasional 50-foot waves. Those numbers are doubled in Beaufort force 11 (56-66 knots) winds. A storm moving fairly fast can continue to impart energy to waves that are moving in the same direction as the storm, producing larger waves. A very large wave can result when two large waves happen to meet at the same location and be in phase (i.e., their crests come together at the same place). For smaller waves this happens fairly often, and a wave about twice the size of the significant wave height can show up about every 80 waves. But this can also occasionally happen when two large waves happen to meet. This can easily happen in a storm situation, but on rare occasions it may happen far from a storm (the resulting huge wave being referred to as a *freak wave* or a *rogue wave*). Another common cause of very high waves is when large waves propagate against a strong ocean current. This interaction is not a simple one to explain (without the mathematics), but it results in waves with shorter wavelengths and greater heights. If the current happens to have warm water (traveling under cooler air), the atmospheric instability that this causes increases the strength of the wind stress and the turbulence, allowing even more energy to be imparted from the wind to the waves.

Some of the largest waves in the world (occasionally reaching 100 feet) occur off the southeast coast of Africa and involve several of the mechanisms just mentioned. First, this area borders on the Southern Ocean, the only area of unlimited fetch in the world, since it encircles Antarctica. Extratropical cyclones with strong winds travel from west to east, moving in the direction of some of the waves they produce. Storms off the southeast coast of Africa can produce large waves and these will be combined with swell reaching this area from all parts of the vast reaches of the Southern Ocean. The final amplification of these waves occurs when they propagate into and against the Aghulhas Current, which flows southeastward at approximately 5 knots. In addition, the Aghulhas Current is a warm current, so it is possible that the instability of the cooler air over these warm waters also increases the transfer of energy from the wind to the waves. (Personal accounts of the huge waves observed in this and other areas of the world can be found in the special Fall 1993 issue of Mariners Weather Log).

Finally, when waves propagate into shallow water they also increase in height, but we will save this discussion for another column since there are a great many things to say about waves in shallow water.⚓

Evicting Sea Lions

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LTJG Lee H. Allison, USCG
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Sea lions are smart. They're cute. But, they sure can be a problem for the National Data Buoy Center (NDBC). NDBC installs, operates, and maintains weather buoys and coastal meteorological stations for the National Weather Service (NWS) along and offshore the U.S. coasts. It is off the northwest coast where sea lions have been the source, directly and indirectly, of some considerable problems.

All of NDBC's 23 Pacific coast buoy stations are in the range of Zalophus Californianus Californianus, the sea lion found in U.S. waters, but it is the stations that are nearshore, off northern California, Oregon, and Washington that are most often the "targets" of sea lions. Sea lions are very social animals that congregate in colonies on rocky and sandy beaches of coastal islands and mainland shorelines. At sea, they travel together in "rafts." In recent years, the sea lion population has seemed to increase, possibly the result of passage of a Federal law protecting marine mammals.

NDBC's problems with sea lions stems from their interest in basking in the sunshine. Buoys provide a great sunning spot for a sea lion that has been foraging for food in the chilly Pacific, so NDBC technicians have often found buoys with sea lions piled high. In one instance, a sea lion was perched high off the deck, nearly 6 feet from the water, in the upper structure of the buoy (see Figure 1). It is this penchant for sunning themselves on NDBC buoys that has caused some problems and led NDBC personnel to learn much more about these beasts.

At first, the problems associated with sea lions were mostly caused by people. Although it is illegal to kill sea lions, they are sometimes seen as one cause of the depletion of some valuable fish stocks. The resulting dislike for sea lions can

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Figure 1. "Hi Mom!" How did he get up there?

Evicting Sea Lions

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be so intense that some people will shoot at the animals while they are on buoys. Most of the buoys have aluminum hulls, so it is easy for a rifle bullet to penetrate the hull or to damage the sensors and electronics on the buoys. NDBC's response to this kind of damage has been to initiate a public information campaign among boaters on the west coast, emphasizing the value of the data to the marine community and the damage that shooting at buoys can cause.

Another problem that was dealt with effectively was a concern that wave data being reported was not accurate because of buoy motions associated with sea lions getting on and off the buoys. With a dozen or more sea lions, each weighing up to or more than 1,000 pounds and potentially over eight feet long, it seemed to be a legitimate concern. However, analysis of the wave data indicated that the statistical techniques being used on the data set, collected over nearly 20 minutes, removed the unwanted signal associated with sea lion arrivals and departures. But there were more serious concerns about sea lions and buoys. Although they are very social among themselves, they are also very territorial and aggressive. Typically, a service visit to a buoy begins with the crew of the U.S. Coast Guard cutter using fire hoses to get the animals off the buoy. Once free of sea lions, the NDBC technicians board the buoy and do their work. On more than one occasion, sea lions have joined the technician on the buoy (see Figure 2) and made it clear that they objected to the human presence. On another occasion, a sea lion jumped into the launch being used to take the technician to the buoy. Sea lions can be very big, and they have strong jaws that can crush bones. Since they are wild animals, Mr. Timothy Hoffland, a seal and sea lion trainer at Marine Life Oceanarium in Gulfport, Mississippi, recommended staying 100 yards away from them, a difficult proposition to make work on a buoy deck only ten feet across.

Possibly bored while sunning themselves, sea lions occupy themselves by chewing on what-

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Figure 2. Treed! Technician Kenny MacDonald and an uninvited assistant.

Evicting Sea Lions

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ever is handy. This causes loss of data from external sensors and loss of solar power when cables can be reached by the animals. Since the cables have to be run through a circuitous route from sensors or solar panels to the electronics inside the buoy, it is impossible to completely protect them from bored, or hungry, sea lions.

Finally, NDBC discovered that sea lions were possibly responsible for water intrusion into the buoys. For some time, NDBC had struggled with water intrusion. When too much sea water gets into the buoy, it drowns the batteries, creating a corrosive slush that destroys the aluminum hull and produces explosive hydrogen gas. It was clear that the intrusion was often the result of water entering the hatch access on the buoy deck. Dog bolts, which are intended to seal the hatch cover, were often found loose. Vandalism was thought to be the cause, but sea lions were the real culprits. With enough sea lions stacked on the hatch, the hatch gasket was compressed to the point that the dog bolts came loose, allowing water to get into the buoy. That same pile of sea lions can also cause a loss of freeboard, sometimes leaving the deck awash and water entering the loose hatch (see Figure 3).

Mr. Hoffland taught NDBC personnel much about sea lions. They can jump eight feet out of the water and can climb fairly well. When they climb, they stand on their hind flippers and jump to the top of a fence or wall. Then, using their front flippers, they hoist themselves over the obstacle. Knowing these things helped in the design of a “sea lion fence.” It was necessary to keep the beasts off the buoys, but at the same time to allow access by technicians. The fence was designed to prevent the sea lion from getting onto the deck by jumping or climbing. It was a simple design, one that used aluminum pipes to create the fence from the deck to the upper structure.

The first buoy with a fence was installed at station 46050, offshore of Newport, Oregon. As soon as the buoy was installed and the cutter withdrew, a sea lion arrived to check out the buoy and seemed quite disappointed that no way was open to get onto his usual sunning spot. Several trips past the buoy have confirmed that no sea lions have been on the buoy, nor is there an indication that they have had any success on getting past the fence. Nine other buoys are being prepared with sea lion fences because of this apparent success. It seems likely that the problems associated with sea lions and their love of buoys have been solved. All NDBC can hope is that sea lions never learn to use a cutting torch. It’s been said that they have nothing but time on their flippers!⚓

Figure 3. A raft of sea lions playing “king of the buoy.”

The Endangered Right Whales—

Reducing the Threat of Ship Strikes with Mandatory Ship Reporting

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Gregory K. Silber
Office of Protected Resources
National Marine Fisheries Service
Silver Spring, Maryland

In December 1998, the International Maritime Organization (IMO), a Specialized Agency of the United Nations that addresses international shipping issues, unanimously approved a U.S. proposal to establish a mandatory ship reporting system to reduce ship strikes of the highly endangered North Atlantic right whale. Starting in July 1999, all commercial ships of 300 gross tons and greater will be required to report to a shore-based station when entering two right whale aggregation areas. This measure, in conjunction with other measures being taken by the United States, is an important attempt to help recover the species.

There are only about 300 right whales remaining in the North Atlantic. Ship strikes kill more right whales than any other source of human-related mortality. Best estimates indicate that an average of about two deaths or serious injuries per year result from collisions with ships, and since 1991, about one-half of all recorded right whale deaths have been attributed to ship strikes. This may represent only a fraction of the total number of whales killed by ships, as many deaths may go undetected if whales drift out to sea.

Although other large whale species may also be hit by ships, the behavior of right whales makes them particularly vulnerable to ship strikes. Right whales live close to shore, and in areas in or adjacent to major shipping lanes. Their feeding and calving areas, and migratory corridors are crossed by international shipping routes. Right whales spend much of their time at the surface, feeding, resting, mating, and nursing.

Calves are particularly vulnerable because they spend most of their time at the surface due to their undeveloped diving capabilities. Right whales appear to be unaware of approaching ships and apparently make little effort to avoid them. Thus, mariners cannot assume that whales will move out of their path. Mariners may have difficulty in seeing right whales because of their dark color and low profile in the water.

Recognizing that ship strikes are likely a major impediment to right

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Endangered Right Whales

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whale recovery, the National Oceanic and Atmospheric Administration (NOAA) initiated a program aimed at reducing the likelihood of such occurrences. Much of the program is aimed at increasing mariner's awareness of the severity of the problem and seeking their input and assistance in minimizing the threat of ship strikes. One cornerstone of the program is the mandatory ship reporting system. The concept and design of the system was initiated by NOAA, the National Marine Fisheries Service (NMFS), and the U.S. Coast Guard (USCG), with significant input from the International Fund for Animal Welfare and the Marine Mammal Commission. The system has received strong backing from Congressmen William Delahunt (D-MA) and Wayne Gilchrest (R-MD).

The requirement for mandatory ship reporting is found in the Safety of Life at Sea Convention, Chapter V, regulation 8-1. Seven mandatory reporting systems exist world-wide. A reporting system for the Dover Straits/Pas de Calais was approved by IMO at the same time as the system proposed by the United States. The effective date for both of these systems was July 1, 1999.

The U.S. reporting system requires that commercial ships of 300 gross tons and greater report to a shore-based station when they enter two areas off the east coast of the United States: one off Massachusetts and one off Georgia and Florida (see charts on pages 28 and 29). The reporting system in the area off Massachusetts will operate year round while the one off Georgia and Florida will operate each year from November 15 to April 15, which corresponds with periods of right whale occurrence.

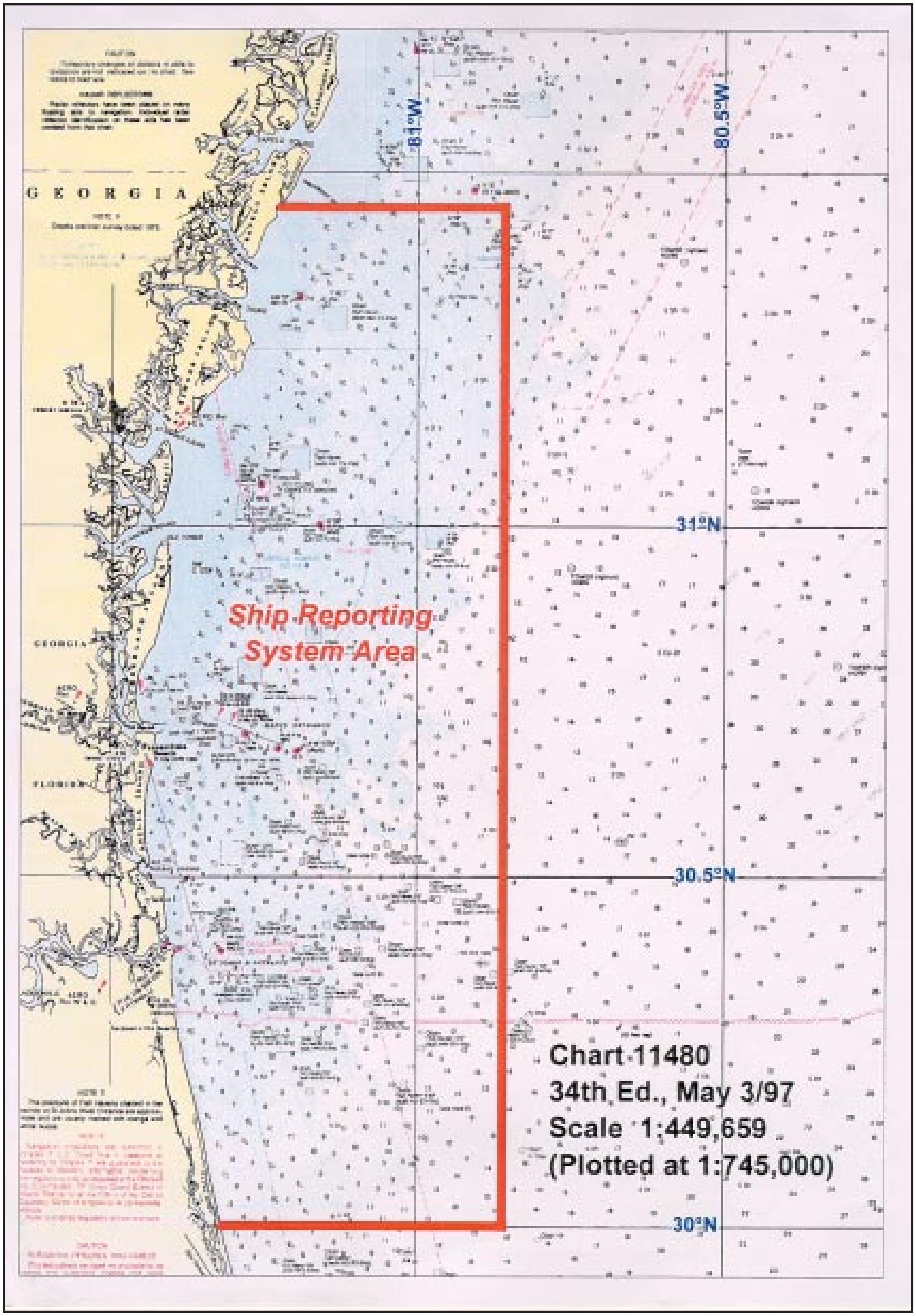
Ships will be required to report their course, speed, location, destination, and route. In return, ships will receive an automated message indicating that the ship is entering an area critical for right whales, that whales are likely to be in the area, and that ship strikes are a serious threat to whales and may cause damage to the ship. The message will also indicate to mariners where they can receive the most recent information on right whale locations, and if possible and when available, recent sighting information will be provided in the return message. The system requires reporting only and will affect no other aspect of vessel operations; there will be no cost to the mariner.

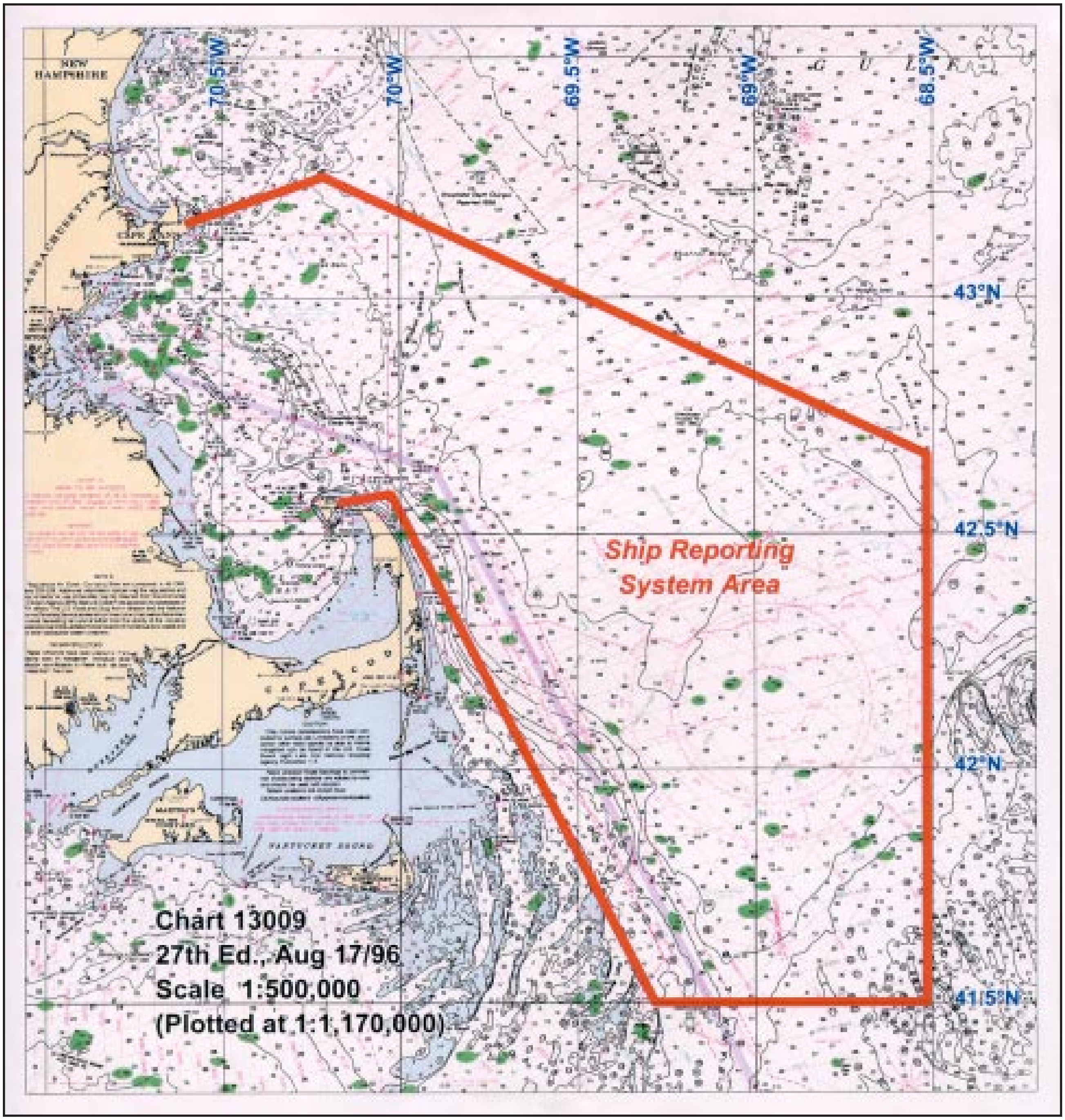
The return message will also contain advice on precautionary measures mariners may take to reduce the possibility of hitting right whales (see page 31). For example, mariners will be advised to refer to navigational publications such as the U.S. Coast Pilot, Sailing Directions, and nautical charts for information on relevant regulations, and the boundaries of the Gerry E. Studds Stellwagen Bank National Marine Sanctuary and right whale critical habitats. They will be advised to obtain information about the location of whales in their vicinity by monitoring various broadcast media, including the USCG's Broadcasts to Mariners, satellite-linked marine safety broadcasts, and NOAA Weather Radio. Right whale location information is obtained from aircraft surveys supported by the U.S. Navy, USCG, Army Corps of Engineers, NMFS, and the states of Massachusetts, Georgia, and Florida. In addition, mariners will further be advised that information placards, videos, and other educational materials are available from shipping agents, port authorities, relevant state agencies, the USCG, and NMFS.

Contact with the shore station will be transmitted via INMARSAT, a satellite-based, ship-to-shore communication system. Ships not equipped with INMARSAT should contact the USCG by VHF radio, which will in turn provide the return message described above. Specific reporting instructions will be provided by the USCG before the system is implemented.

Collectively, the reports will yield data on ship number and routes in right whale habitat which will be useful in identifying possible further measures to reduce ship/whale interactions. The entire program will be reviewed in three to five years to assess its effectiveness.

Continued on Page 30


81°W
80.5°W
GEORGIA
31°N
Ship Reporting System Area
GEORGIA
FLORIDA
30.5°N
Chart 11480
34th Ed., May 3/97
Scale 1:449,659
(Plotted at 1:745,000)
30°N

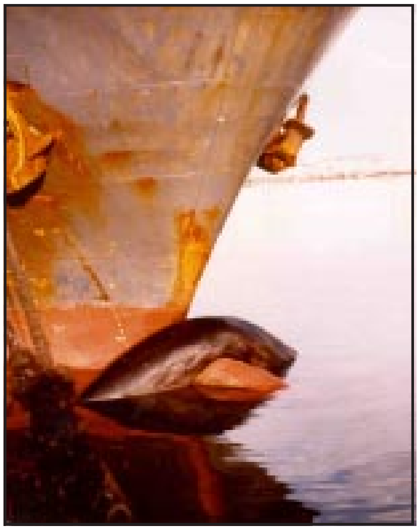

70.5°W
70°W
69.5°W
69°W
68.5°W
NEW HAMPSHIRE
43°N
42.5°N
42°N
41.5°N
Ship Reporting System Area
CAPE COD
NANTUCKET SOUND
Chart 13009
27th Ed., Aug 17/96
Scale 1:500,000
(Plotted at 1:1,170,000)

Endangered Right Wales

Continued from Page 27

NMFS has taken a number of other steps in addition to the mandatory ship reporting system to reduce ship strikes of right whales. For example, in 1994, NMFS designated three right whale feeding and nursery areas along the U.S. east coast as "critical habitats." Other areas important to right whale protection have been established by the United States and Canada, including Stellwagen Bank National Marine Sanctuary off Massachusetts and a whale conservation area in the Bay of Fundy, Canada. In 1997, NMFS issued regulations requiring vessels and aircraft to stay a minimum 500 yards (460 m) from right whales.

In the northeastern and southeastern United States, NMFS established teams composed of representatives of government agencies, the maritime industry, and the scientific community to coordinate right whale protective measures. Among other things, these teams have coordinated the right whale aircraft survey programs. Surveys are conducted off the southeastern United States from December to March (the peak calving period), and whale sightings are broadcast to all vessels in the area by the U.S. Navy. In the northeastern United States, whale advisories and sightings are broadcast periodically by NMFS, and maps of right whale sightings are posted on the Internet by the Massachusetts Office of Environmental Affairs and NMFS (http://whale.wheelock.edu). With significant input and advice from the International Fund for Animal Welfare, the regional recovery teams, and the Marine Mammal Commission, NOAA and NMFS staff are ensuring that information on right whales in relevant navigational publications is timely and accurate.



Whale carried on the bow of a ship after it was struck and killed. Ship strikes are more common among right whales than for other whale species.

A dead whale stranded on the beach. The deep lacerations, from a ship's propeller, killed this whale.

These steps, including the establishment of the mandatory ship reporting system, are attempts to address the serious threat posed by ships to the very survival of the North Atlantic right whale. Although none of these steps alone can ensure survival, this mosaic of protective measures will assist in reducing ship strikes. Efforts to further increase protection of this species will require continued close cooperation between the maritime community, environmental groups, and government entities.⚓

Steps Mariners Can Take To Avoid Collisions with Critically Endangered Right Whales

When transiting right whale critical habitat:

- As soon as possible prior to entering right whale critical habitat, check U.S. Coast Guard Broadcast Notice to Mariners, NAVTEX, NOAA Weather Radio, Cape Cod Canal Vessel Traffic Control, the Bay of Fundy Vessel Traffic Control, and other sources for recent right whale sighting reports.
- When entering ports on the U.S. east coast, refer to Coast Pilot and Notice to Mariners, review right whale identification material described in those documents, and maintain a sharp watch with lookouts familiar with spotting whales. Ask port officials, port pilots, and Coast Guard officers for additional information on right whales.
- When planning passage through right whale critical habitat, attempt to avoid night-time transits, and whenever practical, minimize travel distances through the area. Anticipate delays due to whale sightings.
- When the ability to spot whales is reduced (e.g. night, fog, rain, etc.), mariners should bear in mind that reduced speed may minimize the risk of ship strikes.

In all coastal and offshore waters along the east coast of the U.S. and Canada:

- If a right whale sighting is reported within 20 nautical miles of a ship's position, post a lookout familiar with spotting whales.
- If a right whale is sighted from the ship, or reported along the intended track of a large vessel, mariners should exercise caution and proceed at a slow, safe speed when within a few miles of the sighting location, bearing in mind that reduced speed may minimize the risk of ship strikes.
- Do not assume right whales will move out of your way. Right whales, generally slow moving, seldom travel faster than 5-6 knots. Consistent with safe navigation, maneuver around observed right whales or recently reported sighting locations. It is illegal to approach closer than 500 yards of any right whale (see 50 CFR 222.32, Chapter 2).
- Any whale accidentally struck, any dead whale carcass spotted, and any whale observed entangled in fishing gear should be reported immediately to the U.S. or Canadian Coast Guard noting the precise location and time of the accident or sighting.

In the event of a strike or sighting, the following information should be provided to the U.S. Coast Guard:

- Location and time of the accident or sighting.
- Speed of the vessel.
- Size of the vessel.
- Water depth.
- Wind speed and direction.
- Description of the impact.
- Fate of the animal, if known.
- Species and size, if known.

Right whales can occur anywhere along the east coast of the U.S. and Canada. Mariners are urged to exercise prudent seamanship in their efforts to avoid right whales.

For more information, contact:

National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2289

Lindy Johnson works in NOAA's Office of General Counsel, International Affairs; Gregory Silber is the Coordinator of Large Whale Recovery Activities for the Office of Protected Resources, National Marine Fisheries Service.

Method of Reporting

Vessels transiting MSR reporting areas are required to report their course, speed, position, destination, and route to the U.S. Coast Guard upon entry into the reporting area. Vessels should report via INMARSAT-C or other satelite communications to one of the following addresses:

E-mail: RightWhale.MSR@noaa.gov *or* Telex: 236737831

Vessels unable to use satellite communications should contact the U.S. Coast Guard Communication Area Master Station Chesapeake VA via published voice or SITOR/NBDP frequencies. See page 66 of this issue for details.

Reporting Instructions

Vessels shall make reports in accordance with the format in IMO Resolution A.648(16) General Principles for Ship Reporting Systems and Ship Reporting Requirements. Vessels shall report the following information:

Paragraph	**Function**	**Information Required**
System name	System identifier	Ship reporting system name (whalesnorth or whalessouth).
A	Ship	Vessel name and call sign.
B	Date, time, and month of report	Six digit group giving day of month and time, single letter indicating time zone, and three letters indicating month.
E	True course	3-digit number indicating true course.
F	Speed in knots and tenths	3-digit group indicating knots and tenths.
H	Date, time, and point of entry into system	Date and time expressed as in (B) and latitude and longitude expressed as a four digit group giving latitude, the letter N indicating north, followed by a / , a five digit group ginving longitude, and the letter W indicating west.
I	Destination and ETA	Name of port and arrival time expressed as in (B).
L	Route information	Route information should be reported as direct rhumbline to port (RL) and intended speed or a series of way points (WP). Vessels reporting waypoints should include latitude and longitude, expressed as in (H), and intended speed between waypoints. For vessels transiting within a traffic separation scheme (TSS), give only the WP on entry and departure of TSS.

Example Reports

WHALESNORTH

TO: **RightWhaleMSR@noaa.gov**
WHALESNORTH//
A/CALYPSO/NRUS//
B/031401Z APR//
E/345//
F/15.5//
H/031410Z APR/4104N/06918W//
I/BOSTON/032345Z APR//
L/WP/4104N/06918W/15.5//
L/WP/4210N/06952W/15.5//
L/WP/4230N/07006W/15.5//

WHALESSOUTH

TO: **RightWhaleMSR@noaa.gov**
WHALESSOUTH//
A/BEAGLE/NVES//
B/270810Z MAR//
E/250//
F/17.0//
H/270810Z MAR/3030N/08052W//
I/MAYPORT/271215Z MAR//
L/RL/17.0//

Marine Weather Review
North Atlantic Area
August through November 1998

George Bancroft
Meteorologist
Marine Prediction Center

The main track of low pressure centers in August was from Labrador east or northeast, with some developing gale force winds (34 kt), and re-forming east of Greenland. One low developed storm force winds (48 kt) briefly on August 11. In late August, and especially in September, tropical activity picked up. Otherwise in September and beyond, an upper low over the Greenland-Iceland area increasingly imparted energy to lows moving off the U.S. east coast and Canadian Maritimes, with the lows frequently developing storm winds. An exception to this was the building of an upper ridge over the central Atlantic in the middle of September which directed lows north from near Newfoundland then northwest to the west of Greenland. This allowed the tropics to become active, with up to four hurricanes in existence in the Atlantic basin simultaneously on September 25, the first time ever.

Tropical Activity

Hurricanes Bonnie and Danielle recurved through the mid-Atlantic offshore waters late in August and early September. They are worthy of mention here outside the Tropical Prediction Center's (TPC's) column because they became significant extratropical storms. Tropical cyclones that recurve and accelerate into the middle latitudes while becoming extratropical can be very dangerous since they may travel at the same speed as the swell that they generate, building the wind waves on top of the swell, generating extreme wave heights. Figure 1 is a surface analysis showing Bonnie

Continued on Page 37

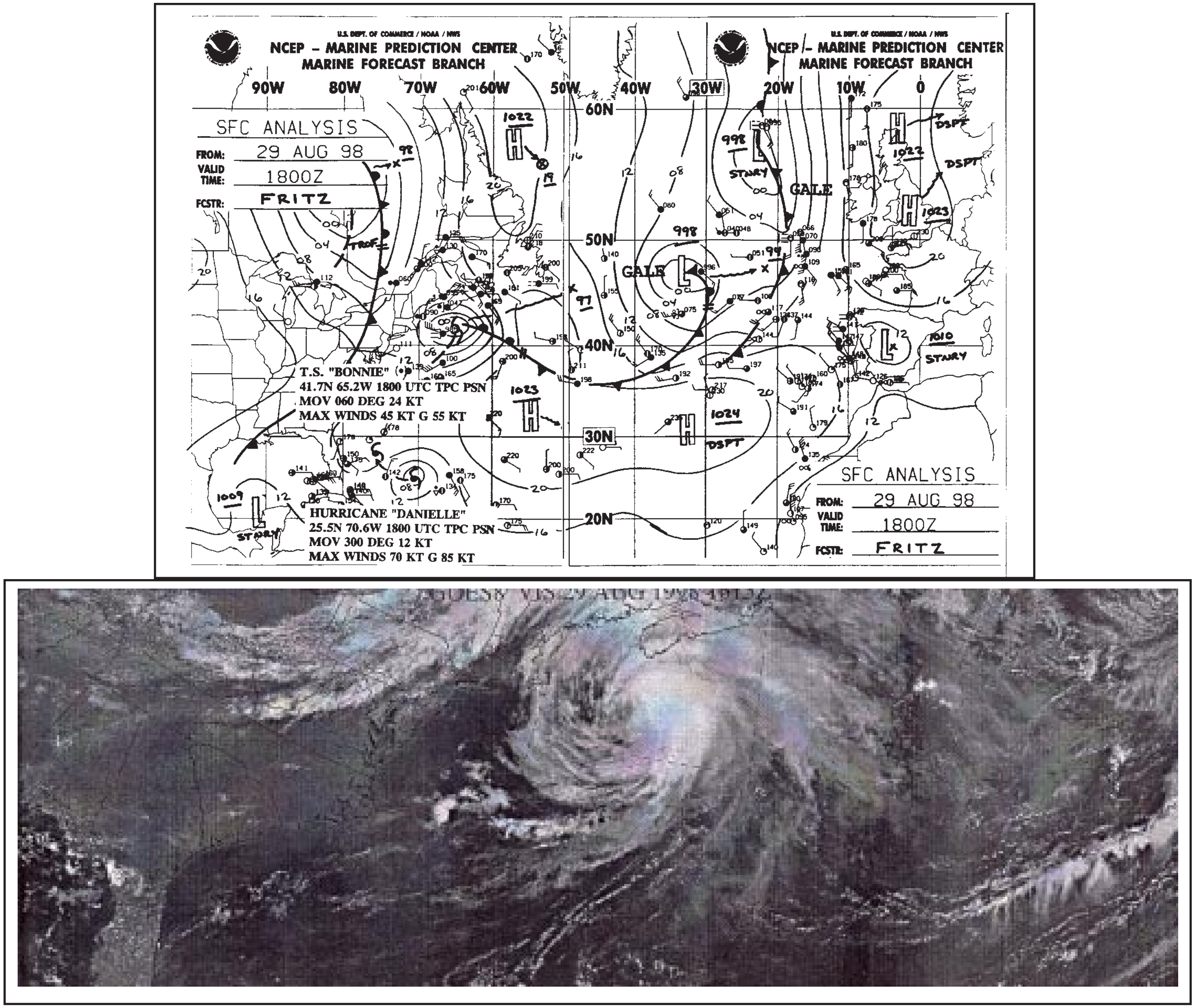


Figure 1. Surface analysis for 18Z 29 August 1998 and a visible GOES-8 satellite image valid at 1615Z 29 August 1998 showing Tropical Storm Bonnie becoming extratropical.

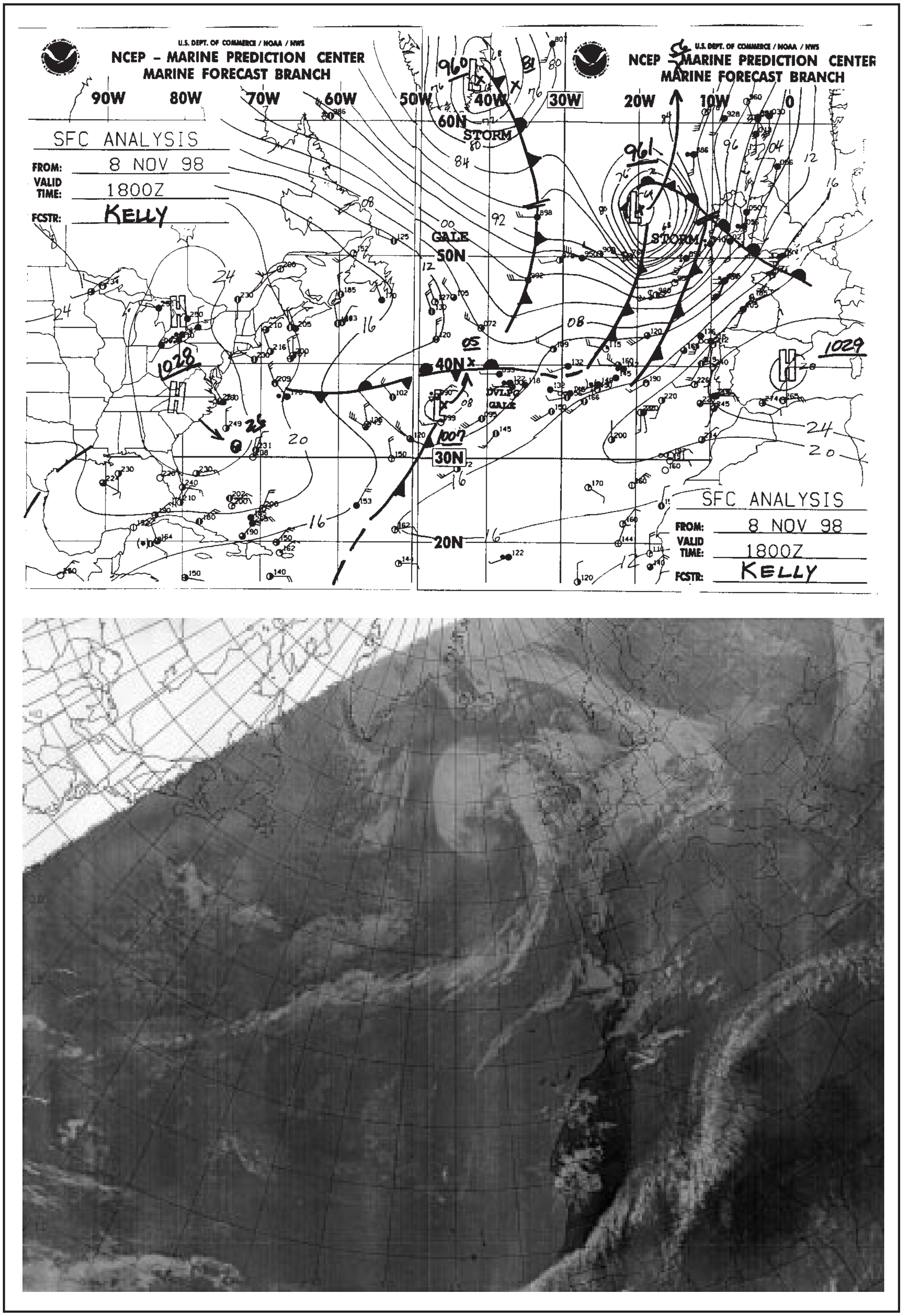


Figure 2. Surface analysis valid 18Z November 8 and a METEOSAT7 infrared image showing former Tropical Storm Mitch as an intense extratropical storm off Great Britain.

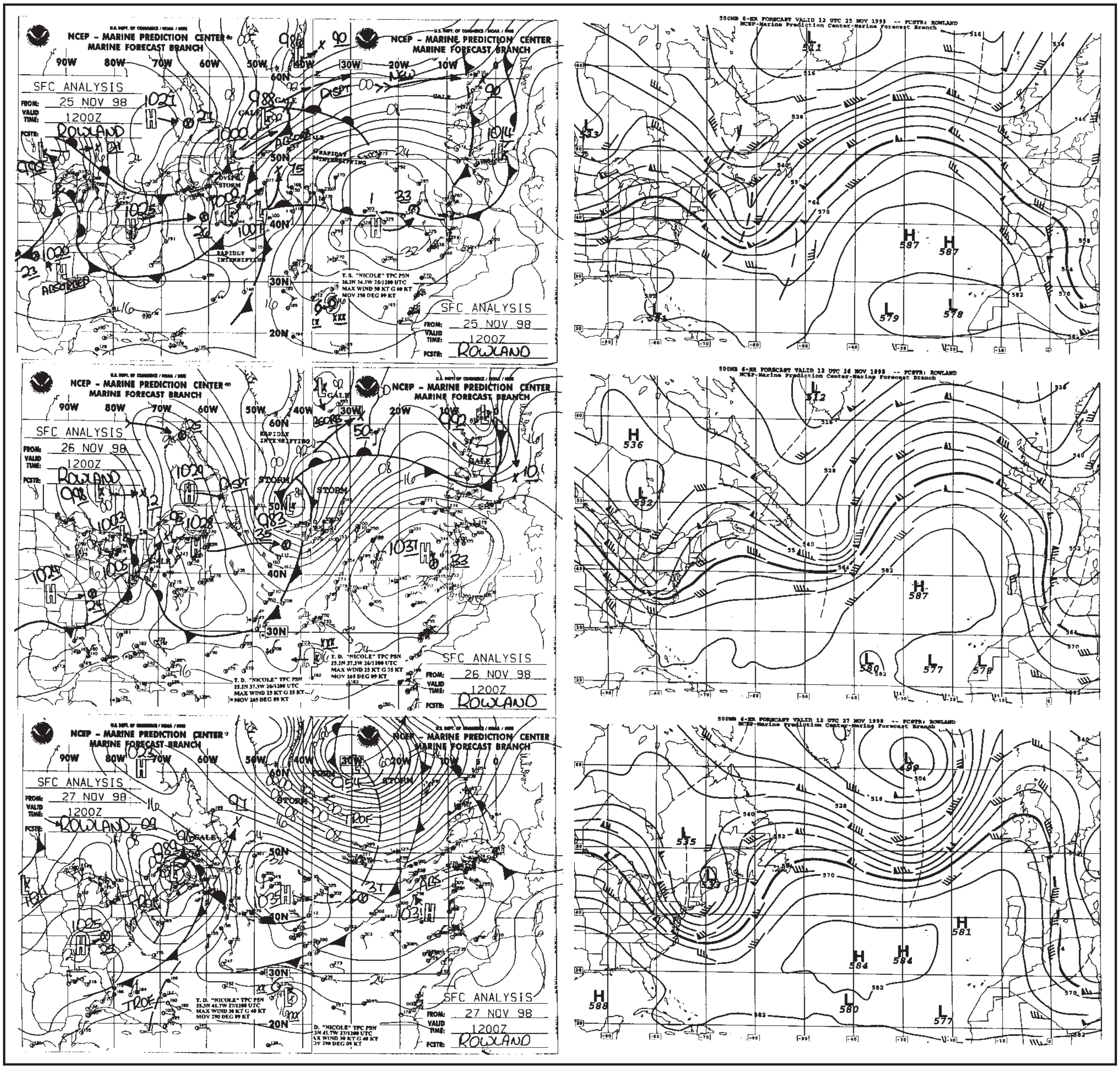


Figure 3. A three-panel display of surface analysis charts and corresponding 500 millibar analysis charts valid at (1) 12Z November 25, (2) 12Z November 26, and (3) 12Z November 27, 1998, depicting the rapid development of a North Atlantic storm.

North Atlantic Area

Continued from Page 33

about to merge with a polar front and become extratropical, and Hurricane Danielle to the south and beginning to recurve. The visible satellite picture shows Bonnie near the analysis time becoming more sheared, with the strong convection mainly east of the center prior to it becoming extratropical. The storm was accelerating at that time and became extratropical 24 hours later. At 00Z August 30, the center passed over the Canadian buoy 44142 (42.5N 64.0W) with pressure down to 989.3 mb. Buoy 44137 to the southeast at 41.8N 60.9W reported a southwest wind of 51 kt and 11 m (35 ft) seas at that time. These seas were higher than than those reported while the storm was a hurricane southeast of the Carolinas. The storm later weakened off the coast of Portugal on September 1. Danielle followed about four days later, missing the East Coast, but recurving and intensifying as an extratropical storm southeast of Cape Race by 18Z September 4. Danielle generated seas up to 16 m (52 ft) as it became extratropical. Later, as it approached Great Britain, it developed a pressure of 967 mb by 00Z September 6. A ship at 43N 23W reported winds to 55 kt and seas of 7 m (23 ft) at 06Z September 5. At 18Z September 6, seas built to 6 to 9 m (20 to 30 ft) west of the Bay of Biscay. Meanwhile the remains of Tropical Storm Earl moved along the Carolina coast on the night of September 3, with winds of 60 kt reported near the coast. Earl strengthened to 965 mb near Newfoundland on September 6. One ship reported a 55 kt southwest wind and 8 m (26 ft) seas near Cape Race. Hibernia Platform in the Grand Banks also reported 55 kt winds. The remains of Danielle and Earl merged into a gale system northwest of Great Britain on the 9th.

In late September three of the four hurricanes that formed in the Atlantic basin (Ivan, Karl, and Jeanne) recurved east as they weakened, with an upper ridge to the north suppressing their redevelopment into strong extratropical storms. In early October, Tropical Storm Lisa intensified and moved north along 40W as a hurricane. However, Lisa weakened abruptly east of Newfoundland on October 9 without becoming a significant extratropical storm.

Tropical Storm Mitch

Mitch became an extratropical storm after crossing Florida on November 5, and then tracked northeast to west of the British Isles on the 8th of November. There was a ship report at 36N 52W 00Z November 7, with a southwest wind 60 kt south of the center. Figure 2 is a surface analysis and infrared METEOSAT7 satellite image valid at or near 18Z on the 8th showing extratropical storm Mitch west of Great Britain with 50 to 60 kt wind reports south of the center. This system was still intensifying at the time, with the lowest central pressure at 948 mb near Iceland 24 hours later. This was one of the most intense lows of the August to November period in the North Atlantic.

Other Significant Weather

A strong upper level low near Greenland maintained a strong influence in November, causing several major developments of lows moving off the east coast of the U.S. and Canada. The redevelopment of Mitch is one of them, described above. Another rapidly deepening storm late in November developed from a cluster of weak lows in the Newfoundland area early on November 25 (Figure 3). The corresponding 500 mb charts are also shown. One finds four separate short wave troughs on the first panel of the Figure which merged with the Greenland upper low over the next 48 hours to form a deep surface and upper level system east of Greenland on the 27th. The pressure of the surface low was 951 mb six hours later (after the valid time of the third panel of Figure 3). Winds of 50 kt or more were reported as far south as 50N near the time of maximum intensity.⚓

Marine Weather Review
North Pacific Area
August through November 1998

George Bancroft
Meteorologist
Marine Prediction Center

The month of August started out more like mid-summer, with weak lows tracking across the northern Bering Sea into Alaska and others moving around the periphery of the North Pacific high pressure ridge which dominated the southern mid-latitudes. Some of these lows attained minimal gale strength. By the middle of the month, the upper air pattern amplified, resulting in stronger lows forming and moving northeast through the Bering Sea. One of these became the first low of the late summer-fall season to develop storm force winds (983 mb central pressure), before moving into mainland Alaska. This series of lows carved out an upper trough by late August over western Alaska and eventually extending into the Gulf of Alaska, setting the stage for a major storm in the Gulf of Alaska.

Gulf of Alaska Storm of August 30-31

Figure 1 depicts this development both at the surface and 500 mb. The long wave 500 mb trough is shown with a northern short wave trough from the Bering Sea coming into phase with a southern short wave rounding the base of the long wave trough. The surface system intensified to 976 mb as shown in the second panel of the figure. Figure 2 is a GOES-10 infrared satellite image of this storm approaching maximum intensity with surface data plotted. The CHEVRON MISSISSIPPI (WXBR) was just south of the center reporting a southwest wind of 63 kt and 13 m (44 ft) combined seas. Note that the ring cloud around the center of the storm near 51N 150W is a signa-

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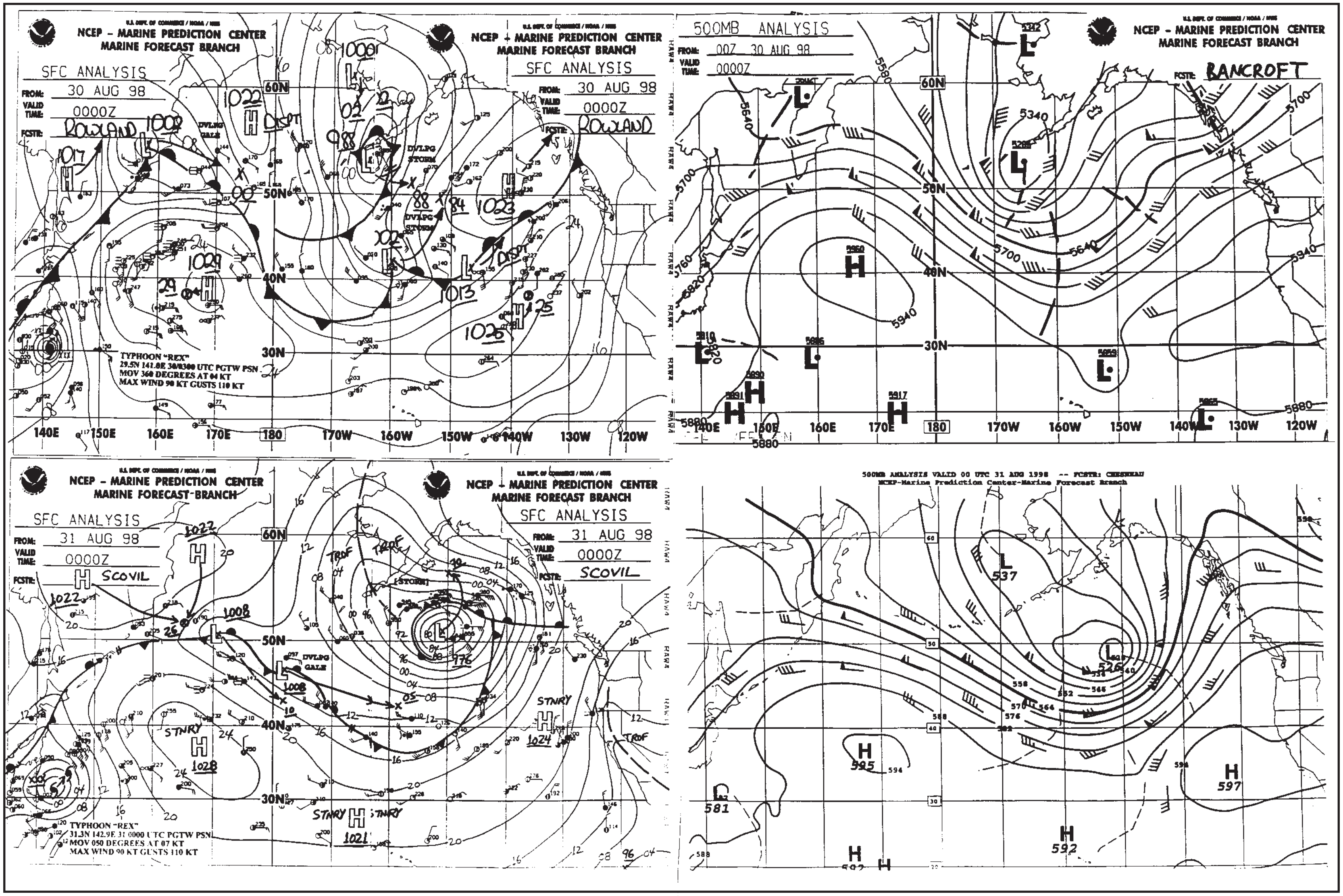

Figure 1. A two-panel display of MPC surface analysis charts and corresponding 500 millibar charts valid at (1) 00Z 30 August and (2) 00Z 31 August 1998.

North Pacific Area

Continued from Page 38

ture of unusually intense lows. The PRESIDENT ADAMS (WRYW) reported at 51.5N 150.5W three hours later with a southeast wind 40 kt close to the center and a pressure of 969 mb. The system was analyzed with 963 mb central pressure near Kodiak Island at 18Z August 31, before it moved northwest and weakened.

Typhoon Rex

September became active with several tropical cyclones, or their remnants. The first to affect the area was Rex, shown in the surface charts of Figure 1 as a typhoon south of Japan. Rex first appeared on the MPC surface analyses on August 26, and meandered northeast for more than a week. It weakened to a tropical storm on September 5, when it started to accelerate. Figure 3 shows Rex being picked up by two short wave troughs and becoming extratropical after merging with a polar front. The two short waves shown in the first panel of figure 3 merged and resulted in rapid intensification into an extratropical storm. The third surface chart of figure 3 has the same valid time as the second 500 mb chart of figure 3, revealing a deep vertically stacked storm. Ship data was lacking near the storm center at maximum intensity. MPC estimated winds to 60 kt and seas up to 11 m (35 ft). There were ship reports of 50 kt and 7 to 9 m seas (23 to 30 ft) southeast of the center at 00Z September 7, before the system became extratropical. This system subsequently began a slow weakening trend but still maintained 45 kt gales as it entered the Gulf of Alaska on September 9.

Three other tropical cyclones followed, with one of them, Stella, deepening like Rex after becoming extratropical, but not as rapidly.

Storm of October 24-27

This was perhaps the most significant event of the four month period in which four container vessels overtaken by this fast moving storm sustained cargo damage. The storm developed from a frontal wave passing south of Japan on October 24. Figure 4 shows the system deepening by 18 mb in a 12-hour period. It deep-

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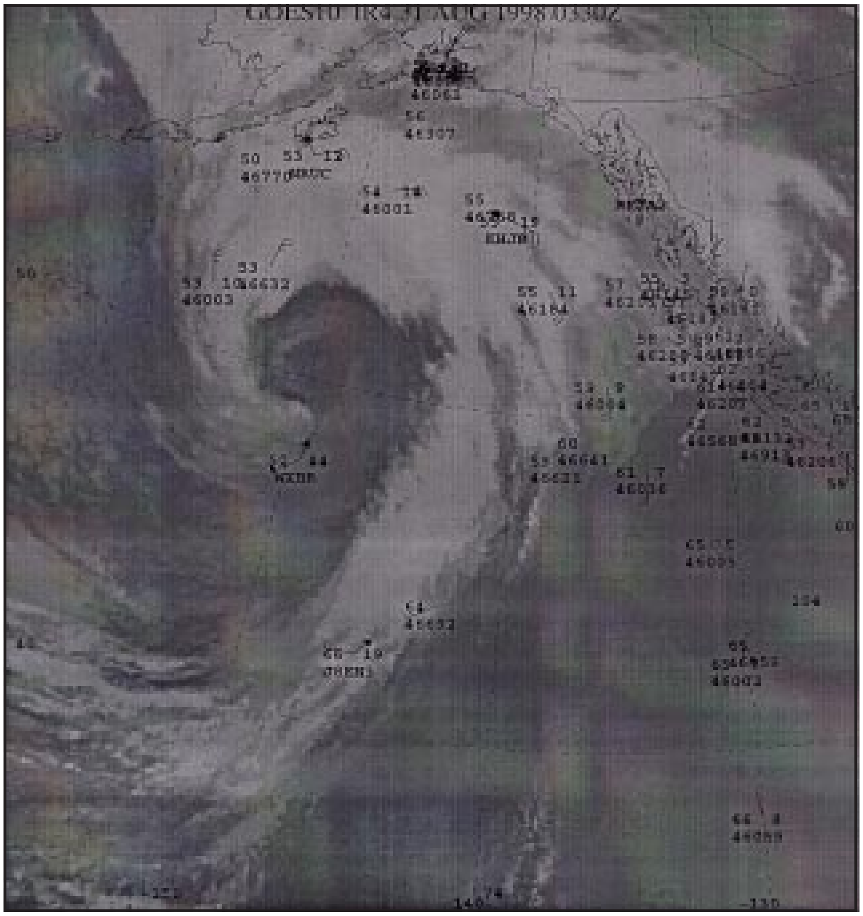

Figure 2. A GOES-10 infrared satellite image with plotted data showing the storm of August 30-31 near maximum intensity.

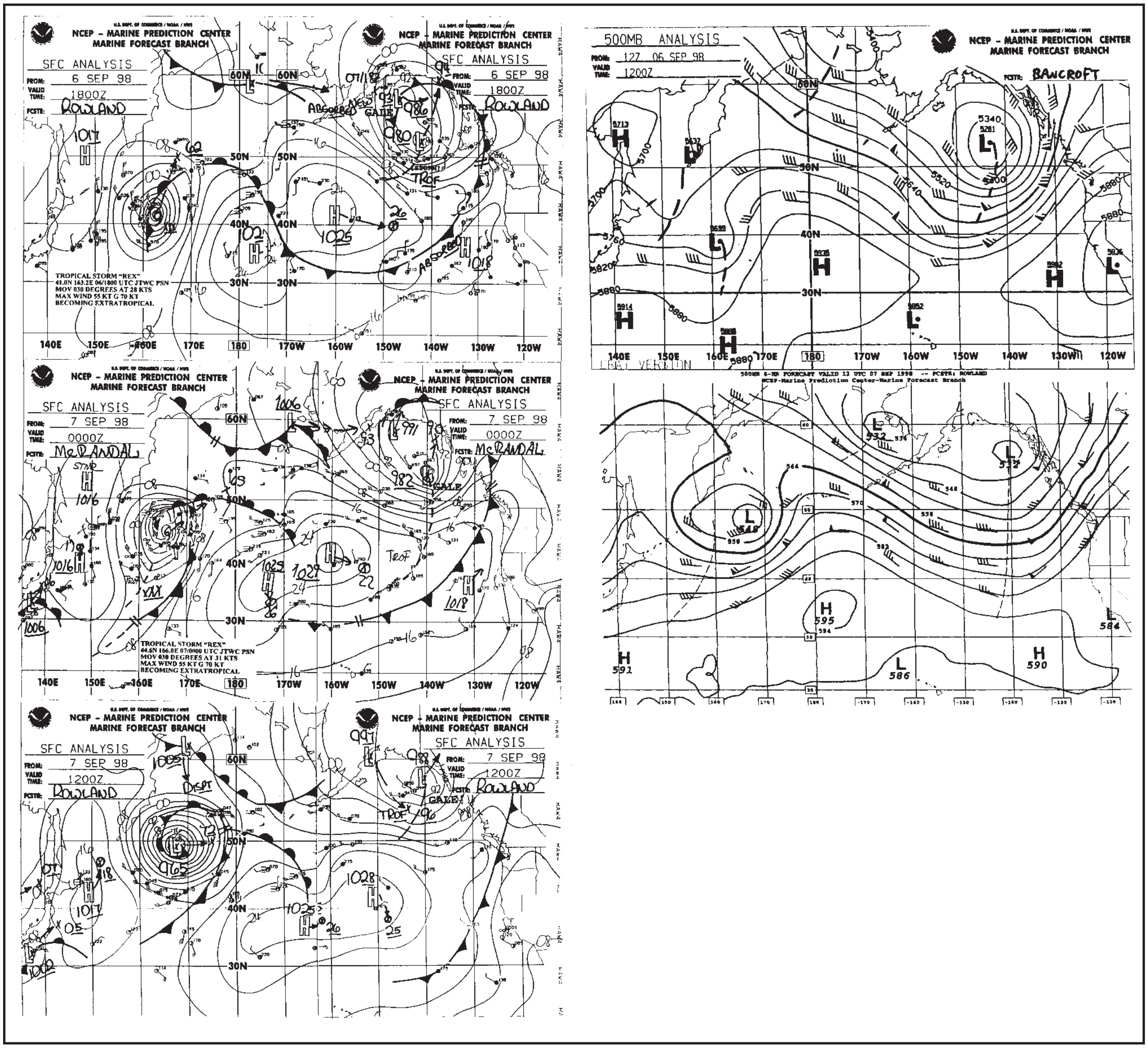

Figure 3. Surface analysis and 500 millibar charts covering the period from 12Z 06 September to 12Z 07 September 1998, depicting the transformation of Tropical Storm Rex into an intense extratropical storm.

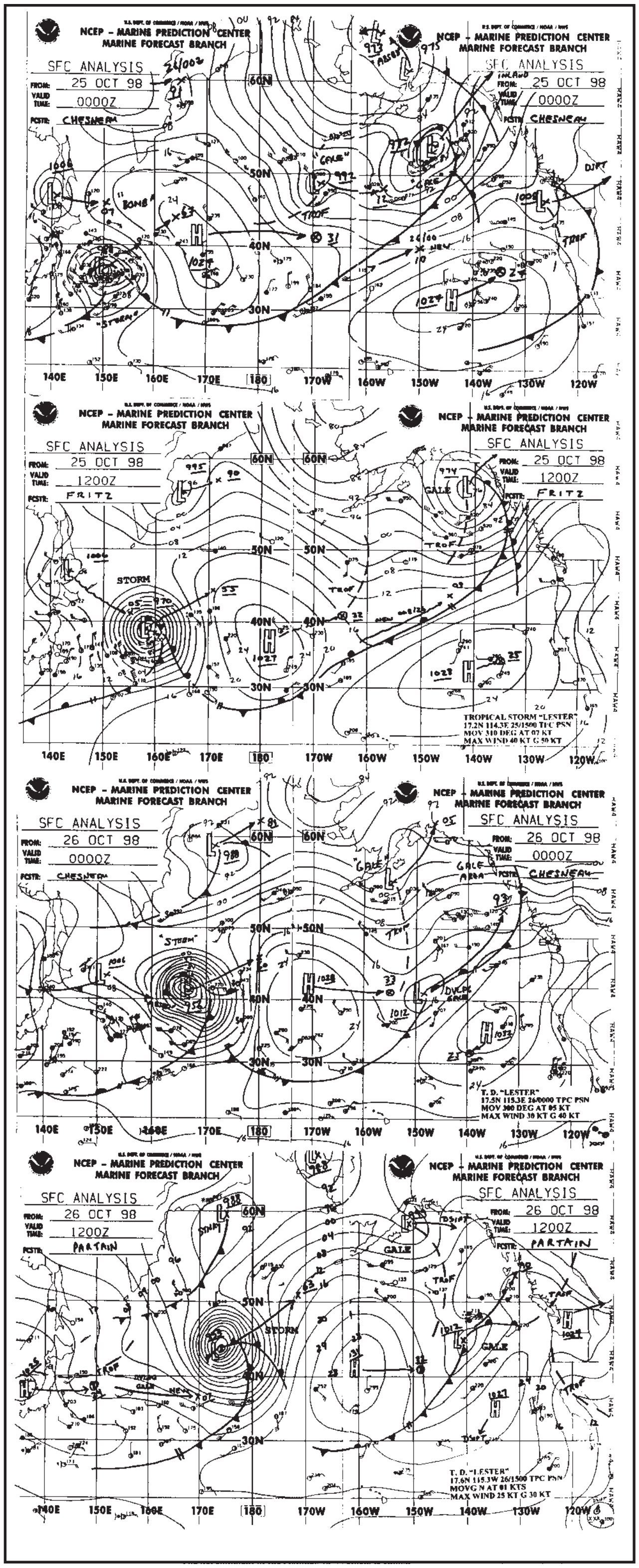

Figure 4. Four-panel display of surface analysis charts valid at 00Z and 12Z 25 October and 00Z and 12Z 26 October 1998. The development of the October 24-27 storm is shown.

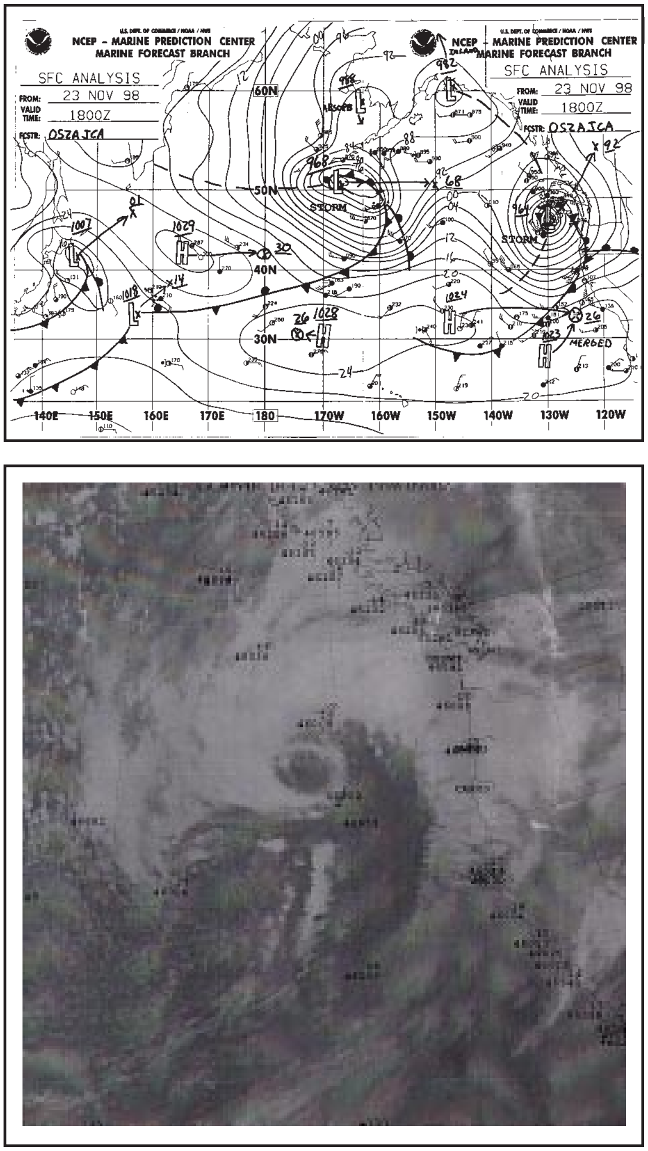

Figure 5. A surface analysis valid at 18Z November 23 and a GOES-10 infrared satellite image valid at 09Z November 23 (with plotted data) depicting the storm in Washington and Oregon offshore waters. White shades on the satellite image imply colder (higher) cloud tops.

North Pacific Area

Continued from Page 40

ened by another 14 mb in the 12-hour period ending at 00Z October 26. With this rate of intensification of more than 24 mb in 24 hours, this storm definitely qualifies as a “bomb.” The winds were reported as high as 100 kt and seas up to 19 m (60 ft) with this storm, and the minimum recorded pressure was 940 mb, 13 mb lower than than was analyzed by MPC. The APL CHINA (V7AL5) sustained the worst damage of the four vessels while encountering the storm near the International Dateline, losing 360 containers overboard and having a similar number remaining on board that were damaged.

Other reports from ships during this event showed winds as high as 50 to 60 kt (shown in Figure 4) and seas as high as 11 to 14 m (35 to 46 ft) from 12Z October 25 to 00Z October 26. The lowest analyzed central pressure was 953 mb. The storm then turned north and weakened by October 27 in the eastern Bering Sea.

See References for related articles.

Other Significant Events

Many significant gale and storm events occurred during October and November, a time of increasing strength, speed, and frequency of cyclonic systems as the fall season progressed. Lows moved along a southwest to northeast track from near or north of Japan to the Bering Sea, with lows sometimes redeveloping in the Gulf of Alaska. The southern stream storm track became more important as October progressed, producing the October 24-27 storm noted above. Another development off the southern storm track followed on November 9, near the Dateline. A ship just ahead of the front near 42N 164W reported a southeast wind of 50 kt and 11 meter seas (35 ft) at 00Z November 10. This storm deepened to 972 mb near 41N 168W early on the 10th before beginning to weaken. A series of developing storms tracked northeast into the Bering Sea early in November, with one attaining 952 mb in the northwest Bering Sea on November 11. Late in the month, the northern storm track was especially active, with systems moving east along or just south of the Aleutians to the Gulf of Alaska. The strongest of these dropped to 966 mb central pressure and took only two days to travel from 160E to the eastern Gulf of Alaska. Several ships south of the center reported 50 kt winds and seas up to 11 m (35 ft) on November 19 and 20. Late in the month, the upper level trough deepened in the Gulf of Alaska, steering lows on a more southern track toward Washington coast. One of these rapidly intensified as it approached the Pacific Northwest offshore waters on November 23, reaching 964 mb after deepening 36 mb in 24 hours. Figure 5 is a satellite photo of the storm approaching its peak with plotted data included, and a surface analysis for 18Z November 23, 9 hours later. This intense system, like the late August storm, has a “ring cloud” around the center, a location for tight pressure gradients and high winds. Note the 60 kt ship report from the MARIT MAERSK (OZFC2) near the center. From 18Z November 23 to 00Z November 24, seas were reported at 8 to 11 meters (25 to 35 ft) south of the storm center with the highest from a ship at 46N 132W at 00Z November 24. Buoy 46050, near the Oregon coast, reported seas to 9.5 m (32 ft). Destruction Island, off the Washington coast, reported peak winds of 70 kt at 05Z on November 24. This was the beginning of a period of active weather in late November, with both northern and southern storm tracks impacting the U.S. West Coast offshore waters.

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Sienkiewicz, Joe and Chesneau, Lee, *Mariner’s Guide to the 500-Millibar Chart* (Mariners Weather Log, Winter 1995).⚓

Tropical Prediction Center
September 1998 through December 1998

Dr. Jack Beven
Tropical Prediction Center
National Hurricane Center
11691 SW 17th Street
Miami, FL 33165-2149

I. Introduction

Sea surface temperature anomalies in the tropical Eastern Pacific changed from warm to cold, showing a change from El Niño to La Niña conditions. This aided well above normal tropical cyclone activity in the Atlantic, which saw 14 tropical storms during the 1998 season (Figure 1). Nine storms became hurricanes, with three becoming major hurricanes (winds 100 kt or greater). A 35-day period from 19 August through 23 September saw ten tropical storms develop, making it one of the most active times ever in the Atlantic. Four hurricanes existed simultaneously on 25-26 September.

The Eastern Pacific basin produced 13 tropical storms during 1998 (Figure 2), of which nine became hurricanes and six major hurricanes. Two non-developing depressions also occurred.

Most 1998 tropical cyclones formed from tropical waves. Several waves spawned cyclones while interacting with an unusually strong monsoon environment over the Gulf of Mexico and Eastern Pacific.

II. The Gulf of Mexico/East Pacific Monsoon of 1998

The word “monsoon” derives from the Hindi word for season and refers to seasonal wind and weather changes over India. In summer, southwest winds bring moisture and considerable rainfall. In winter, north and northeast winds bring cooler and dryer air.

These changes are due to movements of the Intertropical Convergence Zone (ITCZ), which is also called the monsoon trough. In the

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Tropical Prediction Center

Continued from Page 44

northern hemisphere summer, the ITCZ moves north across India and brings southwesterly flow behind it. In the northern hemisphere winter, the ITCZ moves south across the Equator with northeasterly flow north of the Equator.

Similar monsoon trough behavior occurs over much of the world, with two notable exceptions, the Atlantic and eastern Pacific. The Atlantic ITCZ, while migrating with the seasons, usually does not show monsoon-type wind flows except near the African coast. Exceptions occurred during the active Atlantic hurricane season of 1995 and 1996, when the ITCZ more resembled a western Pacific monsoon trough.

The Eastern Pacific ITCZ shows monsoon trough characteristics during the northern hemisphere summer but not during the southern hemisphere summer. It occasionally extends into the Western Caribbean Sea, particularly in May/June and October/November. This produces monsoon-type wind flows in this area.

The monsoon trough is a natural spawning ground for tropical disturbances. These include large low pressure areas called monsoon depressions that have very broad centers. Associated strong winds (often 30-40 kt) and convection are usually 100 nm or more from

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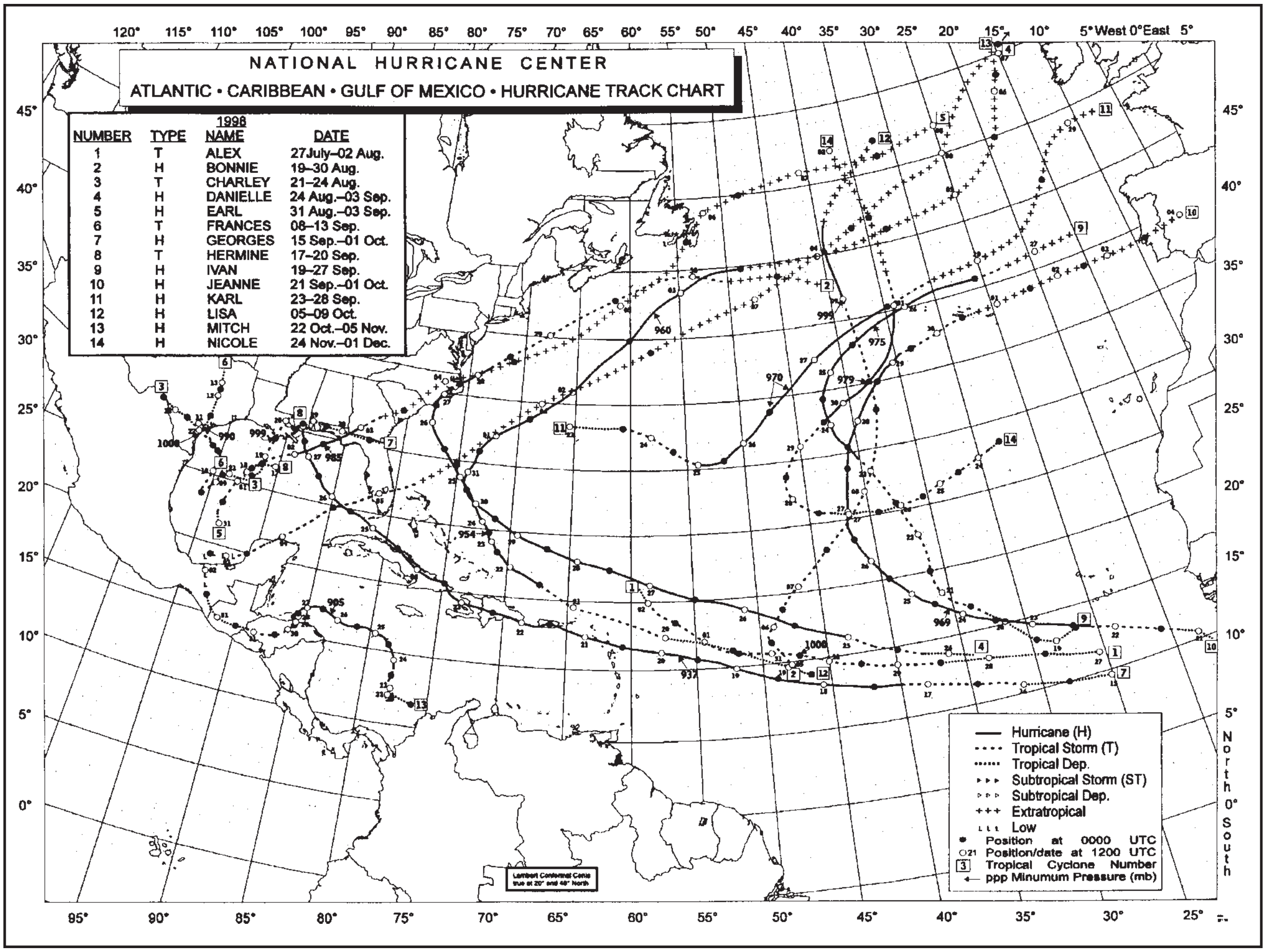

Figure 1. The 1998 Atlantic hurricane and tropical storm tracks.

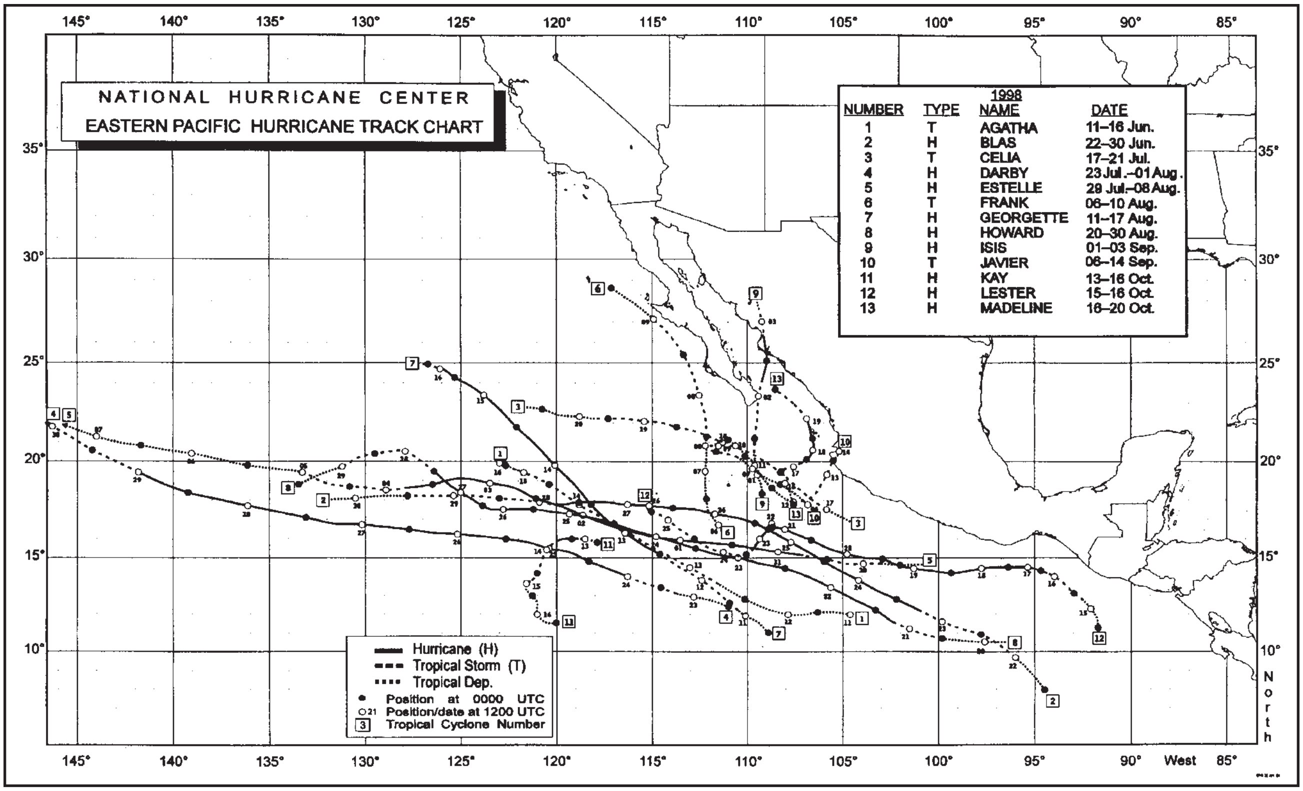

Figure 2. The 1998 Eastern Pacific hurricane and tropical storm tracks.

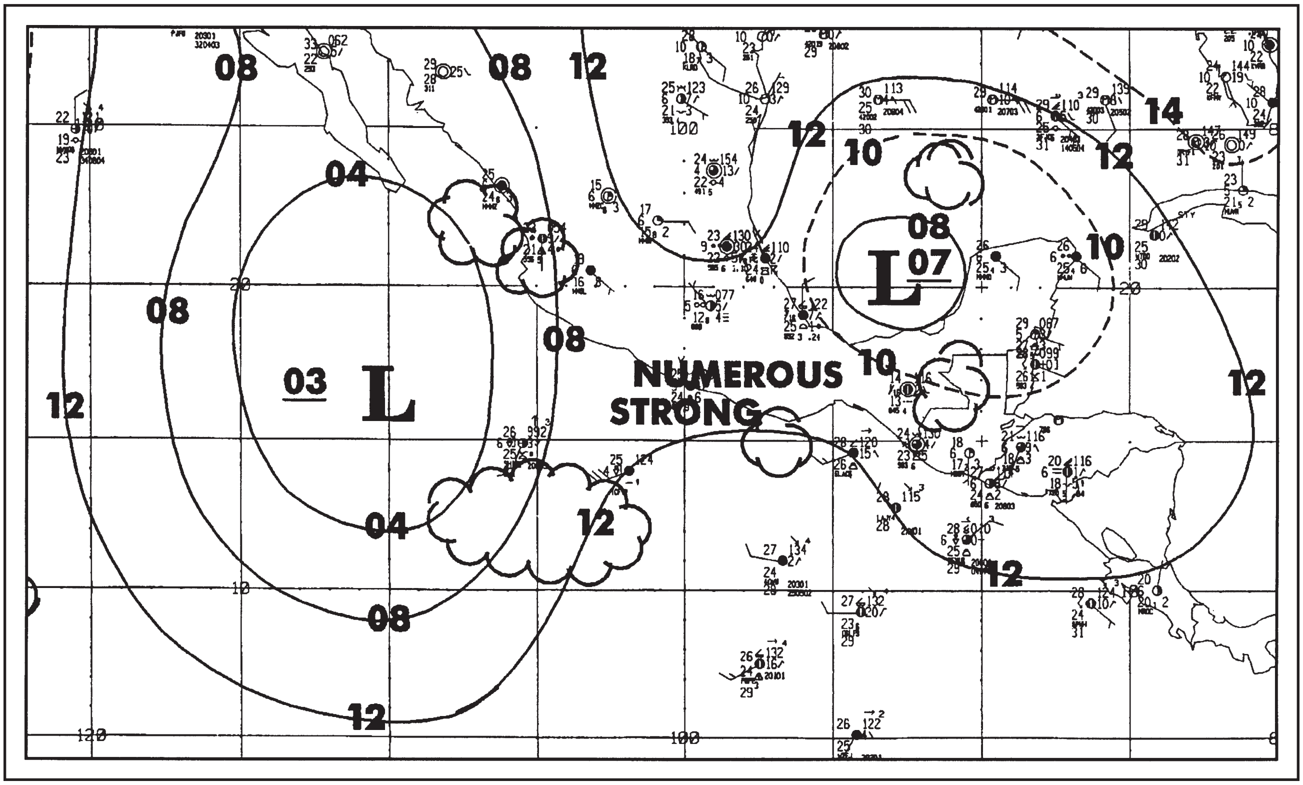

Figure 3. TAFB surface analysis at 0600 UTC 31 August showing the pre-Earl and pre-Isis disturbances.

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the center. Monsoon depressions lack the structure of a tropical cyclone. However, they can develop into tropical cyclones if convection forms near the center.

The period 25 August through 10 September 1998, saw an unusually strong monsoon trough form from the western Gulf of Mexico across Mexico into the Pacific. The trough helped spawn Hurricane Earl and Tropical Storm Frances in the Gulf, and Hurricane Isis and Tropical Storm Javier in the Pacific. All four systems were formed from tropical waves. However, interaction with the monsoon gave them monsoon depression characteristics during their initial development.

Figure 3 shows the Tropical Prediction Center (TPC) Tropical Analysis and Forecast Branch (TAFB) surface analysis for 0600 UTC 31 August showing the pre-Earl and pre-Isis disturbances. Notice the large size of both systems, with the pre-Isis low already 900 nm wide. Both systems were producing 25-30 kt winds at this time but lacked the organized convection needed for tropical depressions. That soon formed, as Earl became a tropical storm later that day and Isis the next day.

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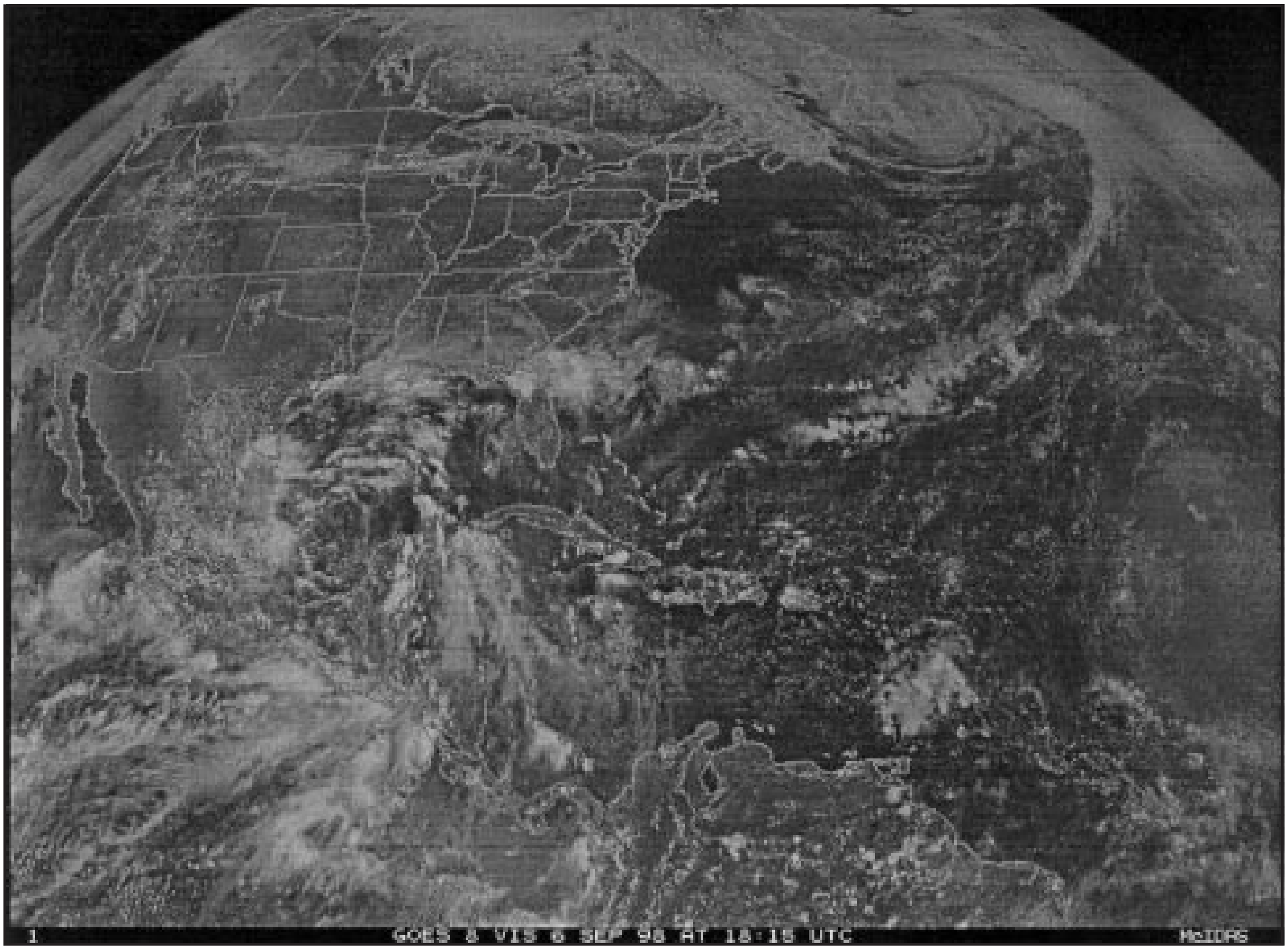

Figure 4. GOES-8 visible image at 1815 UTC 6 September 1998 showing the just developed Tropical Depression Javier (south of Baha, California off the Mexican coast) and the pre-Frances disturbance (in the Western Gulf of Mexico). Image courtesy of the National Climatic Data Center (NCDC).

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Figure 4 shows a GOES-8 visible image at 1815 UTC 6 September. At the far left is Javier, which has just become a tropical depression. The large cloud swirl covering the western Gulf of Mexico and adjacent land areas is the pre-Frances low, which lacks organized convection. Notice the large area of clouds over the Pacific south of southeastern Mexico and Central America. This is associated with 20-25 kt southwest monsoon flow.

A similar but weaker surge occurred in October. This helped develop Mitch, Kay, Lester, Madeline, and a Gulf of Mexico low.

Monsoon trough development this strong is unusual over the eastern Pacific and rare over the Gulf of Mexico. However, similar (but weaker) development was seen there during the 1995 hurricane season (Landsea et al., 1998). One such episode helped produce Tropical Storm Gabrielle in the Gulf and Hurricane Flossie in the Pacific.

III. Significant Weather of the Period

Note: All times are UTC unless stated otherwise.

A. Tropical Cyclones: Eight hurricanes and one additional tropical storm developed in the Atlantic basin during the period, with an additional hurricane (Earl) left over from August. Two of these became major hurricanes. The Eastern Pacific produced six cyclones, of which five became tropical storms and four became hurricanes. One reached major hurricane status.

1. Atlantic:

Hurricane Earl: As the period opened, Tropical Storm Earl was strengthening over the western Gulf of Mexico (Figure 1). An upper level trough steered the cyclone north-northeast on 1 September and northeast for the rest of its life. Earl reached hurricane strength on 2 September with a peak intensity of 85 kt later that day. A weakening hurricane made landfall over Panama City, Florida, early on 3 September. It weakened and became extratropical over the southeastern U.S. later that day. Extratropical Earl was trackable until 8 September, when it was absorbed by a larger low (ex-Hurricane Danielle) over the north Atlantic.

The combination of monsoon characteristics and trough interaction gave Earl a non-classical structure. An eye never formed, and the strongest winds were in a band well east of the center.

Strong winds affected the central and eastern Gulf. A U.S. Navy ship reported 40 kt winds with gusts to 70 kt and a pressure of 989.7 mb at 2100 2 September. Buoy 42039 reported 45 kt winds with gusts to 63 kt and a pressure of 989.4 mb on 3 September. The minimum pressure recorded by reconnaissance aircraft was 985 mb on 3 September.

Earl was responsible for three deaths and U.S. damages of $79 million.

Tropical Storm Frances: Frances' initial development was similar to Earl's a week earlier. The cyclone first developed over the southern Gulf of Mexico and northwest Caribbean on 4 September. It drifted northwest and became Tropical Depression Six about 140 nm east of Brownsville, Texas, on 8 September (Figure 1). An erratic southward drift occurred on 9 September. This was followed by a north-northwest motion the next day as the system became a tropical storm. Frances reached a peak intensity of 55 kt at landfall just north of Corpus Christi, Texas, early on 11 September. The cyclone looped near the coast after landfall, and it remained a tropical storm until 12 September. A northward track resumed later that day, and the remnant low moved into the central U.S. before dissipating on 14 September.

Frances' size produced a large area of tropical storm force winds mainly east of the center. The Coastal Marine Automated Network (C-MAN) station at Sea Rim State Park, Texas, reported 44 kt winds with gusts to 57 kt at 1210 11 September. Buoy 42002 reported 38 kt winds with a gust to

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50 kt at 0550 the same day. Two offshore oil rigs, the K7R8 and the KS58, reported hurricane- force gusts of 77 kt and 70 kt respectively. Minimum pressure reported by reconnaissance aircraft was 990 mb just before landfall.

A Louisiana tornado caused the only known fatality in Frances. Widespread heavy rains of up to 16 inches across eastern Texas and Louisiana caused flooding that contributed most of the $500 million damage estimated for the storm.

Hurricane Georges: This classic Cape Verde hurricane began when a tropical wave spawned Tropical Depression Seven near 10N 25W on 15 September (Figure 1). The cyclone followed a general west to west-northwest track for the next ten days, reaching tropical storm and hurricane strength on 16 and 17 September, respectively. Faster strengthening occurred on 19 September (Figure 5), and Georges reached a peak intensity of 135 kt and an aircraft-measured minimum pressure of 937 mb early the next day. Georges moved through the Leeward Islands, the

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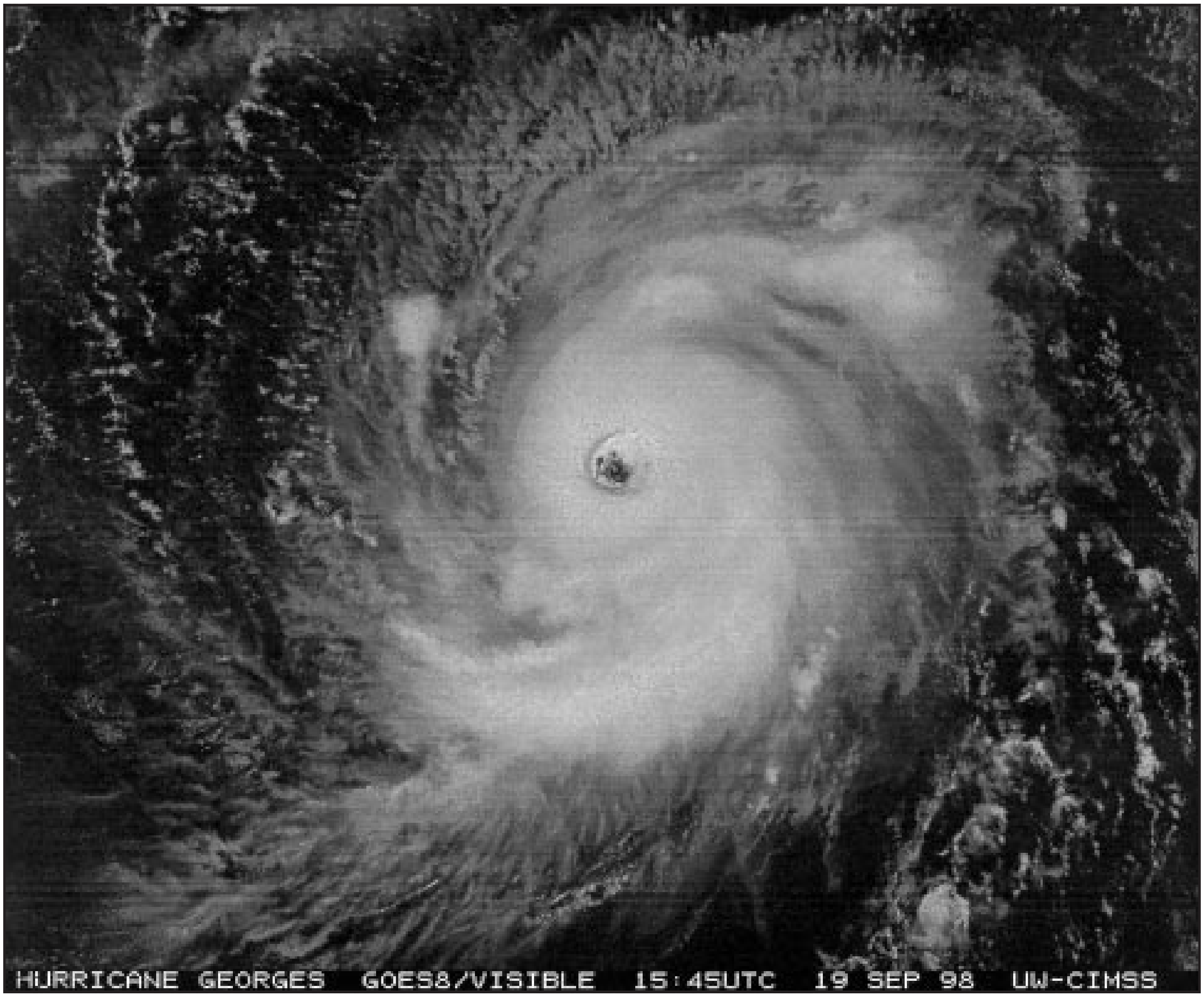

Figure 5. GOES-8 visible image of Hurricane Georges at 1545 UTC 19 September 1998. Image courtesy of the Cooperative Institute for Meteorological Satellite Studies (CIMSS).

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Virgin Islands, and Puerto Rico on 21 September with 90-100 kt winds. It smashed into the Dominican Republic the next day with 105 kt winds. This encounter weakened the cyclone, and it moved across Haiti into eastern Cuba as a minimal hurricane on 23 September. Slow re-intensification occurred on 24-25 September as Georges moved along the north Cuban coast and across Key West, Florida. A northwest motion occurred on 26-27 September as the hurricane maintained 90-95 kt winds (Figure 6). A northward turn took place on 28 September, which brought Georges to a final landfall near Biloxi, Mississippi. After a loop, Georges moved east and merged with a frontal system near the Georgia coast on 1 October.

Ships generally avoided Georges. The PROJECT ARABIA reported 44 kt sustained winds and a 1002.9 mb pressure at 1500 29 September. Nearer the coast, the C-MAN station at Sombrero Key, Florida, reported 81 kt winds with gusts to 92 kt at 1500 25 September. Buoy 42040 reported 54 kt winds with gusts to 68 kt at 1900 27 September and a minimum pressure of 963.4 mb four hours later. The buoy also reported significant wave heights of 36 ft.

Georges is responsible for an estimated 601 deaths, primarily due to flooding and mudslides in the Dominican Republic and Haiti. Total damage figures are not known. However, U.S. damages are estimated at $5.91 billion including $3.5 billion in Puerto Rico.

Tropical Storm Hermine: Tropical Depression Eight formed in the central Gulf of Mexico near 27N 90W on 17 September (Figure 1). The system's origins were complex, involving two tropical waves, an upper level low, and the remains of the monsoon flow over the Gulf. The cyclone made a slow cyclonic loop that ended with a northward track on 19 September. It reached tropical storm strength later that day. Hermine reached a peak intensity of 40 kt and an aircraft-measured minimum pressure of 999 mb just before landfall near Cocodrie, Louisiana, early on 20 September. The system dissipated over land later that day.

Oil rig KS58 reported 42 kt winds with gusts to 51 kt at 1345 19 September. The TMM Mexico (XCMG) reported 35 kt winds at 1200 the same day.

Two associated tornadoes caused the one injury and minor damage associated with Hermine.

Hurricane Ivan: Tropical Depression Nine formed from a tropical wave near 13N 27W on 19 September (Figure 1). Initially moving west, the cyclone turned northwest the next day and continued this motion through 21 September. The depression became Tropical Storm Ivan late on 20 September, and slow strengthening continued for the next two days despite interaction with two upper level troughs. Ivan moved north-northwest from 22-24 September and reached hurricane strength early on the 24th. The hurricane recurved northeastward on 25-26 September, while reaching a peak intensity of 80 kt (Figure 6). Weakening followed as Ivan turned east, and it became extratropical about 300 nm northeast of the Azores on 27 September.

The TINEKE reported 89 kt winds at 0300 24 September. However, the reliability of the report is suspect. The highest reliable winds are from the SLAVONIJA and HADERA, which reported 35 kt at 0600 22 September and 1200 23 September respectively.

There are no reports of damage or casualties from Ivan.

Hurricane Jeanne: Tropical Depression Ten formed from a tropical wave near 10N 17W late on 20 September (Figure 1). The genesis was unusually far east for an Atlantic tropical cyclone, as only one other known cyclone (Tropical Storm Christine in 1973) formed further east. Moving west-northwest, the cyclone reached tropical storm strength on 21 September, and hurricane strength the next day. It reached a peak intensity of 90 kt on 24 September. Jeanne followed a smooth curve track around an eastern Atlantic ridge, turning northwest by 25 September, north on 26 September, northeast by 28

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September, and east by 30 September. The cyclone maintained hurricane strength until 29 September, and then rapidly weakened. It was a depression when it passed through the Azores on 30 September, and it became extratropical just east of the islands later that day. Extratropical Jeanne continued east and moved into Portugal on 4 October.

A French drifting buoy reported 75 kt winds at 1900 26 September. The TEIGNBANK and AUCKLAND STAR reported 36 kt winds at 1200 and 1800 28 September respectively. Gusts to 35 kt were reported in the Azores.

There are no reports of damage or casualties from Jeanne.

Hurricane Karl: A non-tropical low formed near the coast of the Carolinas on 21 September, and tracked east. Convection became better organized, and the low became Tropical Depression Eleven about 50 nm west-northwest of Bermuda on 23 September (Figure 1). The depression turned east-southeast and reached tropical storm strength on 24 September. This was followed by an eastward turn and hurricane strength the next day. When Karl became a hurricane, it marked the first time since 22 August 1893, that four Atlantic hurricanes existed simultaneously (Figure 6). Karl turned northeast on 26 September, and this motion continued for the rest of the

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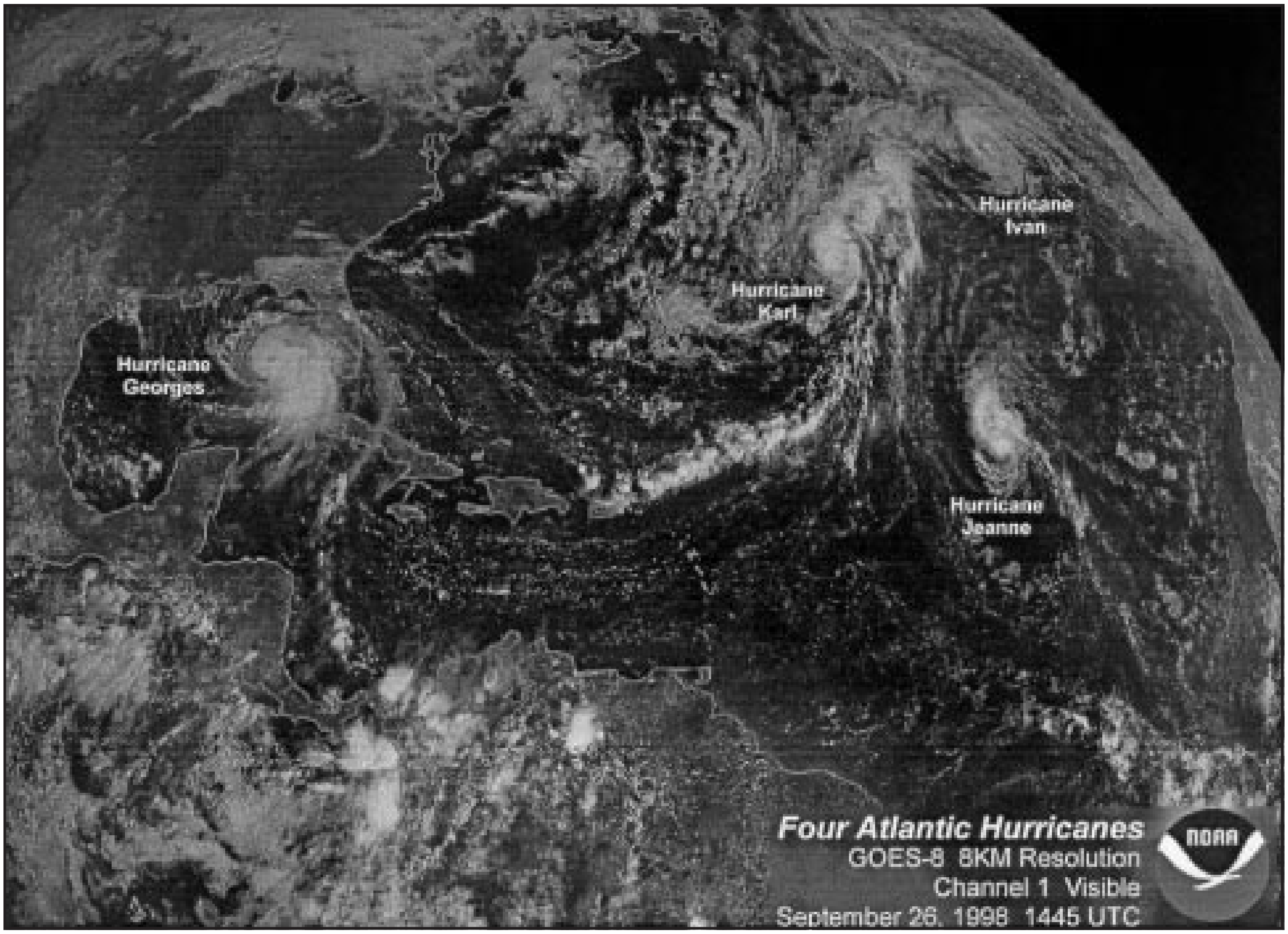

Figure 6. GOES-8 visible image of the four Atlantic hurricanes at 1445 UTC 26 September 1998. Image courtesy of National Climatic Data Center.

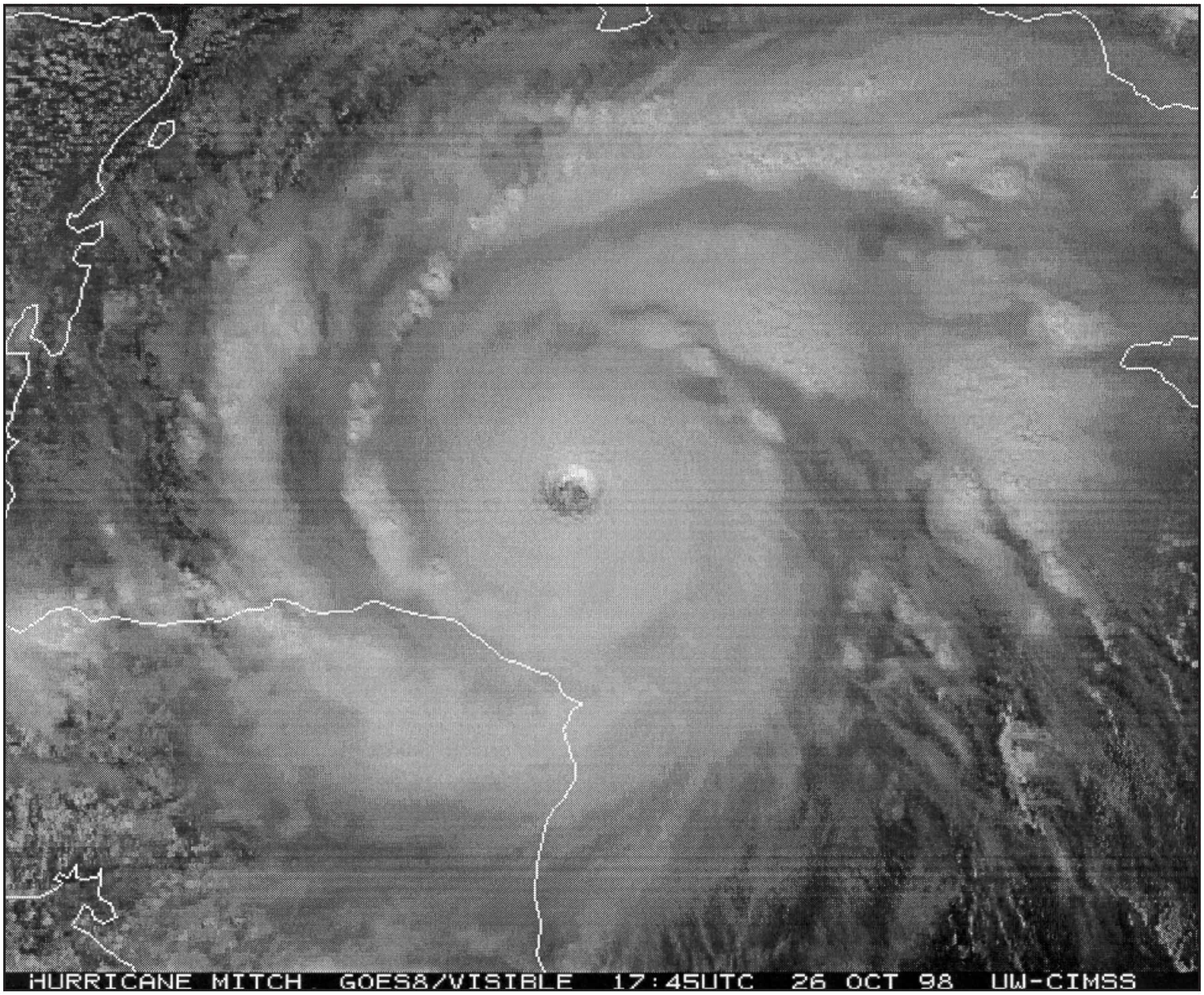

Figure 7. GOES-8 visible image of Hurricane Mitch near peak intensity at 1745 UTC 26 October 1998. Image courtesy of CIMSS.

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storm's life. It reached a peak intensity of 90 kt on 27 September. The hurricane weakened to a tropical storm on 28 September, and became extratropical later that day about 180 nm north of the Azores. Extratropical Karl was trackable until just west of France on 29 September. There are no reports of damage, casualties, or tropical storm force winds from Karl.

Hurricane Lisa: A tropical wave spawned Tropical Depression Twelve near 14N 46W on 5 October (Figure 1). Despite strong wind shear, the system became a tropical storm later that day. Initially moving northwest, Lisa recurved northeast on 6 October, and this motion continued until a northward turn on 8 October. Acceleration occurred with the forward speed exceeding 50 kt by late on 9 September. Lisa briefly became a minimal hurricane on that day, and it became extratropical near 52N 32W early the next day.

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A NOAA drifting buoy reported 35 and 36 kt winds at 0850 and 2138 5 October, which helped determine that Lisa had become a tropical storm. The CHIQUITA FRANCES reported 61 kt winds at 1800 9 October.

There are no reports of damage or casualties from Lisa.

Hurricane Mitch: This classic late-season Caribbean hurricane began when a tropical wave spawned Tropical Depression Thirteen near 12N 76W early on 22 October (Figure 1). Initially moving west, the system reached tropical storm strength later that day. Mitch made a small loop on 23 October. This was followed by a northward motion on 24 October as it reached hurricane strength. Mitch turned to a west to west-northwest track on 25-26 October, while rapidly intensifying. Maximum sustained winds reached 155 kt at 1800 26 October, with an aircraft-measured central pressure of 905 mb (Figure 7). Mitch weakened while moving west-southwest on 27 October, and further weakening took place when the storm stalled near 16N 86W the next day. It drifted south on 29 October, which brought Mitch across the coast of Honduras with 85 kt winds. The cyclone moved south and southwest across Central America on 30 October. Since the large circulation covered parts of both the Caribbean and the Pacific, Mitch was slow to weaken. It remained at tropical storm strength until late on 31 October, while moving west over land.

Most tropical cyclones die after several days over land, but Mitch proved quite tenacious. The remnant low continued west and northwest across Central America and Mexico, and it emerged over the southwest Gulf of Mexico on 2 November. It recurved northeast and re-intensified into a tropical storm the next day. The reborn Mitch moved northeast across the Yucatan Peninsula on 4 November, and the Florida Peninsula on 5 November. It became extratropical over the Atlantic later that day. Extratropical Mitch continued to pack a punch. The storm was tracked until it was northwest of the British Isles on 9 November, and associated gales continued for 2-3 days after Mitch moved north of 31N.

The 905 mb central pressure is the lowest observed pressure of record in an October Atlantic hurricane. It also ties Mitch with Hurricane Camille for the fourth lowest observed in Atlantic hurricanes. Only Hurricane Gilbert of 1988 (888 mb), the Florida Keys Labor Day Hurricane of 1935 (892 mb), and Hurricane Allen of 1980 (899 mb) are known to have lower pressures.

Mitch had wide-ranging marine effects. Many ships reported tropical storm force winds, including the SEABOARD MARINER (C6HH3) with 54 kt at 1500 31 October and the CARNIVAL DESTINY (3FKZ3) with two reports of 48 kt on 4 November. The C-MAN station at Fowey Rocks, Florida, reported 52 kt winds with gusts to 63 kt at 1300 5 November. Swells produced by the hurricane over the Caribbean spread for hundreds of miles and were felt along the northern Gulf of Mexico coast.

Great intensity, large size, and slow movement combined to produce a ghastly tragedy over Central America. An estimated 9,055 people were killed, mainly in Honduras and Nicaragua. At least that many more are missing. Property damage is in the billions. The vast majority of the damage and casualties were from prolonged heavy rains and flooding, not winds and storm surge. However, the sailing ship FANTOME was lost in Mitch near Guanaja Island, Honduras, on 27 October. All 31 aboard perished after an extensive search found only small amounts of debris from the ship.

Hurricane Nicole: This late season hurricane developed into a tropical depression and tropical storm near 28N 28W on 24 November (Figure 1). It formed from a non-tropical low that had persisted in eastern Atlantic for two weeks. The track was a smooth curve: an initial west-southwest motion, then west on 26-28 November, then recurvature

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northeastward on 28-30 November, followed by a northward acceleration on 1 December. The intensity was not so simple. An initial rapid development to 60 kt on 24 November was followed by gradual weakening to a depression on 26 November. Regeneration to a tropical storm occurred late on 27 November, with hurricane status reached on 30 November. A peak intensity of 75 kt occurred early on 1 November. Nicole weakened to a tropical storm before becoming extratropical later that day near 43N 34W.

The MAGIC confirmed satellite estimates that Nicole had developed. It reported 36 kt winds at 1200 24 November, and 58 kt winds six hours later. Additionally, the MOSEL ORE (ELRE5) reported 49 kt winds at 0900 1 December.

There are no reports of damage or casualties from Nicole.

2. Eastern Pacific:

Hurricane Isis: The disturbance that became Isis first developed in the last few days of August. A weak tropical wave interacting with the monsoon spawned a broad low on 29 August, several hundred miles west-southwest of the Mexican coast. The low grew in both size and strength as it moved north (Figure 3). Associated convection became better organized and the system became a tropical depression near 18N 109W early on 1 September (Figure 2). Ship reports indicated the system became a tropical storm later that day. Isis continued north for the rest of its life. It crossed the southern tip of Baja, California, as a tropical storm on 2 September, then it reached a peak intensity of 65 kt later that day. The hurricane maintained this intensity until landfall near Los Mochis, Mexico, early on 3 September. Isis dissipated over northwest Mexico early the next day.

The TCFC (name not available) reported 40 kt winds at 1800 1 September, and 45 kt winds at 0000 2 September. The AMTC (name not available) reported 54 kt winds and a 997.6 mb pressure at 0600 2 September, while the DOLE ECUADOR reported Beaufort force 10 (48-55 kt) and a 993 mb pressure at 2300 1 September.

Isis was responsible for eight deaths in Mexico. Hundreds of homes were reported destroyed.

Tropical Storm Javier: Javier formed from the interaction of the monsoon flow with a tropical wave which spawned Atlantic Hurricane Danielle. The monsoon depression developed off the Mexican coast on 5 September. It consolidated into Tropical Depression Eleven-E near 18N 107W on 6 September, and into Tropical Storm Javier the next day (Figure 2). Javier initially moved northwest. It slowed to an eastward drift between Baja California and Socorro Island on 8 September, as it reached a 50 kt peak intensity. The drift continued on 9-10 September, as Javier weakened to a depression. This was followed by a southeast motion on 11 September. Recurvature to the northeast occurred on 12 September as Javier regained tropical storm status. This brief second peak intensity was 45 kt. The northeast track continued until landfall as a depression near Cabo Corrientes, Mexico, early on 14 September. The cyclone dissipated over land later that day.

The SUN ACE (3EMJ6) reported 44 kt winds and a 1004.4 mb pressure at 2100 12 September. This was instrumental in determining that Javier had re-intensified.

There are no reports of damage or casualties from Javier.

Tropical Depression Twelve-E: Tropical Depression Twelve-E formed near 21N 109W on 1 October. It drifted slowly northwest until it dissipated near 22N 110W on 3 October. Maximum sustained winds were estimated at 30 kt.

Hurricane Kay: Tropical Depression Thirteen-E formed near 16N 118W on 13 October (Figure 2). Initial strengthening was rapid, with the system reaching both tropical storm and hurricane strength later that day. Kay initially drifted west, then it turned

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southwest on 14 October, while weakening to a tropical storm. This was followed by a south to southeast drift until dissipation. Kay weakened to a depression on 15 October, and dissipated near 11N 120W on 17 October. The remnant low drifted east and was eventually absorbed into the ITCZ.

There are no reports of damage, casualties, or tropical storm force winds from Kay.

Hurricane Lester: Lester formed from the same tropical wave that spawned Atlantic Hurricane Lisa. The wave moved into the Pacific on 12 October, and developed into Tropical Depression Fourteen-E early on 15 October, near 11N 92W (Figure 2). Drifting northwest, the system reached tropical storm strength later that day and hurricane strength the next day. Lester turned west on 17 October, passing about 60 nm south of Puerto Angel, Mexico. The same motion with a faster forward speed continued through 19 October. The hurricane moved west-northwest on 20-21 October, then stalled near 17N 109W on 22 October. The stall coincided with the peak intensity of 100 kt. A southwest motion and weakening to a tropical storm occurred on 23 October. Lester resumed a west-northwest motion on 24 October, that continued for the rest of its life. The storm weakened to a depression on 26 October, and dissipated later that day near 18N 115W.

Shipping avoided Lester and the associated strong winds stayed mostly offshore. Thus, there are no reports of damage, casualties, or tropical storm force winds. However, associated heavy rains and coastal flooding did affect portions of southern Mexico. Reconnaissance aircraft flew into Lester and measured a 973 mb pressure on 18 October.

Hurricane Madeline: Tropical Depression Fifteen-E formed about 200 nm west-southwest of Manzanillo, Mexico, on 16 October (Figure 2). The cyclone moved north-northwest and became Tropical Storm Madeline later that day. Madeline turned northeast on 17 October, as it reached hurricane strength, and a slow turn to the north occurred the next day as winds peaked at 75 kt (Figure 8). At this time, Madeline was about 90 nm west of the Mexican coast. Rapid weakening started as Madeline turned north-west on 19 October, and by early on 20 October, Madeline was a depression. The system dissipated later that day near 24N 109W.

A few ships reported tropical storm force winds in Madeline. Most notable was the STAR TRONDANGER (LAQQ2), which reported 50 kt winds and a 1003.8 mb pressure at 2100 17 October. The ALLIGATOR RELIANCE (ZCBN5), which had encountered Mitch the week before, reported 40 kt and 1002.5 mb at 0900 the same day. Reconnaissance aircraft also flew into Madeline and measured a 980 mb central pressure at 2153Z on 18 October.

Although Madeline passed near the Islas Marias, there are no reports of damage or casualties.

B. Other Significant Events

1. Atlantic:

Tropical/Hybrid Low: A broad low pressure area formed over the northwest Caribbean Sea on 19 October. Associated convection gradually organized as the low crossed the Yucatan Peninsula into the Gulf of Mexico on 20-21 October. To this point, the development resembled the early stages of Earl and Frances. However, on 22 October, the system interacted with a strong cold front (with gales to the north) and turned south. It moved inland over the Isthmus of Tehuantepec on 23 October and dissipated over land the next day.

Several ships and land stations reported tropical storm force winds during this event. These included a 58 kt gust at Villahermosa, Mexico, at 1345 23 October, and 45 kt sustained winds from the SEALAND FREEDOM (V7AM3) at 0000 the same day. A reconnaissance aircraft observed 70 kt winds about 120 nm west of the center at 1715 that day. While the reports suggest the system was of tropical storm strength, many winds were

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associated with the cold air surge while others (such as Villahermosa) came from areas known for terrain-enhanced winds.

The exact nature of this cyclone is uncertain. The tropical origin and attempts to develop central convection (particularly on 23 October) suggest tropical cyclone characteristics. However, the cold front and a broad center suggest non-tropical characteristics.

Other Events: Two cold fronts produced gales in the TPC area in December. The first was over the Gulf of Mexico on 22-23 December, and the second was over the western Atlantic on 30-31 December. A large high pressure system over the North Atlantic produced gales over the region south of Bermuda and east of the Bahamas on 2-3 December.

2. Eastern Pacific:

Three Gulf of Tehuantepec gale events occurred, with the most notable being the prolonged event of 12-19 December. The other events were 2-3 December and 24-27 December. Two gale-producing cold fronts affected the area on 30 November and 6-8 December.

IV. References

Landsea, C. W., G. D. Bell, W. M. Gray, and S. B. Goldenberg, 1998: *The extremely active 1995 Atlantic hurricane season: Environmental conditions and verification of season forecasts.* Monthly Weather Review, 126, 1174-1193.⚓

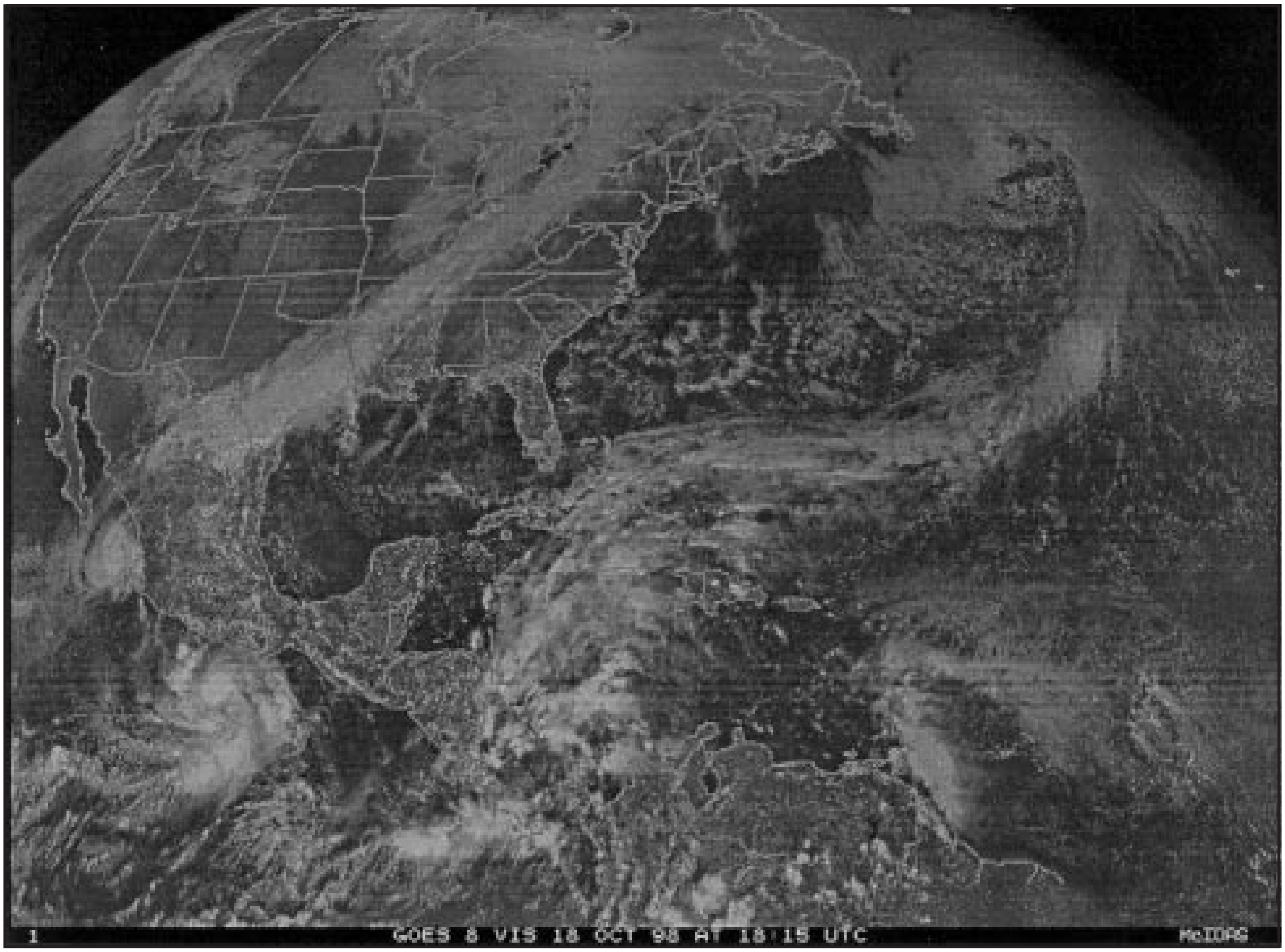
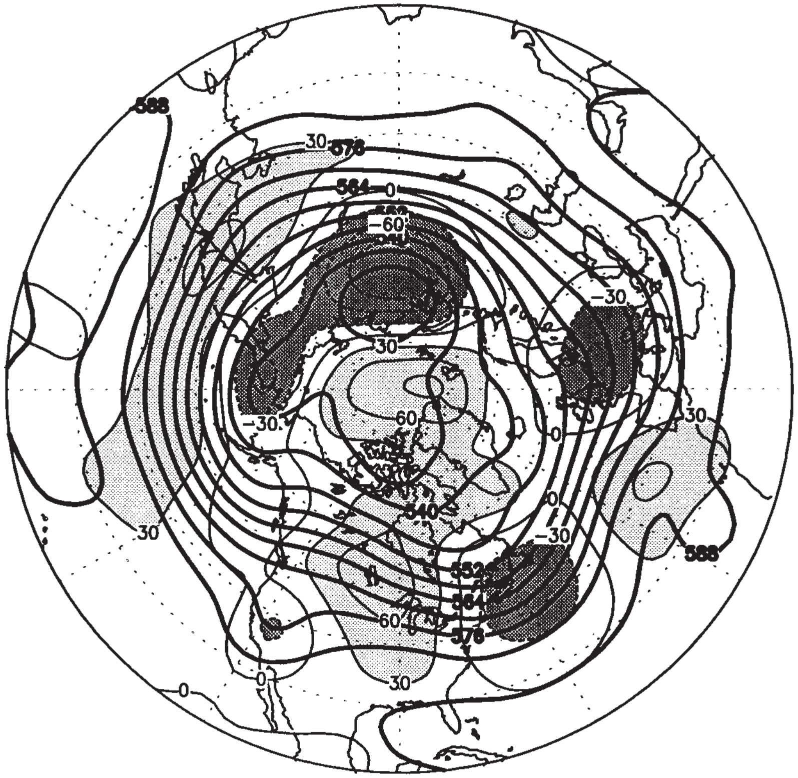


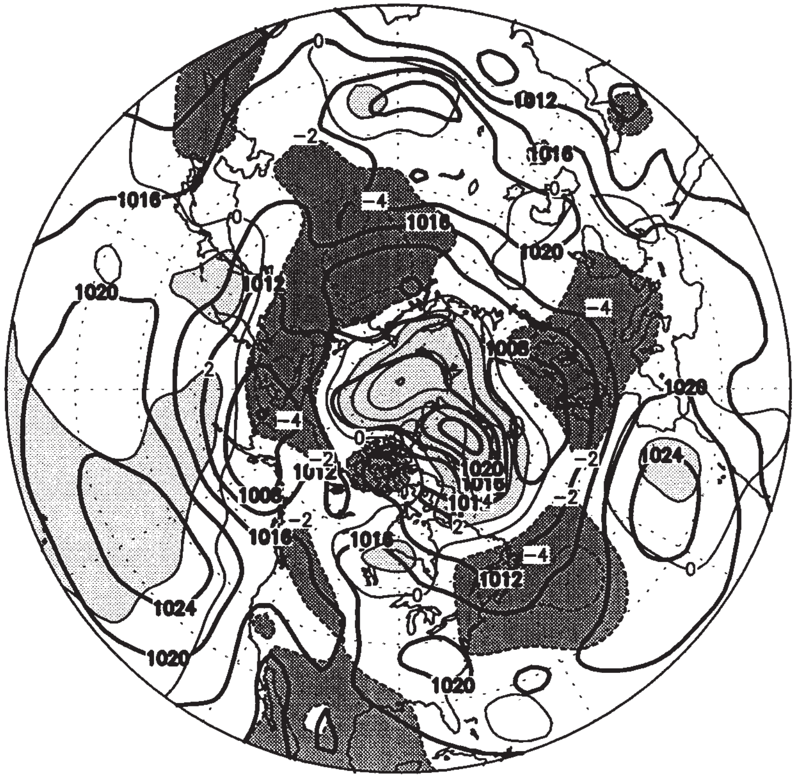
Figure 8. GOES-8 visible image of Hurricanes Lester and Madeline (both on the Pacific coast of Mexico, Lester being farther south).

September–October 1998

500 mb Height, Anomaly

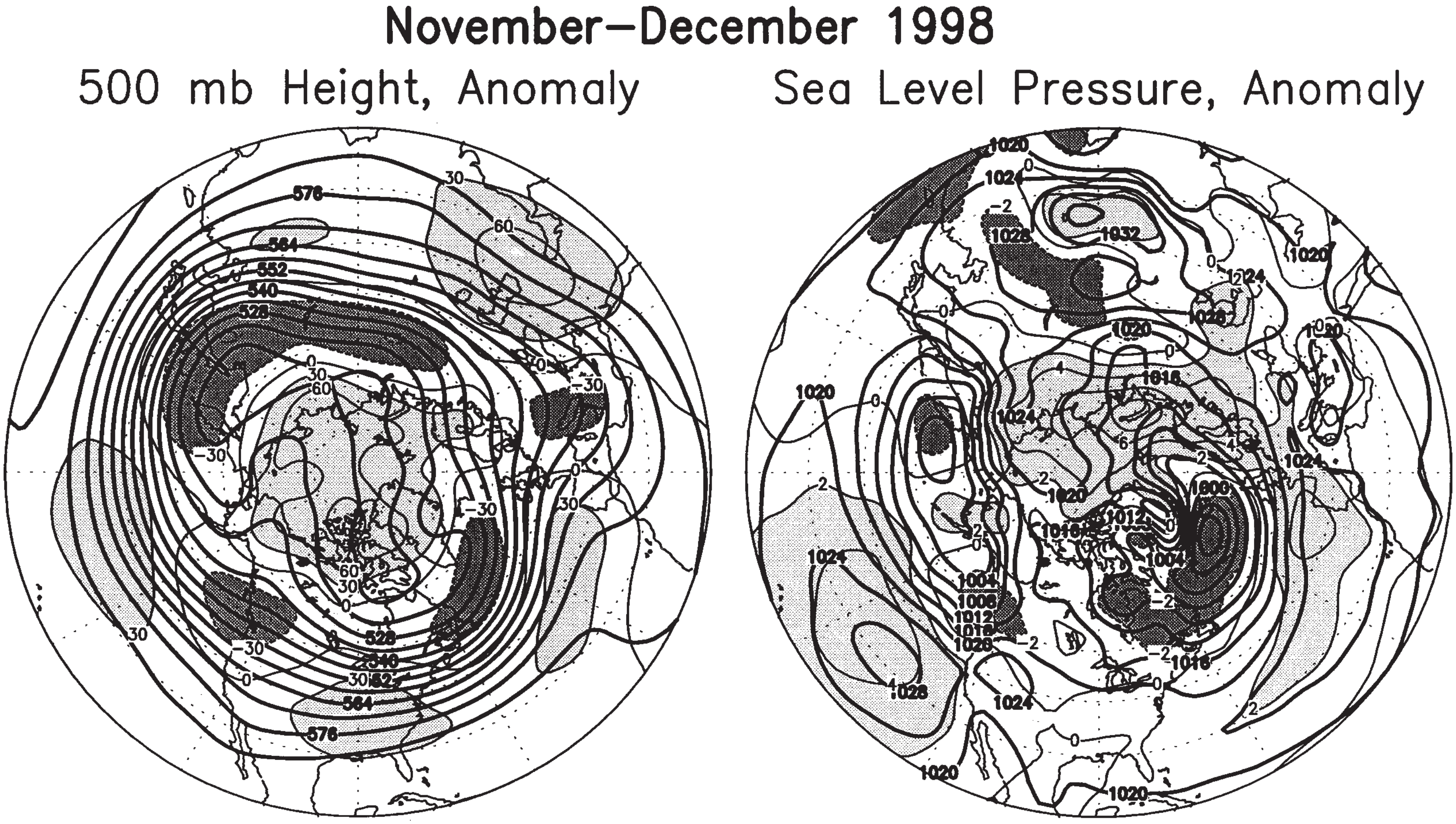


Sea Level Pressure, Anomaly



The chart on the left shows the two-month mean 500-mb height contours at 60 m intervals in solid lines, with alternate contours labeled in decameters (dm). Height anomalies are contoured in dashed lines at 30 m intervals. Areas where the mean height anomaly was greater than 30 m above normal have light shading, and areas where the mean height anomaly was more than 30 m below normal have heavy shading

The chart on the right shows the two-month mean sea level pressure at 4-mb intervals in solid lines, labeled in mb. Anomalies of SLP are contoured in dashed lines and labeled at 2-mb intervals, with light shading in areas more than 2 mb above normal, and heavy shading in areas in excess of 2 mb below normal.



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The chart on the right shows the two-month mean sea level pressure at 4-mb intervals in solid lines, labeled in mb. Anomalies of SLP are contoured in dashed lines and labeled at 2-mb intervals, with light shading in areas more than 2 mb above normal, and heavy shading in areas in excess of 2 mb below normal.

A Winter Voyage Across the Gulf of Alaska

Leif Lie
Meteorologist In Charge
National Weather Service Forecast Office
Juneau, Alaska

In December 1998 I accepted an invitation to sail on the M/V KENNICOTT on her voyage from Juneau to Seward and back to Juneau. The Alaska State ferries make only a few sailings a year across the Gulf of Alaska, and seldom during the winter months. This was an excellent opportunity for me to observe the weather and check the marine forecasts and our new marine verification program.

The distance from Juneau to Seward, across the Gulf, is 600 nautical miles. At 16 knots, it took 36 hours to make the trip. We departed Juneau at at 7 a.m. January 5, and arrived back in Juneau at 3 p.m. January 8. The trip included an eight-hour stopover in Seward.

Prevailing winds, northbound and southbound, were northeast, 15 to 30 knots, and seas ranged from 6 to 12 feet. Southbound, near Yakutat, wind speed reached 44 knots with seas to 19 feet. The gale force winds lasted for three hours.

I was given free access to the bridge, and spent many hours there. I spent much of my time with the captains and mates explaining and interpreting weather maps received onboard. I also stressed the importance of the Voluntary Observing Ship (VOS) program. The KTVA-TV crew onboard for this special sailing interviewed me twice during the trip.

Perhaps the highlight of this trip was being able to see first hand how important a single marine observation can be. On January 4, the captain on the KENNICOTT called the National Weather Service Forecast office Juneau with a report that the wind speed in Lynn Canal was 60 kts (a bit stronger than the forecast). The duty forecaster took immediate action and upgraded our forecast to “storm warning,” thereby alerting other vessels and mariners.

Three of the ship captains I met with on this trip stated that they would be willing to participate in the VOS program. Arrangements have been made to implement the VOS programs on the KENNICOTT and TUSTUMENA. All the Alaska State ferries are now paricipating in our marine verification program (by informing the weather service whenever conditions are different than forecast).

The captain on the M/V TUSTUMENA asked me to take another trip on his ship. He said that to improve our service, we must continue to work closely together.

I think it’s important for mariners and weather forecasters to know more about their respective work and services. When we know more about each other’s needs, we can better work together. This will result in better products and smoother sailing for the mariners.⚓

Coastal Forecast Office News Southern California Area

Don Whitlow
Marine Focal Point
National Weather Service Office San Diego

Although the weather over the coastal waters of San Diego County is usually quite mild, on occasion, some weather conditions can cause havoc with boaters. A Santa Ana* condition on December 15, 1998, caused strong east winds that produced four- to six-foot wind waves. Along with a northwest swell of three to six feet, the confused sea state which developed nearly sank a commercial fishing boat about two miles off Point Loma. Several other boats needed assistance from the Coast Guard. Winds of 30 to 40 knots were reported during the event, with an unofficial gust of 57 knots reported.

Fog can also catch boaters unprepared if they are inexperienced and do not carry the proper equipment. During the first few weeks of January 1999, Southern California coastal waters had much fog. Boaters must be prepared to slow down, as there are many kinds of things they can run into. Also, the fog will redevelop at night (sometimes sooner than expected), and may catch some sailors unprepared. As a result of the recent foggy conditions, some boaters requested Coast Guard escorts into harbors. The Coast Guard recommends that sailors carry a VHF radio, be cognizant of your equipment and navigation, use a GPS unit, and bring an EPIRB. Lifejackets are a must.

*A Santa Ana wind condition results from high pressure at the surface building behind a frontal system and moving into the great basin. This causes a moderate to strong pressure gradient and gusty northeast winds in Southern California.⚓

Voluntary Observing Ship Program

Martin S. Baron
National Weather Service
Silver Spring, Maryland

Weather Observing Handbook, Forms, and Instructions for Shipboard Use

All vessels in the Voluntary Observing Ship (VOS) program should have the weather observing forms and publications shown below. They are all available from National Weather Service Port Meteorological Officers (for the current PMO roster, see “Meteorological Services—Observations” in the back of this publication).

(1) NWS Observing Handbook No. 1. Serves as the main technical reference and source book for VOS Program vessels, with detailed instructions about weather reporting procedures and the ships synoptic code.
(2) Ships Weather Observations Form B-81. Contains the Ships Synoptic Code pre-printed in columns, and is used to record your coded observations. Observations recorded on this form are provided to the PMO for review (who sends them to the National Climatic Data Center for archiving).
(3) Weather Report For Immediate Transmission Form B-80. A compact 8x6 inch form which allows a coded observation to be written down and easily transported aboard ship (i.e., to the radio room) for real-time transmission.
(4) Ships Code Card. A quick reference guide which contains the Ships Synoptic code with all definitions and tables, in abbreviated form.
(5) Barogram, for recording your barograph trace.
(6) Pre-addressed envelopes. These large 12x16 inch envelopes are for mailing your completed Ships Weather Observations forms to your servicing PMO. They require no postage when mailed in the United States. You can order observing supplies from your PMO by checking the appropriate boxes on the the back of the envelopes.
(7) Sea State Wind Speed Poster. This was developed to assist shipboard observers estimating wind speed using the appearance of the sea. It contains 12 sea state photographs with corresponding values for Beaufort Force, wind speed, and wave height.
(8) Cloud Poster. Contains 27 cloud photographs to assist you with observing and coding cloud type information.

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Reporting Sea and Swell

With the possible exception of the wind, waves have a greater impact on vessel operations than any other observed element in the Ships Synoptic Code. Reporting sea and swell is a unique responsibility peculiar to shipboard observers—weather observers on land have no comparable data to record, since the ground is not fluid and does not move.

The ships synoptic code contains four wave groups. This is to report your local wind-driven sea and up to two different observed swells. Three wave characteristics are reported: (1) wave period (for sea and swell), (2) wave direction (for swell only, sea wave direction is not reported since it is presumed to be the wind direction reported as dd in group Nddff), and (3) wave height (for sea and swell).

Sea waves are produced by the local wind, either at the time of observation, or in the recent past. Swell waves are waves that have travelled into your area after having been produced by distant winds, which can be a great distance (thousands of miles) away. In general, swell waves are long in comparison to sea, because shorter wavelength swell waves tend to dissipate (they have less energy and don't travel as far). The longest swells travel the greatest distances, and also travel faster than shorter swells (wave speed equals 3.1 times wave period in seconds). As swell travels, it's height decreases (after travelling 1200 miles, a swell loses about half it's height).

Sea wave period (P_wP_w) and swell wave period ($P_{w1}P_{w1}P_{w2}P_{w2}$) are the time intervals in seconds, for successive wave crests or troughs to pass a given point. Choose a distinctive patch of foam or a small floating object, and note the time it takes for it to go from one one crest or trough to the next. Note several such oscillations, and report the average period you have observed. There is no code table for period—it's reported in seconds.

Swell direction ($d_{w1}d_{w1}d_{w2}d_{w2}$), like wind direction, is the true direction from which the waves are coming. This is coded using the wind direction table (true direction from 00-36). When only one swell is reported, code $d_{w2}d_{w2}$ as //.

Sea wave height (H_wH_w) and swell wave height ($H_{w1}H_{w1}H_{w2}H_{w2}$) are a measure of the vertical distance between the the top of a wave crest and the bottom of an adjacent trough. As estimates, they depend on the skill and ingenuity of the observer. Use a known height, such as that of a man, bulwark, forecastle, or other known ship dimension. Since wave trains always contain waves of varying heights, report the average height of the larger, better formed waves in your visual range (significant wave height). The code for wave height is in units of half meters, i.e., code figure 10 is 5 meters or 16 feet.

Swell has an intriguing use as a weather forecast guide—longer swells will travel ahead of and give advance warning of a storm (which may or may not be approaching your ship). To determine if the storm is coming closer to your vessel, review your cloud as well as your swell observations. Advancing and thickening storm clouds accompanied by increasing swell is a good indication that a storm system with strong winds and heavy seas is approaching.

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New Address For PMO New York

Tim Kenefick, PMO New York City, has moved his office from Newark Airport to South Amboy, New Jersey. If you are sending your completed Ships Weather Observations Forms to him, please correct the mailing address on the PMO envelopes (which are pre-printed with the Newark address). The new address is:

Tim Kenefick, PMO
NOAA, NWS
110 Lower Main Street, Suite 201
South Amboy, NJ 08879-1367
Telephone: 732-316-5409
Fax: 732-316-7643
Pager: 888-399-6512
Email: timothy.kenefick@noaa.gov

Summary of Weather Report Transmission Procedures

Weather observations sent by ships participating in the VOS program are sent at no cost to the ship except as noted.

The stations listed accept weather observations which enter an automated system at National Weather Service headquarters. This system is not intended for other types of messages. To communicate with NWS personnel, see phone numbers and e-mail addresses at the beginning of this manual.

INMARSAT

Follow the instructions with your INMARSAT terminal for sending a telex message. Use the special dialing code 41 (except when using the SEAS/AMVER software in compressed binary format with INMARSAT C), and do not request a confirmation. Here is a typical procedure for using an INMARSAT A transceiver:

1. Select appropriate Land Earth Station Identity (LES-ID). See table below.
2. Select routine priority.
3. Select duplex telex channel.
4. Initiate the call. Wait for the GA+ signal.
5. Select the dial code for meteorological reports, 41+.
6. Upon receipt of our answerback, NWS OBS MHTS, transmit the weather message starting with BBXX and the ship's call sign. The message must be ended with five periods. Do not send any preamble.
   GA+
   41+
   NWS OBS MHTS
   BBXX WLXX 29003 99131 70808 41998 60909 10250 2021/ 4011/ 52003 71611 85264 22234 00261 20201 31100 40803…

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The five periods indicate the end of the message and must be included after each report. Do not request a confirmation.

Land-Earth Station Identity (LES-ID) of U.S. Inmarsat Stations Accepting Ships Weather (BBXX) and Oceanographic (JJYY) Reports

Operator	Service	Station ID			
		AOR-W	AOR-E	IOR	POR
COMSAT	A	01	01	01	01
COMSAT	B	01	01	01	01
COMSAT	C	001	101	321	201
COMSAT	C (AMVER/SEAS)	001	101	321	201
STRATOS/IDB	A (octal ID)	13-1	13-1	13-1	13-1
STRATOS/IDB	A (decimal ID)	11-1	11-1	11-1	11-1
STRATOS/IDB	B	013	013	013	013

Use abbreviated dialing code 41.
Do not request a confirmation

If your ship's Inmarsat terminal does not contain a provision for using abbreviated dialing code 41, TELEX address **0023089406** may be used via COMSAT. Please note that the ship will incur telecommunication charges for any messages sent to TELEX address 0023089406 using any Inmarsat earth station other than COMSAT.

Some common mistakes include: (1) failure to end the message with five periods when using INMARSAT A, (2) failure to include BBXX in the message preamble, (3) incorrectly coding the date, time, latitude, longitude, or quadrant of the globe, (4) requesting a confirmation.

Using The SEAS/AMVER Software

The National Oceanic and Atmospheric Administration (NOAA), in cooperation with the U.S. Coast Guard Automated Mutual-assistance VEssel Rescue program (AMVER) and COMSAT, has developed a PC software package known as AMVER/SEAS which simplifies the creation of AMVER and meteorological (BBXX) reports. The U.S. Coast Guard is able to accept, at no cost to the ship, AMVER reports transmitted via Inmarsat-C in a compressed binary format, created using the AMVER/SEAS program. Typically, in the past, the cost of transmission for AMVER messages has been assumed by the vessel. When ships participate in both the SEAS and AMVER programs, the position of ship provided in the meteorological report is forwarded to the Coast Guard as a supplementary AMVER position report to maintain a more accurate plot. To obtain the AMVER/SEAS program contact your U.S. PMO or AMVER/SEAS representative listed at the back of this publication.

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If using the NOAA AMVER/SEAS software, follow the instructions outlined in the AMVER/SEAS User's Manual. When using Inmarsat-C, use the compressed binary format and 8-bit X.25 (PSDN) addressing (31102030798481), rather than TELEX if possible when reporting weather.

Common errors when using the AMVER/SEAS include sending the compressed binary message via the code 41 or a plain text message via the X.25 address. Only COMSAT can accept messages in the compressed binary format. Text editors should normally not be utilized in sending the data in the compressed binary format as this may corrupt the message.

Telephone (Landline, Cellular, Satphone, etc.)

The following stations will accept VOS weather observations via telephone. **Please note that the ship will be responsible for the cost of the call in this case.**

GLOBE WIRELESS	650-726-6588
MARITEL	228-897-7700
WLO	334-666-5110

The National Weather Service is developing a dial-in bulletin board to accept weather observations using a simple PC program and modem. **The ship will be responsible for the cost of the call when using this system.** For details contact:

CDR Tim Rulon, NOAA
W/OM12 SSMC2 Room 14114
1325 East-West Highway
Silver Spring, MD 20910 USA
301-713-1677 Ext. 128
301-713-1598 (Fax)
timothy.rulon@noaa.gov
marine.weather@noaa.gov

Reporting Through United States Coast Guard Stations

U.S. Coast Guard stations accept SITOR (preferred) or voice radiotelephone weather reports. Begin with the BBXX indicator, followed by the ships call sign and the weather message**.**

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U.S. Coast Guard High Seas Communication Stations

Location	(CALL)	Mode	SEL CAL	MMSI #	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
Boston	(NMF)	Voice		003669991	424	4134	4426	Night[3]
Boston	(NMF)	Voice		003669991	601	6200	6501	24Hr
Boston	(NMF)	Voice		003669991	816	8240	8764	24Hr
Boston	(NMF)	Voice		003669991	1205	12242	13089	Day[3]
Chesapeake	(NMN)	SITOR	1097		604	6264.5	6316	Night[2]
Chesapeake	(NMN)	SITOR	1097		824	8388	8428	24Hr
Chesapeake	(NMN)	SITOR	1097		1227	12490	12592.5	24hr
Chesapeake	(NMN)	SITOR	1097		1627	16696.5	16819.5	24Hr
Chesapeake	(NMN)	SITOR	1097		2227	22297.5	22389.5	Day[2]
Chesapeake	(NMN)	Voice		003669995	424	4134	4426	Night[2]
Chesapeake	(NMN)	Voice		003669995	601	6200	6501	24Hr
Chesapeake	(NMN)	Voice		003669995	816	8240	8764	24Hr
Chesapeake	(NMN)	Voice		003669995	1205	12242	13089	Day[2]
Miami	(NMA)	Voice		003669997	601	6200	6501	24Hr
Miami	(NMA)	Voice		003669997	1205	12242	13089	24Hr
Miami	(NMA)	Voice		003669997	1625	16432	17314	24Hr
New Orleans	(NMG)	Voice		003669998	424	4134	4426	24Hr
New Orleans	(NMG)	Voice		003669998	601	6200	6501	24Hr
New Orleans	(NMG)	Voice		003669998	816	8240	8764	24Hr
New Orleans	(NMG)	Voice		003669998	1205	12242	13089	24Hr
Kodiak	(NOJ)	SITOR	1106		407	4175.5	4213.5	Night
Kodiak	(NOJ)	SITOR	1106		607	6266	6317.5	24Hr
Kodiak	(NOJ)	SITOR	1106		807	8379.5	8419.5	Day
Kodiak	(NOJ)	Voice		003669899[1]	***	4125	4125	24Hr
Kodiak	(NOJ)	Voice		003669899[1]	601	6200	6501	24Hr
Pt. Reyes	(NMC)	SITOR	1096		620	6272.5	6323.5	Night
Pt. Reyes	(NMC)	SITOR	1096		820	8386	8426	24Hr
Pt. Reyes	(NMC)	SITOR	1096		1620	16693	16816.5	Day
Pt. Reyes	(NMC)	Voice		003669990	424	4134	4426	24Hr
Pt. Reyes	(NMC)	Voice		003669990	601	6200	6501	24Hr
Pt. Reyes	(NMC)	Voice		003669990	816	8240	8764	24Hr
Pt. Reyes	(NMC)	Voice		003669990	1205	12242	13089	24Hr
Honolulu	(NMO)	SITOR	1099		827	8389.5	8429.5	24hr
Honolulu	(NMO)	SITOR	1099		1220	12486.5	12589	24hr
Honolulu	(NMO)	SITOR	1099		2227	22297.5	22389.5	Day
Honolulu	(NMO)	Voice		003669993[1]	424	4134	4426	Night[4]

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Location	(CALL)	Mode	SEL CAL	MMSI #	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
Honolulu	(NMO)	Voice		003669993[1]	601	6200	6501	24Hr
Honolulu	(NMO)	Voice		003669993[1]	816	8240	8764	24Hr
Honolulu	(NMO)	Voice		003669993[1]	1205	12242	13089	Day[4]
Guam	(NRV)	SITOR	1100		812	8382	8422	24hr
Guam	(NRV)	SITOR	1100		1212	12482.5	12585	Night
Guam	(NRV)	SITOR	1100		1612	16689	16812.5	24hr
Guam	(NRV)	SITOR	1100		2212	22290	22382	Day
Guam	(NRV)	Voice		003669994[1]	601	6200	6501	Night[5]
Guam	(NRV)	Voice		003669994[1]	1205	12242	13089	Day[5]

Stations also maintain an MF/HF DSC watch on the following frequencies: 2187.5 kHz, 4207.5 kHz, 6312 kHz, 8414.5 kHz, 12577 kHz, and 16804.5 kHz.

Voice frequencies are carrier (dial) frequencies. SITOR and DSC frequencies are assigned frequencies.

Note that some stations share common frequencies.

An automated watch is kept on SITOR. Type “HELP+” for the of instructions or “OBS+” to send the weather report.

For the latest information on Coast Guard frequencies, visit their webpage at: http://www.navcen.uscg.mil/marcomms.

[1] MF/HF DSC has not yet been implemented at these stations.
[2] 2300-1100 UTC Nights, 1100-2300 UTC Days
[3] 2230-1030 UTC Nights, 1030-2230 UTC Days
[4] 0600-1800 UTC Nights, 1800-0600 UTC Days
[5] 0900-2100 UTC Nights, 2100-0900 UTC Days

U.S. Coast Guard Group Communication Stations

U.S. Coast Guard Group communication stations monitor VHF marine channels 16 and 22A and/or MF radiotelephone frequency 2182 kHz (USB). Great Lakes stations do not have MF installations.

The following stations have MF DSC installations and also monitor 2187.5 kHz DSC. Additional stations are planned. Note that although a station may be listed as having DSC installed, that installation may not have yet been declared operational. The U.S. Coast Guard is not expected to have the MF DSC network installed and declared operational until 2003 or thereafter.

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The U.S. Coast Guard is not expected to have an VHF DSC network installed and declared operational until 2005 or thereafter.

STATION			MMSI #
CAMSLANT Chesapeake VA	MF/HF	—	003669995
COMMSTA Boston MA	MF/HF	Remoted to CAMSLANT	003669991
COMMSTA Miami FL	MF/HF	Remoted to CAMSLANT	003669997
COMMSTA New Orleans LA	MF/HF	Remoted to CAMSLANT	003669998
CAMSPAC Pt Reyes CA	MF/HF	—	003669990
COMMSTA Honolulu HI	MF/HF	Remoted to CAMSPAC	003669993
COMMSTA Kodiak AK	MF/HF	—	003669899
Group Atlantic City NJ	MF		003669903
Group Cape Hatteras NC	MF		003669906
Group Southwest Harbor	MF		003669921
Group Eastern Shore VA	MF		003669932
Group Mayport FL	MF		003669925
Group Long Island Snd	MF		003669931
Act New York NY	MF		003669929
Group Ft Macon GA	MF		003669920
Group Astoria OR	MF		003669910

Reporting Through Specified U.S. Commercial Radio Stations

If a U.S. Coast Guard station cannot be communicated with, and your ship is not INMARSAT equipped, U.S. commercial radio stations can be used to relay your weather observations to the NWS. When using SITOR, use the command “OBS +”, followed by the BBXX indicator and the weather message. **Example:**

```
OBS +          BBXX WLXX 29003 99131 70808 41998 60909 10250 2021/
               40110 52003 71611 85264 22234 00261 20201 31100 40803
```

Commercial stations affiliated with Globe Wireless (KFS, KPH, WNU, WCC, etc.) accept weather messages via SITOR or morse code (not available at all times).

Commercial Stations affiliated with Mobile Marine Radio, Inc. (WLO, KLB, WSC) accept weather messages via SITOR, with Radiotelephone and Morse Code (weekdays from 1300-2100 UTC only) also available as backups.

MARITEL Marine Communication System accepts weather messages via VHF marine radiotelephone from near shore (out 50-60 miles), and from the Great Lakes.

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Globe Wireless

Location	(CALL)	Mode	SEL CAL	MMSI #	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
Slidell,	(WNU)	SITOR			401	4172.5	4210.5	24Hr
Louisina	(WNU)	SITOR				4200.5	4336.4	24Hr
	(WNU)	SITOR			627	6281	6327	24Hr
	(WNU)	SITOR			819	8385.5	8425.5	24Hr
	(WNU)	SITOR			1257	12505	12607.5	24Hr
	(WNU)	SITOR			1657	16711.5	16834.5	24Hr
Barbados	(8PO)	SITOR			409	4176.5	4214.5	24Hr
	(8PO)	SITOR			634	6284.5	6330.5	24Hr
	(8PO)	SITOR			834	8393	8433	24Hr
	(8PO)	SITOR			1273	12513	12615.5	24Hr
	(8PO)	SITOR			1671	16718.5	16841.5	24Hr
San Francisco,	(KPH)	SITOR			413	4178.5	4216	24Hr
California	(KPH)	SITOR			613	6269	6320	24Hr
	(KPH)	SITOR			813	8382.5	8422.5	24Hr
	(KPH)	SITOR			822	8387	8427	24Hr
	(KPH)	SITOR			1213	12483	12585.5	24Hr
	(KPH)	SITOR			1222	12487.5	12590	24Hr
	(KPH)	SITOR			1242	12497.5	12600	24Hr
	(KPH)	SITOR			1622	16694	16817.5	24Hr
	(KPH)	SITOR			2238	22303	22395	24Hr
	(KFS)	SITOR			403	4173.5	4211.5	24Hr
	(KFS)	SITOR				6253.5	6436.4	24Hr
	(KFS)	SITOR			603	6264	6315.5	24Hr
	(KFS)	SITOR				8323.5	8526.4	24Hr
	(KFS)	SITOR			803	8377.5	8417.5	24Hr
	(KFS)	SITOR			1203	12478	12580.5	24Hr
	(KFS)	SITOR			1247	12500	12602.5	24Hr
	(KFS)	SITOR				16608.5	17211.4	24Hr
	(KFS)	SITOR			1647	16706.5	16829.5	24Hr
	(KFS)	SITOR			2203	22285.5	22377.5	24Hr
Hawaii	(KEJ)	SITOR				4154.5	4300.4	24Hr
	(KEJ)	SITOR			625	6275	6326	24Hr
	(KEJ)	SITOR			830	8391	8431	24Hr
	(KEJ)	SITOR			1265	12509	12611.5	24Hr
	(KEJ)	SITOR			1673	16719.5	16842.5	24Hr
Delaware,	(WCC)	SITOR				6297	6334	24Hr
USA	(WCC)	SITOR			816	8384	8424	24Hr
	(WCC)	SITOR			1221	12487	12589.5	24Hr
	(WCC)	SITOR			1238	12495.5	12598	24Hr
	(WCC)	SITOR			1621	16693.5	16817	24Hr
Argentina	(LSD836)	SITOR				4160.5	4326	24Hr
	(LSD836)	SITOR				8311.5	8459	24Hr
	(LSD836)	SITOR				12379.5	12736	24Hr
	(LSD836)	SITOR				16560.5	16976	24Hr
	(LSD836)	SITOR				18850.5	19706	24Hr

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Location	(CALL)	Mode	SEL CAL	MMSI #	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
Guam	(KHF)	SITOR			605	6265	6316.5	24Hr
	(KHF)	SITOR			808	8380	8420	24Hr
	(KHF)	SITOR			1301	12527	12629	24Hr
	(KHF)	SITOR			1726	16751	16869	24Hr
	(KHF)	SITOR			1813	18876.5	19687	24Hr
	(KHF)	SITOR			2298	22333	22425	24Hr
Newfoundland	(VCT)	SITOR			414	4179	4216.5	24Hr
Canada	(VCT)	SITOR			416	4180	4217.5	24Hr
	(VCT)	SITOR			621	6273	6324	24Hr
	(VCT)	SITOR			632	6283.5	6329.5	24Hr
	(VCT)	SITOR			821	8386.5	8426.5	24Hr
	(VCT)	SITOR			838	8395	8435	24Hr
	(VCT)	SITOR			1263	12508	12610.5	24Hr
	(VCT)	SITOR			1638	16702	16825	24Hr
Cape Town,	(ZSC)	SITOR			408	4176	4214	24Hr
South Africa	(ZSC)	SITOR			617	6271	6322	24Hr
	(ZSC)	SITOR			831	8391.5	8431.5	24Hr
	(ZSC)	SITOR			1244	12498.5	12601	24Hr
	(ZSC)	SITOR			1619	16692.5	16816	24Hr
	(ZSC)	SITOR			1824	18882	19692.5	24Hr
Bahrain,	(A9M)	SITOR			419	4181.5	4219	24Hr
Arabian Gulf	(A9M)	SITOR				8302.5	8541	24Hr
	(A9M)	SITOR				12373.5	12668	24Hr
	(A9M)	SITOR				16557.5	17066.5	24Hr
	(A9M)	SITOR				18853.5	19726	24Hr
Gothenburg,	(SAB)	SITOR			228	2155.5	1620.5	24Hr
Sweden	(SAB)	SITOR				4166.5	4259	24Hr
	(SAB)	SITOR			626	6275.5	6326.5	24Hr
	(SAB)	SITOR			837	8394.5	8434.5	24Hr
	(SAB)	SITOR			1291	12522	12624	24Hr
	(SAB)	SITOR			1691	16728.5	16851.5	24Hr
Norway,	(LFI)	SITOR				2653	1930	24Hr
	(LFI)	SITOR				4154.5	4339	24Hr
	(LFI)	SITOR				6250.5	6467	24Hr
	(LFI)	SITOR				8326.5	8683.5	24Hr
	(LFI)	SITOR				12415.5	12678	24Hr
	(LFI)	SITOR				16566.5	17204	24Hr
Awanui,	(ZLA)	SITOR			402	4173	4211	24Hr
New Zealand	(ZLA)	SITOR			602	6263.5	6315	24Hr
	(ZLA)	SITOR			802	8377	8417	24Hr
	(ZLA)	SITOR			1202	12477.5	12580	24Hr
	(ZLA)	SITOR			1602	16684	16807.5	24Hr
	(ZLA)	SITOR				18859.5	19736.4	24Hr
Perth,	(VIP)	SITOR			406	4175	4213	24Hr
Western	(VIP)	SITOR			806	8379	8419	24Hr
Austrailia	(VIP)	SITOR			1206	12479.5	12582	24Hr
	(VIP)	SITOR			1210	12481.5	12584	24Hr
	(VIP)	SITOR			1606	16686	16809.5	24Hr

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The frequencies listed are used by the stations in the Global Radio network for both SITOR and GlobeEmail. Stations listed as being 24hr may not be operational during periods of poor propagation.

For the latest information on Globe Wireless frequencies, visit their webpage at: http://www.globewireless.com

Stations and channels are added regularly. Contact any Globe Wireless station/channel or visit the website for an updated list. Information on Morse frequencies available upon request.

Mobile Marine Radio Inc.

Location	(CALL)	Mode	SEL CAL	MMSI #	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
Mobile, AL	(WLO)	SITOR	1090	003660003	406	4175	4213	24Hr
	(WLO)	SITOR	1090	003660003	410	4177	4215	24Hr
	(WLO)	SITOR	1090	003660003	417	4180.5	4218	24Hr
	(WLO)	SITOR	1090	003660003	606	6265.5	6317	24Hr
	(WLO)	SITOR	1090	003660003	610	6267.5	6319	24Hr
	(WLO)	SITOR	1090	003660003	615	6270	6321	24Hr
	(WLO)	SITOR	1090	003660003	624	6274.5	6325.5	24Hr
	(WLO)	SITOR	1090	003660003	806	8379	8419	24Hr
	(WLO)	SITOR	1090	003660003	810	8381	8421	24Hr
	(WLO)	SITOR	1090	003660003	815	8383.5	8423.5	24Hr
	(WLO)	SITOR	1090	003660003	829	8390.5	8430.5	24Hr
	(WLO)	SITOR	1090	003660003	832	8392	8432	24Hr
	(WLO)	SITOR	1090	003660003	836	8394	8434	24Hr
	(WLO)	SITOR	1090	003660003	1205	12479	12581.5	24Hr
	(WLO)	SITOR	1090	003660003	1211	12482	12584.5	24Hr
	(WLO)	SITOR	1090	003660003	1215	12484	12586.5	24Hr
	(WLO)	SITOR	1090	003660003	1234	12493.5	12596	24Hr
	(WLO)	SITOR	1090	003660003	1240	12496.5	12599	24Hr
	(WLO)	SITOR	1090	003660003	1251	12502	12604.5	24Hr
	(WLO)	SITOR	1090	003660003	1254	12503.5	12606	24Hr
	(WLO)	SITOR	1090	003660003	1261	12507	12609.5	24Hr
	(WLO)	SITOR	1090	003660003	1605	16685.5	16809	24Hr
	(WLO)	SITOR	1090	003660003	1611	16688.5	16812	24Hr
	(WLO)	SITOR	1090	003660003	1615	16690.5	16814	24Hr
	(WLO)	SITOR	1090	003660003	1625	16695.5	16818.5	24Hr
	(WLO)	SITOR	1090	003660003	1640	16703	16826	24Hr
	(WLO)	SITOR	1090	003660003	1644	16705	16828	24Hr
	(WLO)	SITOR	1090	003660003	1661	16713.5	16836.5	24Hr
	(WLO)	SITOR	1090	003660003	1810	18875	19685.5	24Hr
	(WLO)	SITOR	1090	003660003	2210	22289	22381	24Hr
	(WLO)	SITOR	1090	003660003	2215	22291.5	22383.5	24Hr
	(WLO)	SITOR	1090	003660003	2254	22311	22403	24Hr
	(WLO)	SITOR	1090	003660003	2256	22312	22404	24Hr
	(WLO)	SITOR	1090	003660003	2260	22314	22406	24Hr

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Location	(CALL)	Mode	SEL CAL	MMSI #	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
	(WLO)	SITOR	1090	003660003	2262	22315	22407	24Hr
	(WLO)	SITOR	1090	003660003	2272	22320	22412	24Hr
	(WLO)	SITOR	1090	003660003	2284	22326	22418	24Hr
	(WLO)	SITOR	1090	003660003	2510	25177.5	26105.5	24Hr
	(WLO)	SITOR	1090	003660003	2515	25180	26108	24Hr
	(WLO)	DSC		003660003		4208	4219	24Hr
	(WLO)	DSC		003660003		6312.5	6331.0	24Hr
	(WLO)	DSC		003660003		8415	8436.5	24Hr
	(WLO)	DSC		003660003		12577.5	12657	24Hr
	(WLO)	DSC		003660003		16805	16903	24Hr
	(WLO)	Voice		003660003	405	4077	4369	24Hr
	(WLO)	Voice			414	4104	4396	24Hr
	(WLO)	Voice			419	4119	4411	24Hr
	(WLO)	Voice		003660003	607	6218	6519	24Hr
	(WLO)	Voice		003660003	824	8264	8788	24Hr
	(WLO)	Voice			829	8279	8803	24Hr
	(WLO)	Voice			830	8282	8806	24Hr
	(WLO)	Voice		003660003	1212	12263	13110	24Hr
	(WLO)	Voice			1226	12305	13152	24Hr
	(WLO)	Voice			1607	16378	17260	24Hr
	(WLO)	Voice			1641	16480	17362	24Hr
	(WLO)	VHFVoice			CH 25,84			24Hr
	(WLO)	DSC Call		003660003	CH 70			24Hr
	(WLO)	DSC Work		003660003	CH 84			24Hr
	(WLO)	CW				434	434	Day
	(WLO)	CW				4250	4250	Day
	(WLO)	CW				6446.5	6446.5	Day
	(WLO)	CW				8445	8445	Day
	(WLO)	CW				8472	8472	Day
	(WLO)	CW				8534	8534	Day
	(WLO)	CW				8658	8658	Day
	(WLO)	CW				12660	12660	Day
	(WLO)	CW				12704.5	12704.5	Day
	(WLO)	CW				13024.9	13024.9	Day
	(WLO)	CW				16969	16969	Day
	(WLO)	CW				17173.5	17173.5	Day
	(WLO)	CW				22686.5	22686.5	Day
Tuckerton, NJ	(WSC)	SITOR	1108		419	4181.5	4219	24Hr
	(WSC)	SITOR	1108		832	8392	8432	24Hr
	(WSC)	SITOR	1108		1283	12518	12620.5	24Hr
	(WSC)	SITOR	1108		1688	16727	16850	24Hr
	(WSC)	SITOR	1108		1805	18872.5	19683	24Hr
	(WSC)	SITOR	1108		2295	22331.5	22423.5	24Hr
	(WSC)	CW				482	482	24Hr
	(WSC)	CW				4316	4316	24Hr
	(WSC)	CW				6484.5	6484.5	24Hr
	(WSC)	CW				8680	8680	24Hr

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VOS Program

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Location	(CALL)	Mode	SEL CAL	MMSI #	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
	(WSC)	CW				12789.5	12789.5	24Hr
	(WSC)	CW				16916.5	16916.5	24Hr
Seattle, WA	(KLB)	SITOR	1113		408	4176	4214	24Hr
	(KLB)	SITOR	1113		608	6266.5	6318	24Hr
	(KLB)	SITOR	1113		818	8385	8425	24Hr
	(KLB)	SITOR	1113		1223	12488	12590.5	24Hr
	(KLB)	SITOR	1113		1604	16685	16808.5	24Hr
	(KLB)	SITOR	1113		2240	22304	22396	24Hr
	(KLB)	CW				488	488	24Hr
	(KLB)	CW				4348.5	4348.5	24Hr
	(KLB)	CW				8582.5	8582.5	24Hr
	(KLB)	CW				12917	12917	24Hr
	(KLB)	CW				17007.7	17007.7	24Hr
	(KLB)	CW				22539	22539	24Hr

WLO Radio is equipped with an operational Thrane & Thrane TT-6200A DSC system for VHF and MF/HF general purpose digital selective calling communications.

To call an Mobile Marine Radio Inc., coast station facility on Morse Code ‘CW’, use a frequency from the worldwide channels listed below.

CW Calling Frequencies

4184.0, 6276.0, 8368.0, 12552.0, 16736.0, 22280.5, 25172.0
4184.5, 6276.5, 8369.0, 12553.5, 16738.0, 22281.0

Ship Telex Automatic System Computer Commands and Guidelines for Contacting Mobile Marine Radio stations.

Ship Station Response	Land Station Response
1) INITIATE ARQ CALL	
	2) RTTY CHANNEL
	3) “WHO ARE YOU” (Requests Ship’s Answerback)
4) SHIP’S ANSWERBACK IDENTITY	
	5) GA+?
6) Send Command OBS+ (Weather Observations) OPR+ (Operator Assistance) HELP+ (Operator Procedure)	

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7) MOM
8) MSG+?
9) SEND MESSAGE
10) KKKK (End of Message Indicator,
    WAIT for System Response
    DO NOT DISCONNECT)
11) RTTY CHANNEL
12) SHIP’S ANSWERBACK
13) SYSTEM REFERENCE,
    INFORMATION, TIME, DURATION
14) GA+?
15) GO TO STEP 6, or
16) BRK+? Clear Radio Circuit)

Stations listed as being 24Hr may not be operational during periods of poor propogation.

For the latest information on Mobile Marine Radio frequencies, visit their webpage at: http://www.wloradio.com.

MARITEL Stations

Instructions for MARITEL

Key the mike for five seconds on the working channel for that station. You should then get a recording telling you that you have reached the MARITEL system, and if you wish to place a call, key your mike for an additional five seconds. A MARITEL operator will then come on frequency. Tell them that you want to pass a marine weather observation.

For the latest information on MARITEL frequencies, visit their webpage at: http://www.maritelinc.com.

Stations	VHF Channel(s)
WEST COAST	
Bellingham, WA	28,85
Port Angeles, WA	25
Camano Island, WA	24
Seattle, WA	26
Tumwater, WA	85
Astoria, OR	24,26
Portland, OR	26
Newport, OR	28
Coos Bay, OR	25
Santa Cruz, CA	27
Santa Barbara, CA	86
Redondo Bch, CA	27,85,87
HAWAII	
Haleakala,HI (Maui)	26
GREAT LAKES	
Duluth, MN (Superior)	84
Ontonagon, MI (Superior)	86
Copper Harbor (Superior)	87
Grand Marias (Superior)	84
Sault Ste Marie (Superior)	86
Port Washington, WI (Mich)	85
Charlevoix (Michican)	84
Roger City (Huron)	28
Alpena, MI (Huron)	84
Tawas City, MI (Huron)	87
Detroit, MI (Erie)	28
Cleveland, OH (Erie)	86
Buffalo, NY (Erie)	28
NORTH EAST COAST	
Portland, ME	87
Southwest Harbor, ME	28
Rockport, ME	26,84
Gloucester, MA	25
Boston, MA	26,27
Hyannisport, MA	28
Nantucket, MA	85

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New Bedford, MA	24,26
Narragansett, RI	84
New London, CT	26,86
Bridgeport, CT	27
Staten Island, NY	28
Sandy Hook, NJ	24
Toms River, NJ	27
Ship Bottom, NJ	28
Beach Haven, NJ	25
Atlantic City, NJ	26
Philadelphia, PA	26
Delaware WW Lewes, DE	27
Dover, DE	84
Ocean City, MD	26
Virginia Bch, VA	26,27

CHESAPEAKE BAY

Baltimore, MD	25,26
Cambridge, MD	28
Point Lookout, MD	26
Belle Haven, VA	25

SOUTH EAST COAST

Morehead City, NC	28
Wilmington, NC	26
Georgetown, SC	24
Charleston, SC	26
Savannah, GA	27
Jacksonville, FL	26
Daytona Beach, FL	28
Cocoa Bch, FL	26
Vero Bch, FL	27
St Lucie, FL	26
W Palm Bch,	28
Ft Lauderdale, FL	84
Miami, FL	24,25
Key Largo, FL	28
Marathon, FL	27
Key West, FL	26,84

GULF COAST

Port Mansfield, TX	25
Corpus Christi, TX	26
Port O'Conner, TX	24
Matagorda, TX	84
Freeport, TX	27
Galveston, TX	24
Arcadia, TX	87
Houston, TX	26
Port Arthur, TX	27
Lake Charles, LA	28,84
Erath, LA	87
Morgan City, LA	24,26
Houma, LA	86
Venice, LA	27,28,86
New Orleans, LA	24,26,87
Hammond, LA	85
Hopedale, LA	85
Gulfport, MS	28
Pascagoula, MS	27
Pensacola, FL	26
Ft Walton Bch, FL	28
Panama City, FL	26
Apalachicola, FL	28
Crystal River, FL	28
Clearwater, FL	26
Tampa Bay, FL	24
Venice, FL	27
Ft Myers, FL	26
Naples, FL	25

Military Communications Circuits

Navy, Naval, and U.S. Coast Guard ships wishing to participate in the VOS program may do so by sending unclassified weather observations in synoptic code (BBXX format) to the following Plain Language ADdress (PLAD):

SHIP OBS NWS SILVER SPRING MD

As weather observations received by NWS are public data, vessels should check with their local command before participating in the VOS Program.

New Recruits—September through December 1998

During the four-month period ending December 31, 1998, PMOs recruited 34 vessels as weather observers/reporters in the National Weather Service (NWS) Voluntary Observing Ship (VOS) Program. Thank you for joining the program.

All Voluntary Observing Ships are asked to follow the worldwide weather reporting schedule—by reporting weather four times daily at 0000, 0600, 1200, and 1800 UTC. The United States and Canada have a three-hourly weather reporting schedule from coastal waters out 200 miles from shore, and from anywhere on the Great Lakes. From these coastal areas, please report weather at 0000, 0300, 0600, 0900, 1200, 1500, 1800, and 2100 ZULU or UTC, whenever possible.⚓

National Weather Service Voluntary Observing Ship Program

New Recruits from September 1 to December 31, 1998

NAME OF SHIP	CALL	AGENT NAME	RECRUITING PMO
AQUARIUS ACE	3FHB8	HUAL AGENCIES, INC	NEW YORK CITY, NY
CAPE JUBY	WEBW	AMSEA	NORFOLK, VA
CARNIVAL PARADISE	3FOB5	CARNIVAL CRUISE LINE	MIAMI, FL
CHOYANG SUCCESS	3FPV8	INCHCAPE SHIPPING SERVICES	NEW YORK CITY, NY
EL MORRO	KCGH	SEA STAR SHIPPING	LOS ANGELES, CA
EL YUNQUE	WGJT	SEA STAR SHIPPING	JACKSONVILLE, FL
ENTERPRISE	WAUY	FARRELL LINES INC	NEW YORK CITY, NY
EVER DEVELOP	3FLF8	EVERGREEN AMERICA CORP.	NEW YORK CITY, NY
EVER DEVOTE	3FIF8	EVERGREEN AMERICA CORP.	NEW YORK CITY, NY
EVER DIAMOND	3FSQ8	EVERGREEN AMERICA CORP.	NEW YORK CITY, NY
EVER DYNAMIC	3FUB8	EVERGREEN AMERICA CORP	NEW YORK CITY, NY
HANJIN KEELUNG	P3VH7	UNIVAN SHIP MANAGEMENT LTD	HOUSTON, TX
INDEPENDENT LEADER	DHOU	RICE, UNRUH, REYNOLDS CO.	NEW YORK CITY, NY
KAPITAN MASLOV	UBRO	FESCO AGENCIES N.A., INC	SEATTLE, WA
KEN YO	3FIC5	INUI STEAMSHIP CO., LTD	SEATTLE, WA
LEOPARDI	V7AU8	JOHN S. CONNOR, INC.	BALTIMORE, MD
MAERSK BROOKLYN	C6OE8	MAERSK SHIPPING INC	NEW YORK CITY, NY
MSC GINA	C4LV	MEDITERRANEAN SHIPPING COMPANY	NEW YORK CITY, NY
NATHANIEL B. PALMER	WBP3210	EDISON CHOUEST OFFSHORE	SEATTLE, WA
NORWEGIAN DREAM	C6LG5	NORWEGIAN CRUISE LINE	MIAMI, FL
NORWEGIAN WIND	C6LG6	NORWEGIAN CRUISE LINE	MIAMI, FL
PRESIDENT GRANT	WCY2098	AMERICAN SHIP MANAGEMENT	LOS ANGELES, CA
REMBRANDT	C6IP4	PREMIER CRUISES	NEW YORK CITY, NY
RENEGADE	ZCMF9	BRETON INVESTMENTS LTD	MIAMI, FL
RIO APURE	ELUG7	KING OCEAN....CHINA NAV CO.	MIAMI, FL
SEABOURN PRIDE	LALT2	ROBERT CHAMBERLAIN	MIAMI, FL
STAR HARMONIA	LAGB5	A/S BILLABONG	BALTIMORE, MD
STELLAR KOHINOOR	3FFG8	SHOWA LINE ENG. CO, LTD.	SEATTLE, WA
TORM MARTA	3FYV6	CAPES SHIPPING	NORFOLK, VA
TOWER BRIDGE	ELJL3	K LINE AMERICA, INC	SEATTLE, WA
TROPICAL DAWN	ELTK9	INCHCAPE SHIPPING SERVICES	BALTIMORE, MD
USNS BOB HOPE	NHNM	USNS BOB HOPE	NORFOLK, VA
USNS MT BAKER	NZHN	COMMANDER MSC, NFAF EAST	NORFOLK, VA
WORLD SPIRIT	ELWG7	M.O.SHIP MANAGEMENT CO., LTD, 8TH FLR	SEATTLE, WA
WORLD SPIRIT	ELWF7	M.O.SHIP MANAGEMENT CO., LTD, 8TH FLR	SEATTLE, WA

VOS Program Awards and Presentations Gallery

New Orleans PMO Jack Warrelmann (left) presents a 1998 VOS award to Radio Officer Correia, Captain Nielsson, Captain Olsen, and first officer Varpenius of the ***M/V SAN ANTONIO****.*

The crew of the ***MEKHANIK MOLDOVANOV*** *while in Seattle discussed AMVER/ SEAS reports with Seattle PMO Pat Brandow.*

*Two crew members of the **RUBIN KOBE** received AMVER/SEAS instruction from Seattle PMO Pat Brandow while in port in Tacoma, Washington.*

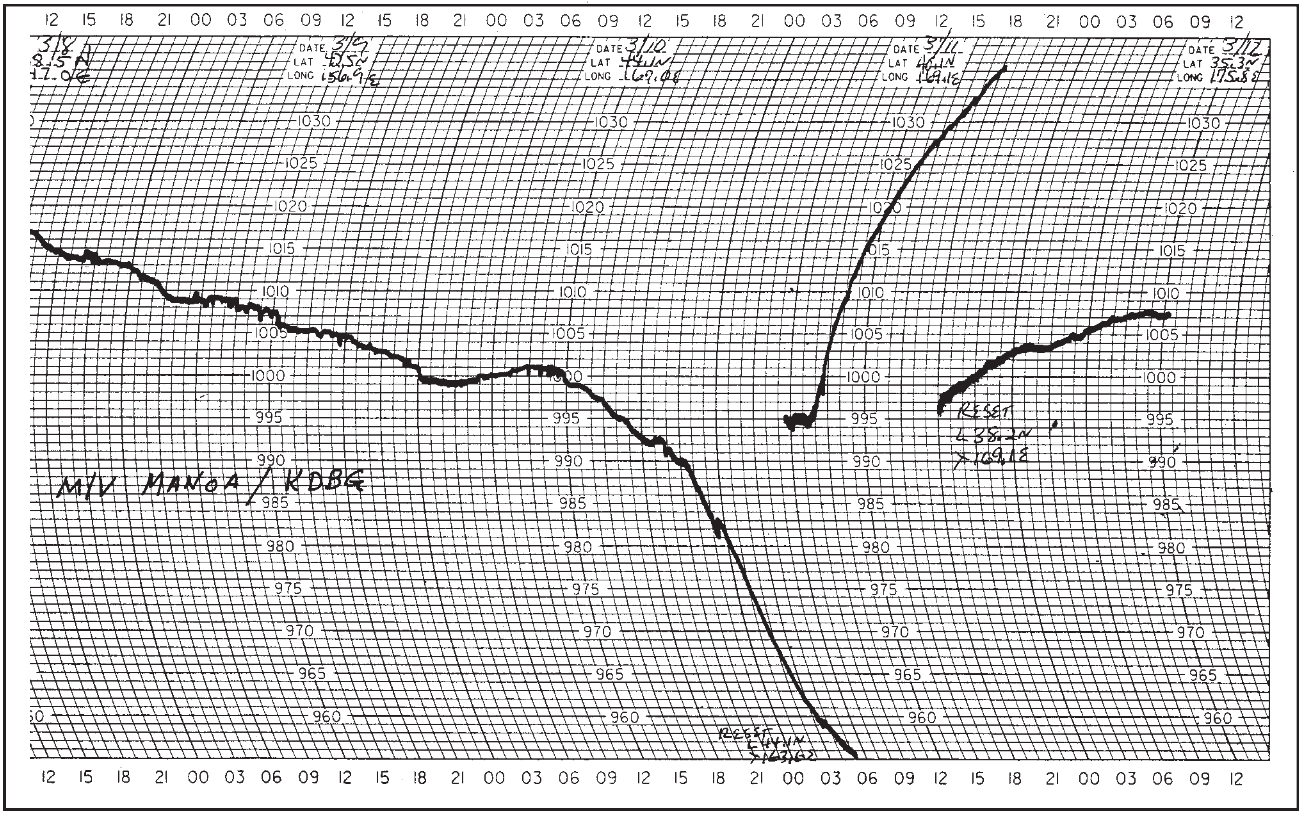
*Jim Saunders, PMO Baltimore (left) presents Second Officer of the **M/V AGULHAS** with a VOS award for 1998.*

*Lt. Joseph A. Pica (left) of NOAA Ship **OREGON II** receiving a 1998 VOS award from PMO New Orleans Jack Warrelmann.*

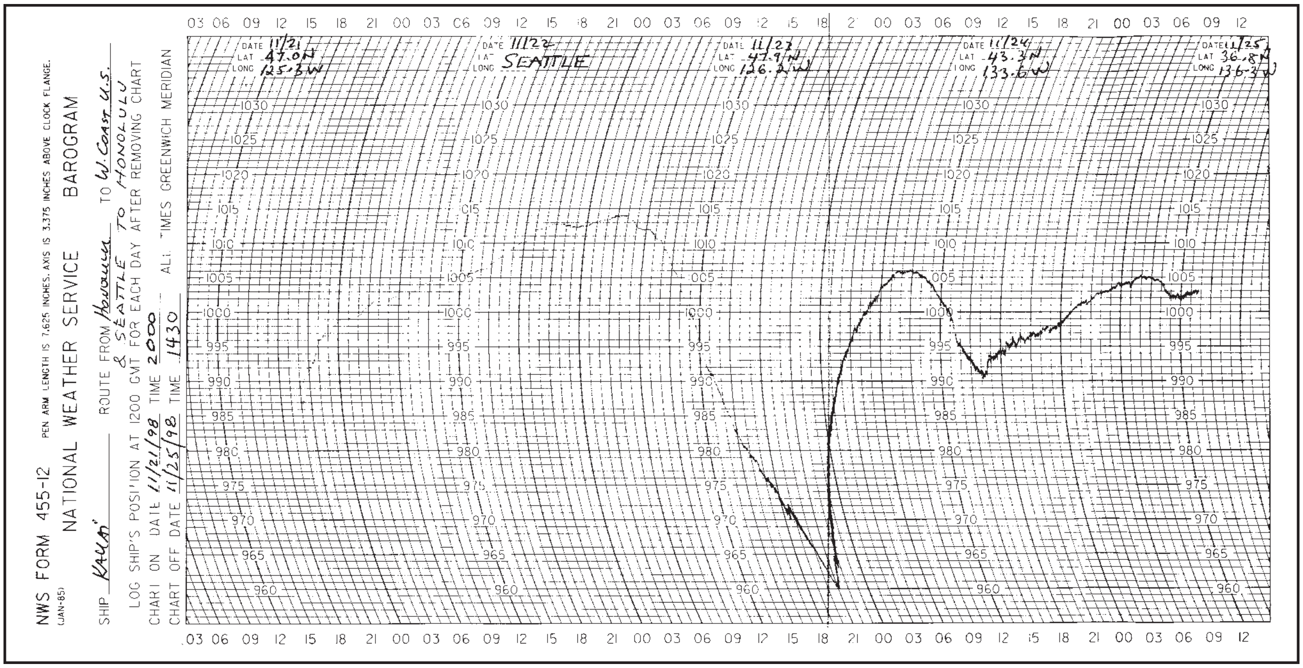
Jim Saunders, PMO Baltimore (left) presents Capt. Juergen Herter, ***M/C COLUMBINE*** *with an outstanding performance award for 1998.*

Baltimore PMO Jim Saunders (left) presents Capt. Scribner, ***ITB JACKSONVILLE****, with a VOS award for 1998.*

George Burkley (left), Instructor at the Maritime Institute of Technology, and Lee Chesneau of NCEP-Marine Forecast Branch. Lee is a visiting professor at MITAG'S Heavy Weather course for mariners. Photo by Jim Saunders.



*Barograph trace from the **M/V MANOA** enroute from Yokohama to Oakland on March 10, 1998.*



*Barograph trace from the **KAUAI** enroute from Honolulu to Seattle. Wind of 50 knots was reported at 1800 on November 23, 1998.*

VOS Coop Ship Reports — September through December 1998

The National Climatic Data Center compiles the tables for the VOS Cooperative Ship Report from radio messages. The values under the monthly columns represent the number of weather reports received. Port Meteorological Officers supply ship names to the NCDC. Comments or questions regarding this report should be directed to NCDC, Operations Support Division, 151 Patton Avenue, Asheville, NC 28801, Attn: Dimitri Chappas (828-271-4055 or dchappas@ncdc.noaa.gov).

SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
1ST LT BALDOMERO LOPEZ	WJKV	Jacksonville	0	0	30	234	264
1ST LT JACK LUMMUS	WJLV	New York City	41	0	15	160	216
2ND LT. JOHN P. BOBO	WJKH	Norfolk	0	33	0	0	33
AALSMEERGRACHT	PCAM	Long Beach	32	33	40	50	155
ACT 7	GWAN	Newark	64	68	77	86	295
ADAM E. CORNELIUS	WCF7451	Chicago	6	41	9	94	150
ADVANTAGE	WPPO	Norfolk	46	38	0	34	118
AGDLEK	OUGV	Miami	45	15	24	2	86
AGULHAS	3ELE9	Baltimore	26	41	75	42	184
AL AWDAH	9KWA	Houston	0	38	68	204	310
AL FUNTAS	9KKX	Miami	0	19	33	2	54
AL SAMIDOON	9KKF	Houston	49	28	0	26	103
AL SHUHADAA	9KKH	Houston	53	91	117	168	429
ALBEMARLE ISLAND	C6LU3	Newark	63	84	49	124	320
ALBERNI DAWN	ELAC5	Houston	21	32	40	22	115
ALBERTO TOPIC	ELPG7	Norfolk	0	0	0	12	12
ALDEN W. CLAUSEN	ELBM4	Norfolk	38	58	99	72	267
ALEXANDER VON HUMBOLD	Y3CW	Miami	701	731	705	1448	3585
ALKMAN	C6OG4	Houston	52	21	29	58	160
ALLEGIANCE	WSKD	Norfolk	41	33	44	46	164
ALLIANCA AMERICA	DHGE	Baltimore	0	0	0	8	8
ALLIGATOR AMERICA	JPAL	Seattle	54	13	6	0	73
ALLIGATOR BRAVERY	3FXX4	Oakland	48	72	58	102	280
ALLIGATOR COLUMBUS	3ETV8	Seattle	29	36	36	66	167
ALLIGATOR FORTUNE	ELFK7	Seattle	20	70	56	94	240
ALLIGATOR GLORY	ELJP2	Seattle	8	7	16	60	91
ALLIGATOR HOPE	ELFN8	Seattle	8	9	14	18	49
ALLIGATOR LIBERTY	JFUG	Seattle	48	13	56	10	127
ALLIGATOR STRENGTH	3FAK5	Oakland	57	55	16	92	220
ALPENA	WAV4647	Cleveland	3	3	111	28	145
ALTAIR	DBBI	Miami	607	669	371	1094	2741
AMAZON	S6BJ	Norfolk	0	28	5	100	133
AMBASSADOR BRIDGE	3ETH9	Oakland	0	0	0	78	78
AMERICA STAR	C6JZ2	Houston	92	81	62	110	345
AMERICAN CORMORANT	KGOP	Jacksonville	0	0	6	8	14
AMERICAN MERLIN	WRGY	Norfolk	0	9	0	0	9
AMERICANA	LADX2	New Orleans	30	12	0	0	42
AMERIGO VESPUCCI	ICBA	Norfolk	0	11	6	148	165
ANASTASIS	9HOZ	Miami	3	16	15	4	38
ANATOLIY KOLESNICHENKO	UINM	Seattle	34	19	29	42	124
ANKERGRACHT	PCQL	Baltimore	17	0	46	102	165
AOMORI WILLOW	3FIO6	Seattle	0	112	0	0	112
APL CHINA	V7AL5	Seattle	40	16	27	82	165
APL GARNET	9VVN	Oakland	41	70	40	112	263
APL JAPAN	V7AL7	Seattle	29	13	18	20	80
APL KOREA	WCX8883	Seattle	33	41	57	130	261
APL PHILIPPINES	WCX8884	Seattle	46	32	53	72	203
APL SINGAPORE	WCX8812	Seattle	83	66	71	130	350
APL THAILAND	WCX8882	Seattle	23	28	18	22	91
APOLLOGRACHT	PCSV	Baltimore	30	37	24	102	193
AQUARIUS ACE	3FHB8	New York City	21	43	19	0	83
ARCO ALASKA	KSBK	Long Beach	8	11	17	60	96
ARCO CALIFORNIA	WMCV	Long Beach	7	3	9	0	19
ARCO FAIRBANKS	WGWB	Long Beach	4	2	17	28	51
ARCO INDEPENDENCE	KLHV	Long Beach	0	12	20	44	76

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
ARCO PRUDHOE BAY	KPFD	Long Beach	4	0	0	0	4
ARCO SAG RIVER	WLDF	Long Beach	9	1	13	26	49
ARCO SPIRIT	KHLD	Long Beach	8	12	20	48	88
ARCO TEXAS	KNFD	Long Beach	5	0	10	36	51
ARCTIC OCEAN	C6T2062	Newark	10	0	0	8	18
ARCTIC SUN	ELQB8	Long Beach	37	42	35	100	214
ARGONAUT	KFDV	Newark	41	64	42	26	173
ARIES	KGBD	New York City	151	24	2	28	205
ARINA ARCTICA	OVYA2	Miami	98	106	118	250	572
ARKTIS SPRING	OWVD2	Miami	13	53	0	2	68
ARMCO	WE6279	Cleveland	0	5	71	330	406
ARTHUR M. ANDERSON	WE4805	Chicago	105	89	37	346	577
ATLANTIC	3FYT	Miami	201	217	223	456	1097
ATLANTIC CARTIER	C6MS4	Norfolk	32	36	39	92	199
ATLANTIC COMPANION	SKPE	Newark	26	23	16	68	133
ATLANTIC COMPASS	SKUN	Norfolk	18	23	34	68	143
ATLANTIC CONCERT	SKOZ	Norfolk	27	25	12	12	76
ATLANTIC CONVEYOR	C6NI3	Norfolk	16	26	24	36	102
ATLANTIC ERIE	VCQM	Baltimore	0	0	1	0	1
ATLANTIC OCEAN	C6T2064	Newark	34	4	34	182	254
ATLANTIC SPIRIT	ELUV4	Jacksonville	44	72	1	0	117
ATLANTIS	KAQP	New Orleans	55	17	16	0	88
AUCKLAND STAR	C6KV2	Baltimore	70	88	77	150	385
AUTHOR	GBSA	Houston	42	29	34	56	161
B. T. ALASKA	WFQE	Long Beach	15	15	0	0	30
BARBARA ANDRIE	WTC9407	Chicago	63	116	25	38	242
BARRINGTON ISLAND	C6QK	Miami	23	56	61	118	258
BAY BRIDGE	ELES7	Seattle	25	34	25	60	144
BELLONA	3FEA4	Jacksonville	26	16	0	0	42
BERING SEA	C6YY	Miami	40	24	34	58	156
BERNARDO QUINTANA A	C6KJ5	New Orleans	76	42	24	76	218
BLOSSOM FOREVER	DZSL	Seattle	36	5	57	38	136
BLUE GEMINI	3FPA6	Seattle	57	163	81	110	411
BLUE HAWK	D5HZ	Norfolk	23	22	21	48	114
BLUE NOVA	3FDV6	Seattle	46	52	24	74	196
BOHINJ	V2SG	Oakland	26	0	0	0	26
BONN EXPRESS	DGNB	Houston	493	0	180	1172	1845
BOSPORUS BRIDGE	3FMV3	Oakland	12	37	87	0	136
BP ADMIRAL	ZCAK2	Houston	0	1	0	82	83
BREMEN EXPRESS	9VUM	Norfolk	20	5	5	12	42
BRIGHT PHOENIX	DXNG	Seattle	61	39	50	270	420
BRIGHT STATE	DXAC	Seattle	42	51	48	112	253
BRIGIT MAERSK	OXVW4	Oakland	20	8	40	48	116
BRISBANE STAR	C6LY4	Seattle	29	23	14	70	136
BRITISH ADVENTURE	ZCAK3	Seattle	53	65	61	122	301
BRITISH HAWK	ZCBK6	New Orleans	79	62	96	144	381
BRITISH RANGER	ZCAS6	Houston	61	85	50	78	274
BROOKLYN BRIDGE	3EZJ9	Oakland	29	65	54	38	186
BT NIMROD	ZCBL5	Long Beach	17	27	12	52	108
BUCKEYE	WAQ3520	Cleveland	0	2	2	0	4
BUNGA ORKID DUA	9MBQ4	Seattle	12	23	9	106	150
BUNGA ORKID SATU	9MBQ3	Seattle	11	0	0	0	11
BURNS HARBOR	WQZ7049	Chicago	194	313	75	600	1182
CALCITE II	WB4520	Chicago	7	20	0	2	29
CALIFORNIA CURRENT	ELMG2	New Orleans	14	6	0	0	20
CALIFORNIA HIGHWAY	3FHQ4	Seattle	0	0	0	24	24
CALIFORNIA JUPITER	ELKU8	Long Beach	25	20	14	32	91
CALIFORNIA LUNA	3EYX5	Seattle	0	12	0	0	12
CALIFORNIA MERCURY	JGPN	Seattle	23	37	0	22	82
CAPE CHARLES	3EFX5	Seattle	12	13	10	54	89
CAPE HENRY	3ENQ9	Norfolk	13	9	8	28	58
CAPE INSCRIPTION	WSCJ	Long Beach	0	0	0	476	476
CAPE MAY	JBCN	Norfolk	14	13	35	26	88
CAPE VINCENT	KAES	Houston	0	0	0	4	4
CAPT STEVEN L BENNETT	KAXO	New Orleans	24	3	9	0	36
CARDIGAN BAY	ZCBF5	New York City	60	5	64	118	247
CARIBBEAN BULKER	C6PL3	New Orleans	14	18	6	0	38
CARIBBEAN MERCY	3FFU4	Miami	0	0	31	24	55
CARLA A. HILLS	ELBG9	Oakland	45	58	75	154	332
CARNIVAL DESTINY	3FKZ3	Miami	121	63	76	106	366

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
CARNIVAL PARADISE	3FOB5	Miami	0	0	34	54	88
CAROLINA	WYBI	Jacksonville	60	53	92	32	237
CASON J. CALLAWAY	WE4879	Chicago	15	105	36	90	246
CELEBRATION	ELFT8	Miami	0	9	30	54	93
CENTURY	ELQX6	Miami	0	0	0	274	274
CENTURY HIGHWAY #2	3EJB9	Long Beach	16	21	16	24	77
CENTURY HIGHWAY NO. 1	3FFJ4	Houston	0	36	24	42	102
CENTURY HIGHWAY NO. 5	3FVN4	Jacksonville	0	0	16	68	84
CENTURY HIGHWAY_NO. 3	8JNP	Houston	8	16	19	0	43
CENTURY LEADER NO. 1	3FBI6	Houston	10	39	19	98	166
CHARLES E. WILSON	WZE4539	Cleveland	3	1	126	44	174
CHARLES ISLAND	C6JT	Miami	32	76	41	84	233
CHARLES M. BEEGHLEY	WL3108	Cleveland	0	2	62	32	96
CHARLES PIGOTT	5LPA	Oakland	0	0	0	228	228
CHASTINE MAERSK	OWNJ2	New York City	18	7	20	24	69
CHELSEA	KNCX	New York City	121	40	44	56	261
CHEMBULK FORTITUDE	3ESF7	Norfolk	14	45	83	0	142
CHEMICAL PIONEER	KAFO	Houston	13	0	0	0	13
CHESAPEAKE BAY	WMLH	Houston	43	47	33	130	253
CHESAPEAKE TRADER	WGZK	Houston	28	52	41	72	193
CHEVRON ARIZONA	KGBE	Miami	10	20	2	0	32
CHEVRON ATLANTIC	C6KY3	New Orleans	136	90	7	60	293
CHEVRON EDINBURGH	VSBZ5	Oakland	27	0	73	144	244
CHEVRON EMPLOYEE PRIDE	C6MC5	Baltimore	9	78	0	0	87
CHEVRON MISSISSIPPI	WXBR	Oakland	99	167	69	98	433
CHEVRON NAGASAKI	A8BK	Oakland	132	88	0	2	222
CHEVRON PERTH	C6KQ8	Oakland	0	61	13	0	74
CHEVRON SOUTH AMERICA	ZCAA2	New Orleans	10	1	0	122	133
CHIEF GADAO	WEZD	Oakland	20	15	20	92	147
CHIQUITA BARU	ZCAY7	Jacksonville	16	17	0	0	33
CHIQUITA BELGIE	C6KD7	Baltimore	35	54	56	88	233
CHIQUITA BREMEN	ZCBC5	Miami	44	54	65	88	251
CHIQUITA BRENDA	ZCBE9	Miami	57	60	36	84	237
CHIQUITA DEUTSCHLAND	C6KD8	Baltimore	37	47	46	84	214
CHIQUITA ELKESCHLAND	ZCBB9	Miami	47	56	62	30	195
CHIQUITA FRANCES	ZCBD9	Miami	52	65	1	0	118
CHIQUITA ITALIA	C6KD5	Baltimore	4	50	38	68	160
CHIQUITA JEAN	ZCBB7	Jacksonville	47	43	42	66	198
CHIQUITA JOY	ZCBC2	Miami	52	52	57	64	225
CHIQUITA NEDERLAND	C6KD6	Baltimore	58	59	33	92	242
CHIQUITA ROSTOCK	ZCBD2	Miami	56	39	33	58	186
CHIQUITA SCANDINAVIA	C6KD4	Baltimore	53	55	44	100	252
CHIQUITA SCHWEIZ	C6KD9	Baltimore	38	53	49	18	158
CHITTINAD TRADITION	VTRX	New Orleans	4	0	0	0	4
CHO YANG ATLAS	DQVH	Seattle	41	57	35	132	265
CHOYANG VISION	9VOQ	Seattle	22	14	1	24	61
CITY OF DURBAN	GXIC	Long Beach	78	78	11	124	291
CLEVELAND	KGXA	Houston	7	15	14	0	36
COLORADO	KWFE	Miami	8	4	18	26	56
COLUMBIA BAY	WRB4008	Houston	2	2	0	16	20
COLUMBIA STAR	WSB2018	Cleveland	6	2	34	36	78
COLUMBIA STAR	C6HL8	Long Beach	67	91	65	130	353
COLUMBINE	3ELQ9	Baltimore	0	157	0	0	157
COLUMBUS AMERICA	ELSX2	Norfolk	15	65	85	56	221
COLUMBUS AUSTRALIA	ELSX3	Houston	33	38	27	86	184
COLUMBUS CALIFORNIA	ELUB7	Long Beach	56	125	37	72	290
COLUMBUS CANADA	ELQN3	Seattle	0	78	77	126	281
COLUMBUS QUEENSLAND	ELUB9	Norfolk	17	24	31	92	164
COLUMBUS VICTORIA	ELUB6	Long Beach	33	40	53	64	190
CONTSHIP AMERICA	3EIP3	Houston	23	33	4	0	60
CONTSHIP MEXICO	P3ZH4	Miami	22	20	8	0	50
CONTSHIP SUCCESS	ZCBE3	Houston	0	0	70	98	168
COPACABANA	PPXI	Norfolk	11	76	0	58	145
CORDELIA	3ESJ3	Long Beach	89	0	7	18	114
CORMORANT ARROW	C6IO9	Seattle	14	46	30	32	122
CORNUCOPIA	KPJC	Oakland	15	5	0	0	20
CORWITH CRAMER	WTF3319	Norfolk	30	54	42	20	146
COSMOWAY	3EVO3	Seattle	9	15	12	14	50
COURTNEY BURTON	WE6970	Cleveland	0	0	229	100	329
COURTNEY L	ZCAQ8	Baltimore	38	45	43	70	196

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
CPL. LOUIS J. HAUGE JR.	WPHV	Norfolk	0	27	0	0	27
CRISTINA 1	DUJG	Seattle	7	0	0	0	7
CRISTOFORO COLOMBO	ICYS	Norfolk	8	6	29	34	77
CROWN OF SCANDINAVIA	OXRA6	Miami	87	98	84	112	381
CSAV SUAPE	DHFN	Norfolk	0	5	2	4	11
CSL CABO	D5XH	Seattle	17	56	24	72	169
CSS HUDSON	CGDG	Norfolk	1	40	44	0	85
DAGMAR MAERSK	DHAF	New York City	64	77	35	40	216
DAISHIN MARU	3FPS6	Seattle	77	73	66	192	408
DAN MOORE	WTW6721	Norfolk	1	0	0	0	1
DANIA PORTLAND	OXEH2	Miami	79	43	32	32	186
DAWN PRINCESS	ELTO4	Miami	0	15	39	56	110
DELAWARE BAY	WMLG	Houston	41	26	26	104	197
DELAWARE TRADER	WXWL	Long Beach	71	75	77	156	379
DENALI	WSVR	Long Beach	64	71	23	48	206
DG COLUMBIA	PPSL	Norfolk	110	61	5	0	176
DIRCH MAERSK	OXQP2	Long Beach	13	27	20	72	132
DIRECT FALCON	C6MP7	Long Beach	75	85	70	146	376
DIRECT KEA	C6MP8	Long Beach	74	79	73	180	406
DIRECT KOOKABURRA	C6MQ2	Long Beach	52	75	74	122	323
DOCK EXPRESS 20	PJRF	Baltimore	2	0	0	0	2
DON QUIJOTE	SFQP	New York City	53	14	25	60	152
DORTHE OLDENDORFF	ELQJ6	Seattle	78	0	0	122	200
DRAGOER MAERSK	OXPW2	Long Beach	24	42	28	24	118
DUHALLOW	ZCBH9	Baltimore	70	0	8	194	272
DUNCAN ISLAND	C6JS	Miami	53	37	36	106	232
DUSSELDORF EXPRESS	S6IG	Long Beach	232	645	422	1406	2705
EAGLE BEAUMONT	S6JO	New York City	0	0	0	2	2
EASTERN BRIDGE	C6JY9	Baltimore	61	66	69	124	320
ECSTASY	ELNC5	Miami	5	15	7	8	35
EDELWEISS	VRUM3	Seattle	57	42	60	104	263
EDGAR B. SPEER	WQZ9670	Chicago	287	106	131	300	824
EDWARD L. RYERSON	WM5464	Chicago	0	27	9	18	54
EDWIN H. GOTT	WXQ4511	Chicago	101	74	58	180	413
EDYTH L	C6YC	Baltimore	19	16	12	44	91
ELATION	3FOC5	Miami	17	6	2	18	43
ELLIOTT BAY	DZFF	Seattle	0	79	15	0	94
ELTON HOYT II	WE3993	Cleveland	0	0	47	20	67
ENCHANTMENT OF THE SEAS	LAXA4	Miami	44	28	2	32	106
ENDEAVOR	WCE5063	Norfolk	64	51	79	68	262
ENDEAVOR	WAUW	New York City	62	43	56	92	253
ENDURANCE	WAUU	New York City	24	12	29	40	105
ENERGY ENTERPRISE	WBJF	Baltimore	12	20	4	42	78
ENGLISH STAR	C6KU7	Long Beach	58	83	76	150	367
ENIF	9VVI	Houston	37	30	18	42	127
ENTERPRISE	WAUY	New York City	34	45	32	138	249
ETERNAL WIND	3FIX7	Baltimore	0	78	106	112	296
EVER DELUXE	3FBE8	Norfolk	14	6	0	14	34
EVER DEVOTE	3FIF8	New York City	2	0	0	0	2
EVER DIADEM	3FOF8	New York City	1	0	0	0	1
EVER GARLAND	3EOB8	Long Beach	7	0	0	8	15
EVER GENERAL	BKHY	Baltimore	0	0	3	4	7
EVER GLOWING	BKJZ	Long Beach	1	7	0	0	8
EVER GOLDEN	BKHL	Baltimore	0	0	1	0	1
EVER GUEST	BKJH	Norfolk	1	0	0	10	11
EVER LAUREL	BKHH	Long Beach	0	0	0	188	188
EVER LEVEL	BKHJ	Miami	6	23	22	44	95
EVER RACER	3FJL4	Norfolk	2	0	0	0	2
EVER ROUND	3FQN3	Long Beach	8	0	0	4	12
EVER UNION	3FFG7	Seattle	3	5	3	6	17
EVER UNISON	3FTL6	Long Beach	0	0	14	28	42
EVER UNITED	3FMQ6	Seattle	0	0	0	2	2
FAIRLIFT	PEBM	Norfolk	5	27	17	56	105
FAIRMAST	PJLC	Norfolk	29	37	0	0	66
FANAL TRADER	VRUY4	Seattle	52	47	62	144	305
FANTASY	ELKI6	Miami	37	13	8	18	76
FARALLON ISLAND	FARIS	Oakland	140	147	138	288	713
FASCINATION	3EWK9	Miami	0	1	6	18	25
FAUST	WRYX	Jacksonville	28	36	33	88	185
FEYZA	TCFJ	Newark	0	0	0	12	12

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
FIDELIO	WQVY	Jacksonville	49	55	42	120	266
FLAMENGO	PPXU	Norfolk	48	0	0	58	106
FOREST CHAMPION	3FSH3	Seattle	0	0	0	36	36
FRANCES HAMMER	KRGC	Jacksonville	18	42	81	88	229
FRANCES L	C6YE	Baltimore	0	45	19	94	158
FRANKFURT EXPRESS	9VPP	New York City	34	30	35	112	211
FRED R. WHITE JR	WAR7324	Cleveland	5	5	19	26	55
FROTA BELEM	PPOA	New York City	0	0	58	0	58
G AND C PARANA	LADC2	Long Beach	36	16	13	48	113
GALVESTON BAY	WPKD	Houston	66	57	41	124	288
GEORGE A. SLOAN	WA5307	Chicago	4	69	101	178	352
GEORGE A. STINSON	WCX2417	Cleveland	3	2	169	102	276
GEORGE H. WEYERHAEUSER	C6FA7	Oakland	0	4	0	0	4
GEORGE SCHULTZ	ELPG9	Baltimore	81	78	34	122	315
GEORGE WASHINGTON BRIDGE	JKCF	Long Beach	54	62	65	76	257
GERMAN SENATOR	P3ZZ6	Norfolk	0	0	49	0	49
GINGA MARU	JFKC	Long Beach	0	0	72	180	252
GLOBAL LINK	WWDY	Baltimore	4	0	12	0	16
GLOBAL MARINER	WWXA	Baltimore	36	0	18	84	138
GLOBAL SENTINEL	WRZU	Baltimore	20	50	68	64	202
GLORIOUS SUCCESS	DUHN	Seattle	38	24	0	0	62
GOLDEN BELL	3EBK9	Seattle	0	16	0	0	16
GOLDEN GATE	KIOH	Long Beach	30	37	38	6	111
GOLDEN GATE BRIDGE	3FWM4	Seattle	62	62	46	148	318
GOLDENSARI INDAH	9VVB	Seattle	2	1	0	0	3
GRAFTON	ZCBO5	Baltimore	13	0	0	2	15
GRANDEUR OF THE SEAS	ELTQ9	Miami	23	19	15	14	71
GREAT LAND	WFDP	Seattle	56	49	38	42	185
GREEN BAY	KGTH	Long Beach	13	30	24	34	101
GREEN ISLAND	KIBK	New Orleans	36	0	17	138	191
GREEN LAKE	KGTI	Baltimore	75	67	57	122	321
GREEN RAINIER	3ENI3	Seattle	36	48	28	68	180
GREEN RIDGE	WRYL	Seattle	0	0	0	4	4
GREEN SAIKAI	3EVS5	Seattle	0	0	8	0	8
GREEN SASEBO	3EUT5	Seattle	0	7	80	46	133
GREEN VALLEY	KHAG	Houston	0	0	120	2	122
GRETE MAERSK	OZNF2	New York City	9	10	0	48	67
GROTON	KMJL	Newark	28	32	20	40	120
GUANAJUATO	ELMH8	Jacksonville	4	13	17	0	34
GUAYAMA	WZJG	Jacksonville	0	65	0	0	65
HADERA	ELBX4	Baltimore	59	40	37	68	204
HANDY LOGGER	DZBH	Seattle	1	0	0	0	1
HANJIN BARCELONA	3EXX9	Long Beach	0	12	0	2	14
HANJIN COLOMBO	3FTF4	Oakland	15	0	0	26	41
HANJIN KAOHSIUNG	P3BN8	Seattle	7	6	16	26	55
HANJIN KEELUNG	P3VH7	Houston	0	37	82	80	199
HANJIN LOS ANGELES	3FPQ7	Newark	0	1	0	0	1
HANJIN PORTLAND	3FSB3	Newark	0	0	9	14	23
HANJIN SHANGHAI	3FGI5	Newark	1	0	0	0	1
HANJIN TOKYO	3FZJ3	New York City	4	6	8	20	38
HARBOUR BRIDGE	ELJH9	Seattle	6	0	5	82	93
HEIDELBERG EXPRESS	DEDI	Houston	684	395	664	1410	3153
HEKABE	C6OU2	New Orleans	28	12	14	12	66
HENRY HUDSON BRIDGE	JKLS	Long Beach	64	86	69	130	349
HERBERT C. JACKSON	WL3972	Cleveland	2	2	10	64	78
HOEGH DRAKE	LAGN5	Norfolk	0	119	24	40	183
HOEGH DYKE	LAGM5	Norfolk	0	0	14	20	34
HOEGH MINERVA	LAGI5	Seattle	0	15	0	52	67
HOEGH MIRANDA	LAGJ5	Norfolk	12	32	0	0	44
HOLIDAY	3FPN5	Long Beach	0	12	2	46	60
HONG KONG SENATOR	DEIP	Seattle	0	0	13	90	103
HONSHU SILVIA	3EST7	Seattle	53	22	83	134	292
HOOD ISLAND	C6LU4	Newark	45	38	46	100	229
HORIZON	ELNG6	Miami	60	24	22	34	140
HOUSTON	FNXB	Houston	19	4	16	62	101
HOUSTON EXPRESS	DLBB	Houston	13	19	0	0	32
HUMACAO	WZJB	Norfolk	17	45	28	94	184
HUMBERGRACHT	PEUQ	Houston	7	28	1	0	36
HYUNDAI DISCOVERY	3FFR6	Seattle	1	318	47	104	470
HYUNDAI EXPLORER	3FTG4	Seattle	20	54	40	94	208

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
HYUNDAI FORTUNE	3FLG6	Seattle	19	110	24	48	201
HYUNDAI FREEDOM	3FFS6	Seattle	9	6	13	26	54
HYUNDAI LIBERTY	3FFT6	Seattle	16	16	10	32	74
IGARKA	EKYO	Seattle	7	1	3	0	11
IMAGINATION	3EWJ9	Miami	14	13	10	14	51
INDEPENDENT LEADER	DHOU	New York City	0	0	0	288	288
INDIAN OCEAN	C6T2063	New York City	24	25	10	412	471
INDIANA HARBOR	WXN3191	Cleveland	1	1	301	120	423
INLAND SEAS	WCJ6214	Chicago	18	2	0	0	20
INSPIRATION	3FOA5	Miami	20	5	10	14	49
IRENA ARCTICA	OXTS2	Miami	39	62	78	176	355
ISLA DE CEDROS	3FOA6	Seattle	30	30	25	0	85
ISLAND PRINCESS	GBBM	Long Beach	4	9	3	28	44
ITB BALTIMORE	WXKM	Baltimore	40	25	26	22	113
ITB MOBILE	KXDB	New York City	23	13	5	28	69
ITB NEW YORK	WVDG	Newark	22	69	7	154	252
IVER EXPLORER	PEXV	Houston	24	20	23	16	83
IVER EXPRESS	PEXX	Houston	8	32	7	58	105
IWANUMA MARU	3ESU8	Seattle	108	146	73	136	463
J. DENNIS BONNEY	ELLE2	Baltimore	50	39	4	104	197
J.A.W. IGLEHART	WTP4966	Cleveland	2	3	24	30	59
JACKLYN M.	WCV7620	Chicago	96	96	21	130	343
JACKSONVILLE	WNDG	Baltimore	68	65	48	76	257
JADE ORIENT	ELRY6	Seattle	5	16	12	28	61
JADE PACIFIC	ELRY5	Seattle	0	5	0	8	13
JAHRE SPIRIT	LAWS2	Houston	11	8	12	42	73
JAMES	ELRR6	New Orleans	17	20	32	100	169
JAMES N. SULLIVAN	ELPG8	Baltimore	37	31	47	56	171
JAMES R. BARKER	WYP8657	Cleveland	0	0	299	142	441
JEB STUART	WRGQ	Oakland	0	4	5	8	17
JO CLIPPER	PFEZ	Baltimore	19	53	34	102	208
JO ELM	PFFD	Baltimore	27	19	0	0	46
JOHN G. MUNSON	WE3806	Chicago	72	68	31	156	327
JOHN YOUNG	ELNG9	Oakland	15	68	60	0	143
JOIDES RESOLUTION	D5BC	Norfolk	49	121	0	284	454
JOSEPH L. BLOCK	WXY6216	Chicago	35	53	17	142	247
JOSEPH LYKES	ELRZ8	Houston	0	0	13	80	93
JUBILEE	3FPM5	Long Beach	0	29	4	118	151
JULIUS HAMMER	KRGJ	Jacksonville	0	6	0	22	28
KAIJIN	3FWI3	Seattle	93	133	0	116	342
KANIN	ELEO2	New Orleans	33	62	39	54	188
KANSAS TRADER	KSDF	Houston	1	18	8	0	27
KAPITAN BYANKIN	UAGK	Seattle	55	65	44	106	270
KAPITAN KONEV	UAHV	Seattle	41	29	27	60	157
KAREN ANDRIE	WBS5272	Chicago	80	116	22	240	458
KAUAI	WSRH	Long Beach	53	69	4	4	130
KAYE E. BARKER	WCF3012	Cleveland	0	0	137	112	249
KAZIMAH	9KKL	Houston	56	42	44	146	288
KEE LUNG	BHFN	Seattle	0	12	0	16	28
KEN KOKU	3FMN6	Seattle	21	21	0	24	66
KEN SHIN	YJQS2	Seattle	8	1	3	16	28
KEN YO	3FIC5	Seattle	0	49	34	32	115
KENAI	WSNB	Houston	0	2	0	16	18
KENNETH E. HILL	C6FA6	Newark	42	58	22	140	262
KENNETH T. DERR	C6FA3	Newark	34	47	45	268	394
KINSMAN INDEPENDENT	WUZ7811	Cleveland	29	30	202	300	561
KISHORE	ATMC	New York City	9	1	0	0	10
KNOCK ALLAN	ELOI6	Houston	62	36	78	80	256
KOELN EXPRESS	9VBL	New York City	467	695	596	228	1986
KOMET	V2SA	Miami	2	0	0	0	2
KURE	3FGN3	Seattle	8	41	20	58	127
LAWRENCE H. GIANELLA	WLBX	Norfolk	0	68	0	278	346
LEE A. TREGURTHA	WUR8857	Cleveland	8	8	175	70	261
LEGEND OF THE SEAS	ELRR5	New Orleans	8	11	7	0	26
LEISE MAERSK	OXGR2	Oakland	26	44	2	24	96
LEOPARDI	V7AU8	Baltimore	69	85	76	76	306
LIBERTY SEA	KPZH	New Orleans	14	0	4	0	18
LIBERTY STAR	WCBP	New Orleans	37	38	6	56	137
LIBERTY SUN	WCOB	Houston	0	60	41	248	349
LIHUE	WTST	Seattle	53	35	54	100	242

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
LILAC ACE	3FDL4	Long Beach	16	12	17	52	97
LINDA OLDENDORF	ELRR2	Baltimore	40	50	28	20	138
LIRCAY	ELEV8	Houston	5	6	1	10	22
LNG AQUARIUS	WSKJ	Oakland	87	22	62	176	347
LNG CAPRICORN	KHLN	New York City	24	14	12	30	80
LNG LEO	WDZB	New York City	65	37	31	82	215
LNG LIBRA	WDZG	New York City	0	70	71	66	207
LNG TAURUS	WDZW	New York City	43	5	7	88	143
LNG VIRGO	WDZX	New York City	55	40	32	86	213
LOK PRAGATI	ATZS	Seattle	29	0	40	42	111
LONG BEACH	3FOU3	Seattle	15	35	0	0	50
LOOTSGRACHT	PFPT	Houston	17	49	38	48	152
LOUIS MAERSK	OXMA2	Baltimore	0	63	0	166	229
LTC CALVIN P. TITUS	KAKG	Baltimore	2	4	0	0	6
LUCY OLDENDORFF	ELPA2	Long Beach	23	14	17	100	154
LUISE OLDENDORFF	3FOW4	Seattle	37	54	60	82	233
LURLINE	WLVD	Oakland	12	4	24	46	86
LUTJENBURG	ELVF6	Long Beach	0	0	16	124	140
LYKES ADVENTURER	KNFG	Jacksonville	18	17	3	52	90
LYKES CHALLANGER	FNHV	Houston	0	31	23	34	88
LYKES COMMANDER	3ELF9	Baltimore	35	4	36	42	117
LYKES DISCOVERER	WGXO	Houston	24	47	65	140	276
LYKES EXPLORER	WGLA	Houston	15	21	32	50	118
LYKES LIBERATOR	WGXN	Houston	36	39	55	84	214
LYKES NAVIGATOR	WGMJ	Houston	16	16	10	200	242
LYKES PATHFINDER	3EJT9	Baltimore	64	26	3	96	189
M. P. GRACE	ELBG	New Orleans	0	0	3	2	5
M/V FRANCOIS L.D.	FNEQ	Norfolk	50	81	92	136	359
M/V SP5. ERIC G. GIBSON	KAKF	Baltimore	76	3	0	0	79
MAASDAM	PFRO	Long Beach	2	41	27	24	94
MACKINAC BRIDGE	JKES	Long Beach	55	67	81	134	337
MADISON MAERSK	OVJB2	Oakland	68	35	36	56	195
MAERSK BROOKLYN	C6OE8	New York City	0	80	54	194	328
MAERSK CALIFORNIA	WCX5083	Houston	32	9	0	4	45
MAERSK COLORADO	WCX5081	Miami	23	90	28	44	185
MAERSK GANNET	GJLK	Miami	68	62	11	128	269
MAERSK GIANT	OU2465	Miami	21	0	186	470	677
MAERSK SANTOS	ELRR4	Baltimore	5	9	3	4	21
MAERSK SHETLAND	MSQK3	Miami	53	18	9	8	88
MAERSK SOMERSET	MQVF8	New Orleans	43	43	39	84	209
MAERSK STAFFORD	MRSS9	Miami	43	34	42	68	187
MAERSK SUN	S6ES	Seattle	73	100	113	108	394
MAERSK SURREY	MRSG8	Houston	7	33	21	18	79
MAERSK TAIKI	9VIG	Baltimore	3	0	45	72	120
MAERSK TENNESSEE	WCX3486	Houston	72	61	0	0	133
MAERSK TEXAS	WCX3249	Houston	7	4	0	66	77
MAGLEBY MAERSK	OUSH2	Newark	23	54	12	10	99
MAHARASHTRA	VTSQ	Seattle	5	8	9	8	30
MAHIMAHI	WHRN	Oakland	54	20	69	70	213
MAIRANGI BAY	GXEW	Long Beach	49	18	62	86	215
MAJ STEPHEN W PLESS MPS1	WHAU	Norfolk	0	55	12	0	67
MAJESTIC MAERSK	OUJH2	Newark	11	47	27	12	97
MAJESTY OF THE SEAS	LAOI4	Miami	0	0	18	130	148
MALCOLM BALDRIGE	WTER	Miami	0	0	1	0	1
MANHATTAN BRIDGE	3FWL4	Long Beach	51	32	23	260	366
MANOA	KDBG	Oakland	25	56	63	116	260
MANUKAI	KNLO	Oakland	35	0	4	4	43
MARCARRIER	V2VM	Newark	218	137	0	0	355
MARCHEN MAERSK	OWDQ2	Long Beach	29	17	8	124	178
MAREN MAERSK	OWZU2	Long Beach	1	36	28	198	263
MARGRETHE MAERSK	OYSN2	Long Beach	25	18	6	16	65
MARI BETH ANDRIE	WUY3362	Chicago	51	0	0	0	51
MARIE MAERSK	OULL2	Newark	32	19	14	228	293
MARINE COLUMBIA	KLKZ	Oakland	58	98	66	126	348
MARIT MAERSK	OZFC2	Oakland	44	21	24	78	167
MARK HANNAH	WYZ5243	Chicago	0	18	0	28	46
MATHILDE MAERSK	OUUU2	Long Beach	30	40	25	114	209
MATSONIA	KHRC	Oakland	58	67	59	146	330
MAUI	WSLH	Long Beach	22	57	29	64	172
MAURICE EWING	WLDZ	Newark	101	32	0	0	133

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
MAYAGUEZ	WZJE	Jacksonville	25	30	18	48	121
MAYVIEW MAERSK	OWEB2	Oakland	20	58	20	80	178
MC-KINNEY MAERSK	OUZW2	Newark	37	10	8	42	97
MEDUSA CHALLENGER	WA4659	Cleveland	39	34	297	198	568
MEKHANIK KALYUZHNIY	UFLO	Seattle	100	102	66	182	450
MEKHANIK MOLDOVANOV	UIKI	Seattle	65	68	68	138	339
MELBOURNE STAR	C6JY6	Newark	55	33	14	78	180
MELVILLE	WECB	Long Beach	54	0	0	0	54
MERCHANT PREMIER	VROP	Houston	250	40	37	82	409
MERCHANT PRINCIPAL	VRIO	Miami	17	16	18	34	85
MERCURY	3FFC7	Miami	0	0	4	0	4
MERLION ACE	9VHJ	Long Beach	15	22	29	212	278
MESABI MINER	WYQ4356	Cleveland	4	8	169	72	253
METEOR	DBBH	Houston	196	178	53	400	827
METTE MAERSK	OXKT2	Long Beach	88	30	10	120	248
MICHIGAN	WRB4141	Chicago	43	13	4	138	198
MIDDLETOWN	WR3225	Cleveland	0	0	28	12	40
MING ASIA	BDEA	New York City	7	8	40	84	139
MING PEACE	ELVR9	Long Beach	12	19	23	40	94
MOANA WAVE	WUS9293	Norfolk	15	0	0	0	15
MOKIHANA	WNRD	Oakland	61	39	53	84	237
MOKU PAHU	WBWK	Oakland	77	63	41	104	285
MORELOS	PGBB	Houston	39	38	45	120	242
MORMACSKY	WMBQ	New York City	26	12	18	12	68
MORMACSTAR	KGDF	Houston	27	55	3	18	103
MORMACSUN	WMBK	Norfolk	15	30	25	62	132
MOSEL ORE	ELRE5	Norfolk	45	72	76	114	307
MSC BOSTON	9HGP4	New York City	26	24	23	46	119
MSC GINA	C4LV	New York City	0	8	45	60	113
MSC JESSICA	C6BK6	Newark	114	75	123	214	526
MSC JESSICA	C6IO5	Newark	9	0	0	0	9
MSC NEW YORK	9HIG4	New York City	45	55	32	58	190
MUNKEBO MAERSK	OUNI5	New York City	28	26	0	0	54
MV MIRANDA	3FRO4	Norfolk	24	74	0	2	100
MYRON C. TAYLOR	WA8463	Chicago	58	23	14	128	223
NADA II	ELAV2	Seattle	19	36	9	84	148
NAJA ARCTICA	OXVH2	Miami	108	113	130	120	471
NATHANIEL B. PALMER	WBP3210	Seattle	22	63	59	96	240
NATIONAL DIGNITY	DZRG	Long Beach	27	21	13	8	69
NATIONAL PRIDE	DZPK	Long Beach	0	0	1	0	1
NEDLLOYD DELFT	PGDD	Houston	0	3	1	0	4
NEDLLOYD HOLLAND	KRHX	Houston	216	49	61	78	404
NEDLLOYD MONTEVIDEO	PGAF	Long Beach	25	10	8	8	51
NEDLLOYD RALEIGH BAY	PHKG	Houston	0	0	12	30	42
NEDLLOYD VAN DAJIMA	PGDB	Houston	18	0	0	0	18
NEDLLOYD VAN DIEMEN	PGFE	Houston	17	5	19	34	75
NEGO LOMBOK	DXQC	Seattle	10	0	36	108	154
NELVANA	YJWZ7	Baltimore	50	30	25	60	165
NEPTUNE ACE	JFLX	Long Beach	50	84	0	0	134
NEPTUNE RHODONITE	ELJP4	Long Beach	6	11	9	26	52
NEW CARISSA	3ELY7	Seattle	73	70	68	88	299
NEW HORIZON	WKWB	Long Beach	10	56	57	146	269
NEW NIKKI	3FHG5	Seattle	45	33	90	80	248
NEWARK BAY	WPKS	Houston	107	60	64	72	303
NEWPORT BRIDGE	3FGH3	Oakland	18	13	12	42	85
NIEUW AMSTERDAM	PGGQ	Long Beach	12	13	0	0	25
NOAA DAVID STARR JORDAN	WTDK	Seattle	65	66	69	26	226
NOAA SHIP ALBATROSS IV	WMVF	Norfolk	35	116	43	0	194
NOAA SHIP DELAWARE II	KNBD	New York City	71	108	76	20	275
NOAA SHIP FERREL	WTEZ	Norfolk	12	51	31	34	128
NOAA SHIP KA’IMIMOANA	WTEU	Seattle	60	47	41	204	352
NOAA SHIP MCARTHUR	WTEJ	Seattle	132	212	196	160	700
NOAA SHIP MILLER FREEMAN	WTDM	Seattle	1	946	0	0	947
NOAA SHIP OREGON II	WTDO	New Orleans	101	124	102	0	327
NOAA SHIP RAINIER	WTEF	Seattle	89	90	2	0	181
NOAA SHIP RONALD H BROWN	WTEC	New Orleans	105	541	72	0	718
NOAA SHIP T. CROMWELL	WTDF	Seattle	0	31	25	0	56
NOAA SHIP WHITING	WTEW	Baltimore	57	74	68	0	199
NOAAS GORDON GUNTER	WTEO	New Orleans	193	3	94	0	290
NOBEL STAR	KRPP	Houston	1	24	2	26	53

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
NOL STENO	ZCBD4	New York City	12	10	6	2	30
NOLIZWE	MQLN7	New York City	148	112	111	280	651
NOMZI	MTQU3	Baltimore	164	67	59	198	488
NOORDAM	PGHT	Miami	16	22	24	30	92
NORASIA SHANGHAI	DNHS	New York City	9	14	1	0	24
NORD JAHRE TRANSPORTER	LACF4	Baltimore	5	6	18	32	61
NORDMAX	P3YS5	Seattle	89	85	56	152	382
NORDMORITZ	P3YR5	Seattle	58	67	67	88	280
NORTHERN LIGHTS	WFJK	New Orleans	43	47	19	0	109
NORWAY	C6CM7	Miami	0	23	13	0	36
NTABENI	3EGR6	Houston	34	37	27	80	178
NUERNBERG EXPRESS	9VBK	Houston	702	726	687	1292	3407
NUEVO LEON	XCKX	Houston	15	22	28	22	87
NUEVO SAN JUAN	KEOD	Norfolk	14	51	13	296	374
NYK SEABREEZE	ELNJ3	Seattle	0	0	1	0	1
NYK SPRINGTIDE	S6CZ	Houston	4	13	11	38	66
NYK STARLIGHT	3FUX6	Long Beach	10	42	64	26	142
NYK SUNRISE	3FYZ6	Seattle	41	50	41	104	236
NYK SURFWIND	ELOT3	Seattle	26	26	0	0	52
OCEAN BELUGA	3FEI6	Jacksonville	5	24	28	34	91
OCEAN CAMELLIA	3FTR6	Seattle	0	1	0	0	1
OCEAN CITY	WCYR	Houston	0	0	44	100	144
OCEAN CLIPPER	3EXI7	New Orleans	102	97	72	126	397
OCEAN HARMONY	3FRX6	Seattle	3	10	1	32	46
OCEAN LAUREL	3FLX4	Seattle	6	4	13	0	23
OCEAN LILY	3EQS7	Seattle	2	0	0	0	2
OCEAN PALM	3FDO7	Seattle	34	28	24	496	582
OCEAN SERENE	DURY	Seattle	35	58	73	80	246
OGLEBAY NORTON	WAQ3521	Cleveland	0	2	216	156	374
OLEANDER	PJJU	Newark	58	48	34	98	238
OLIVEBANK	3ETQ5	Baltimore	50	0	41	4	95
OLYMPIA	V7AZ4	Baltimore	96	66	69	104	335
OLYMPIAN HIGHWAY	3FSH4	Seattle	0	11	6	0	17
OMI CHAMPION	KIGP	Long Beach	3	0	2	14	19
OOCL AMERICA	ELSM7	Oakland	24	36	38	54	152
OOCL CALIFORNIA	ELSA4	Seattle	50	38	45	82	215
OOCL CHINA	ELSU8	Long Beach	41	57	79	194	371
OOCL ENVOY	ELNV7	Seattle	31	23	22	62	138
OOCL FAIR	ELFV2	Long Beach	19	27	14	684	744
OOCL FAITH	ELFU9	Norfolk	45	148	52	160	405
OOCL FIDELITY	ELFV8	Long Beach	47	30	32	84	193
OOCL FORTUNE	ELFU8	Norfolk	38	22	41	78	179
OOCL FREEDOM	VRCV	Norfolk	45	47	38	68	198
OOCL FRIENDSHIP	ELFV3	Long Beach	41	2	28	44	115
OOCL HONG KONG	VRVA5	Oakland	32	43	29	92	196
OOCL INNOVATION	WPWH	Houston	27	100	52	116	295
OOCL INSPIRATION	KRPB	Houston	105	40	45	114	304
OOCL JAPAN	ELSU6	Long Beach	56	79	59	152	346
ORANGE BLOSSOM	ELEI6	Newark	0	0	20	148	168
ORIANA	GVSN	Miami	10	19	34	112	175
ORIENTAL ROAD	3FXT6	Houston	0	66	16	150	232
ORIENTE GRACE	3FHT4	Seattle	10	45	0	136	191
ORIENTE HOPE	3ETH4	Seattle	0	3	9	40	52
ORIENTE NOBLE	3FVF5	Seattle	35	35	34	76	180
ORIENTE PRIME	3FOU4	Seattle	8	9	15	12	44
OURO DO BRASIL	ELPP9	Baltimore	10	9	8	56	83
OVERSEAS CHICAGO	KBCF	Oakland	12	26	0	6	44
OVERSEAS HARRIET	WRFJ	Houston	8	0	0	0	8
OVERSEAS JOYCE	WUQL	Jacksonville	50	51	77	206	384
OVERSEAS JUNEAU	WWND	Seattle	84	53	0	28	165
OVERSEAS MARILYN	WFQB	Houston	3	0	13	2	18
OVERSEAS NEW ORLEANS	WFKW	Houston	6	23	31	40	100
OVERSEAS NEW YORK	WMCK	Houston	21	20	31	16	88
OVERSEAS OHIO	WJBG	Oakland	55	75	25	52	207
OVERSEAS WASHINGTON	WFGV	Houston	20	0	1	0	21
P & O NEDLLOYD BUENOS	AI PGEC	Houston	0	0	1	0	1
P&O NEDLLOYD CHILE	DVRA	New York City	8	7	10	10	35
P&O NEDLLOYD TEXAS	ZCBF6	Houston	72	61	62	138	333
PACASIA	ELKM7	Seattle	13	0	0	0	13
PACDREAM	ELQO6	Seattle	0	0	0	32	32

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
PACDUKE	A8SL	Seattle	5	0	0	0	5
PACIFIC ARIES	ELJQ2	Seattle	0	12	39	34	85
PACIFIC HIRO	3FOY5	Seattle	0	0	0	72	72
PACIFIC PRINCESS	GBCF	New York City	0	0	4	0	4
PACIFIC SANDPIPER	GDRJ	Miami	26	105	12	188	331
PACIFIC SELESA	DVCK	Seattle	57	28	40	66	191
PACIFIC SENATOR	ELTY6	Long Beach	2	68	0	12	82
PACKING	ELBX3	Seattle	12	5	7	26	50
PACOCEAN	XYLA	Seattle	13	33	21	20	87
PACPRINCE	ELED7	Seattle	13	13	7	24	57
PACPRINCESS	ELED8	Houston	6	8	11	14	39
PACROSE	YJQK2	Seattle	0	0	13	18	31
PACSEA	XYKX	Seattle	20	7	5	24	56
PATRIOT	KGBQ	Houston	0	0	11	90	101
PAUL BUCK	KDGR	Houston	0	0	10	4	14
PAUL H. TOWNSEND	WF9016	Cleveland	0	0	5	0	5
PAUL R. TREGURTHA	WYR4481	Cleveland	0	0	139	682	821
PEGASUS HIGHWAY	3FMA4	New York City	0	0	0	32	32
PEGGY DOW	PJOY	Long Beach	63	59	61	128	311
PFC DEWAYNE T. WILLIAMS	WJKJ	Norfolk	0	27	10	0	37
PFC EUGENE A. OBREGON	WHAQ	Norfolk	0	33	25	14	72
PFC JAMES ANDERSON JR	WJXG	Newark	0	9	0	70	79
PFC WILLIAM B. BAUGH	KRPW	Norfolk	0	13	0	22	35
PHILADELPHIA	KSYP	Baltimore	12	13	13	0	38
PHILIP R. CLARKE	WE3592	Chicago	38	84	60	250	432
PIERRE FORTIN	CG2678	Norfolk	211	239	94	0	544
PINO GLORIA	3EZW7	Seattle	13	17	1	52	83
PISCES EXPLORER	MWQD5	Long Beach	1	21	23	4	49
POLAR EAGLE	ELPT3	Long Beach	37	37	38	66	178
POLYNESIA	D5NZ	Long Beach	79	91	111	166	447
POTOMAC TRADER	WXBZ	Houston	30	14	28	30	102
PRESIDENT ADAMS	WRYW	Oakland	33	70	60	118	281
PRESIDENT GRANT	WCY2098	Long Beach	56	53	36	316	461
PRESIDENT HOOVER	WCY2883	Oakland	43	22	59	62	186
PRESIDENT JACKSON	WRYC	Oakland	58	79	46	124	307
PRESIDENT KENNEDY	WRYE	Oakland	43	82	73	118	316
PRESIDENT POLK	WRYD	Oakland	41	0	0	342	383
PRESIDENT TRUMAN	WNDP	Oakland	47	85	71	106	309
PRESIDENT WILSON	WCY3438	Long Beach	4	28	38	350	420
PRESQUE ISLE	WZE4928	Chicago	9	178	53	398	638
PRIDE OF BALTIMORE II	WUW2120	Baltimore	220	136	45	0	401
PRINCE OF OCEAN	3ECO9	Seattle	22	22	9	0	53
PRINCE WILLIAM SOUND	WSDX	Long Beach	0	6	0	0	6
PRINCESS OF SCANDINAVIA	OWEN2	Miami	86	101	128	204	519
PROJECT ARABIA	PJKP	Miami	15	7	25	62	109
PROJECT ORIENT	PJAG	Baltimore	49	54	35	18	156
PUDONG SENATOR	DQVI	Seattle	39	21	34	20	114
PUSAN SENATOR	DQVG	Seattle	28	0	41	20	89
QUEEN ELIZABETH 2	GBTT	New York City	64	29	72	118	283
QUEEN OF SCANDINAVIA	OUSE6	Miami	62	62	64	120	308
QUEENSLAND STAR	C6JZ3	Houston	49	54	69	160	332
R. HAL DEAN	C6JN	Long Beach	57	8	0	0	65
R.J. PFEIFFER	WRJP	Long Beach	61	18	37	66	182
RAINBOW BRIDGE	3EYX9	Long Beach	0	50	63	194	307
RAYMOND E. GALVIN	ELCO5	Oakland	0	0	10	42	52
REBECCA LYNN	WCW7977	Chicago	42	53	90	66	251
REGAL PRINCESS	ELVR6	Miami	0	0	0	92	92
REGINA MAERSK	OZIN2	New York City	71	12	19	110	212
RENEGADE	ZCMF9	Miami	42	0	0	28	70
REPULSE BAY	MQYA3	Houston	44	66	57	108	275
RESERVE	WE7207	Cleveland	0	0	16	186	202
RESOLUTE	KFDZ	Norfolk	14	82	12	210	318
RHAPSODY OF THE SEAS	LAZK4	Miami	0	1	8	10	19
RICHARD REISS	WBF2376	Cleveland	0	0	86	18	104
RICKMERS TIANJIN	C6IM9	Norfolk	0	0	28	12	40
RIO APURE	ELUG7	Miami	0	0	42	124	166
ROBERT E. LEE	KCRD	New Orleans	0	18	42	0	60
ROGER BLOUGH	WZP8164	Chicago	53	71	32	182	338
ROGER REVELLE	KAOU	New Orleans	0	31	12	0	43
ROSSEL CURRENT	J8FI6	Houston	4	0	1	0	5

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
ROYAL ETERNITY	DUXW	Norfolk	30	37	40	74	181
ROYAL PRINCESS	GBRP	Long Beach	9	3	30	56	98
RUBIN BONANZA	3FNV5	Seattle	19	46	47	80	192
RUBIN KOBE	DYZM	Seattle	0	120	47	64	231
RUBIN PEARL	YJQA8	Seattle	45	60	48	154	307
RUBIN ROSE	ELML4	Seattle	7	98	85	72	262
RUBIN STELLA	3FAP5	Seattle	23	407	26	4	460
RYNDAM	PHFV	Miami	4	20	5	0	29
SAGA CREST	LATH4	Miami	0	0	1	8	9
SALOME	S6CL	Newark	18	0	0	0	18
SAM HOUSTON	KDGA	Houston	14	50	39	16	119
SAMUEL GINN	C6OB	Oakland	64	8	0	0	72
SAMUEL H. ARMACOST	C6FA2	Oakland	63	53	27	42	185
SAMUEL L. COBB	KCDJ	Oakland	0	0	26	42	68
SAMUEL RISLEY	CG2960	Norfolk	34	52	175	392	653
SAN ANTONIO	LATN4	New Orleans	36	55	30	54	175
SAN FELIPE	DNEN	Houston	2	10	37	46	95
SAN FERNANDO	DGGD	Houston	15	13	9	22	59
SAN FRANCISCO	DIGF	Houston	54	44	33	88	219
SAN ISIDRO	ELVG8	Norfolk	38	29	21	22	110
SAN MARCOS	ELND4	Jacksonville	0	0	14	0	14
SAN PEDRO	DHHO	Norfolk	0	0	23	112	135
SANKO LAUREL	3EXQ3	Seattle	1	0	0	76	77
SANTA CHRISTINA	3FAE6	Seattle	32	10	12	16	70
SANTORIN 2	P3ZL4	Seattle	0	187	37	66	290
SARAMATI	9VIW	Baltimore	0	32	0	0	32
SC HORIZON	ELOC8	New York City	85	30	72	150	337
SCHACKENBORG	OYUY4	Houston	0	0	19	52	71
SEA CHAMPION	DYGS	Seattle	3	47	0	30	80
SEA FOX	KBGK	Jacksonville	30	33	16	66	145
SEA INITIATIVE	DEBB	Houston	54	47	67	124	292
SEA ISLE CITY	WCYQ	Houston	0	0	59	24	83
SEA LION	KJLV	Jacksonville	68	63	88	232	451
SEA LYNX	DGOO	Jacksonville	37	67	63	76	243
SEA MAJESTY	DYAA	Seattle	24	0	0	0	24
SEA MARINER	J8FF9	Miami	12	29	7	48	96
SEA PRINCESS	KRCP	New Orleans	14	7	55	22	98
SEA PUMA	DHPK	Jacksonville	5	0	0	0	5
SEA RACER	ELQI8	Jacksonville	41	29	42	104	216
SEA WISDOM	3FUO6	Seattle	0	0	0	174	174
SEA-LAND CHARGER	V7AY2	Long Beach	0	0	8	82	90
SEA-LAND EAGLE	V7AZ8	Long Beach	30	50	15	142	237
SEA/LAND VICTORY	DIDY	New York City	13	10	16	14	53
SEABOARD FLORIDA	3FBW5	Miami	0	0	24	30	54
SEABOARD SUN	ELRV6	Jacksonville	18	30	11	30	89
SEABOARD UNIVERSE	ELRU3	Miami	16	22	33	66	137
SEALAND ANCHORAGE	KGTX	Seattle	51	146	52	90	339
SEALAND ARGENTINA	DGVN	Jacksonville	34	34	35	68	171
SEALAND ATLANTIC	KRLZ	Norfolk	30	27	33	152	242
SEALAND CHALLENGER	WZJC	Newark	17	51	80	146	294
SEALAND CHAMPION	V7AM9	Oakland	6	40	30	48	124
SEALAND COMET	V7AP3	Oakland	50	35	33	110	228
SEALAND CONSUMER	WCHF	Long Beach	27	4	23	86	140
SEALAND CRUSADER	WZJF	Jacksonville	318	25	17	80	440
SEALAND DEFENDER	KGJB	Oakland	14	102	54	22	192
SEALAND DEVELOPER	KHRH	Long Beach	70	42	42	62	216
SEALAND DISCOVERY	WZJD	Jacksonville	125	0	0	318	443
SEALAND ENDURANCE	KGJX	Long Beach	18	68	18	126	230
SEALAND ENTERPRISE	KRGB	Oakland	79	266	62	146	553
SEALAND EXPEDITION	WPGJ	Jacksonville	7	4	16	48	75
SEALAND EXPLORER	WGJF	Long Beach	37	55	42	88	222
SEALAND EXPRESS	KGJD	Long Beach	37	94	22	30	183
SEALAND FREEDOM	V7AM3	Seattle	9	24	30	222	285
SEALAND HAWAII	KIRF	Houston	418	62	48	110	638
SEALAND INDEPENDENCE	WGJC	Long Beach	51	46	21	210	328
SEALAND INNOVATOR	WGKF	Oakland	38	38	30	40	146
SEALAND INTEGRITY	WPVD	Houston	85	47	46	354	532
SEALAND INTREPID	V7BA2	Norfolk	71	18	13	78	180
SEALAND KODIAK	KGTZ	Seattle	21	66	48	84	219
SEALAND LIBERATOR	KHRP	Oakland	61	39	70	100	270

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
SEALAND MARINER	V7AM5	Seattle	21	38	22	88	169
SEALAND MERCURY	V7AP6	Oakland	4	20	0	0	24
SEALAND METEOR	V7AP7	Long Beach	8	14	35	0	57
SEALAND NAVIGATOR	WPGK	Long Beach	73	128	64	84	349
SEALAND PACIFIC	WSRL	Long Beach	74	157	58	200	489
SEALAND PATRIOT	KHRF	Oakland	22	9	61	64	156
SEALAND PERFORMANCE	KRPD	Norfolk	140	39	57	124	360
SEALAND PRODUCER	WJBJ	Long Beach	56	44	57	48	205
SEALAND QUALITY	KRNJ	Jacksonville	111	37	43	146	337
SEALAND RACER	V7AP8	Long Beach	42	31	48	80	201
SEALAND RELIANCE	WFLH	Long Beach	57	216	72	132	477
SEALAND SPIRIT	WFLG	Oakland	74	27	65	42	208
SEALAND TACOMA	KGTY	Seattle	54	285	52	72	463
SEALAND TRADER	KIRH	Oakland	50	201	78	30	359
SEALAND VOYAGER	KHRK	Seattle	40	88	53	88	269
SEARIVER BATON ROUGE	WAFA	Oakland	0	5	21	8	34
SEARIVER BENICIA	KPKL	Long Beach	8	10	12	0	30
SEARIVER LONG BEACH	WHCA	Long Beach	6	0	0	0	6
SEARIVER NORTH SLOPE	KHLQ	Oakland	15	31	8	24	78
SENATOR	V7AY7	Miami	0	26	0	4	30
SENSATION	3ESE9	Miami	12	8	1	0	21
SETO BRIDGE	JMQY	Oakland	36	62	28	94	220
SEVEN OCEAN	3EZB8	Seattle	0	0	19	36	55
SEWARD JOHNSON	WST9756	Miami	12	70	237	322	641
SGT WILLIAM A BUTTON	WJLX	Norfolk	0	0	0	82	82
SGT. METEJ KOCAK	WHAC	Norfolk	0	11	0	150	161
SHIRAOI MARU	3ECM7	Seattle	33	62	63	96	254
SIDNEY STAR	C6JY7	Houston	30	47	60	106	243
SKANDERBORG	OYRI4	Houston	0	0	3	0	3
SKAUBRYN	LAJV4	Seattle	37	66	44	108	255
SKAUGRAN	LADB2	Seattle	12	48	13	30	103
SOL DO BRASIL	ELQQ4	Baltimore	20	4	29	48	101
SOLAR WING	ELJS7	Jacksonville	62	38	38	126	264
SONG OF AMERICA	LENA3	Miami	6	7	10	14	37
SONORA	XCTJ	Houston	59	15	33	78	185
SOUTH FORTUNE	3FJC6	Seattle	57	24	0	116	197
SOUTHERN LION	V7AW8	Long Beach	2	0	0	0	2
SPERO	LAON4	Seattle	66	48	83	102	299
ST BLAIZE	J8FO	Norfolk	45	53	36	96	230
STAR ALABAMA	LAVU4	Long Beach	2	22	0	56	80
STAR AMERICA	LAVV4	Jacksonville	9	47	31	52	139
STAR EAGLE	LAWO2	Houston	29	19	23	28	99
STAR EVVIVA	LAHE2	Jacksonville	0	7	8	2	17
STAR FLORIDA	LAVW4	Houston	3	28	47	106	184
STAR FUJI	LAVX4	Seattle	15	16	13	52	96
STAR GEIRANGER	LAKQ5	Long Beach	5	0	0	0	5
STAR GRAN	LADR4	Long Beach	17	37	25	36	115
STAR GRINDANGER	ELFT9	Norfolk	22	31	0	148	201
STAR HARDANGER	LAXD4	Baltimore	4	0	2	12	18
STAR HARMONIA	LAGB5	Baltimore	43	12	20	38	113
STAR HERDLA	LAVD4	Baltimore	55	57	9	0	121
STAR HOYANGER	LAXG4	Long Beach	0	1	0	0	1
STAR SKARVEN	LAJY2	Miami	41	45	26	58	170
STAR SKOGANGER	LASS2	Houston	5	8	4	6	23
STAR STRONEN	LAHG2	Houston	36	20	29	70	155
STAR TRONDANGER	LAQQ2	Baltimore	24	33	10	134	201
STATENDAM	PHSG	Miami	0	49	50	34	133
STELLAR KOHINOOR	3FFG8	Seattle	0	0	12	136	148
STEPAN KRASHENINNIKOV	UYPO	Seattle	19	0	0	0	19
STEPHAN J	V2JN	Miami	159	110	92	272	633
STEWART J. CORT	WYZ3931	Chicago	132	201	39	388	760
STOLT CONDOR	D5VF	Newark	4	20	1	0	25
STONEWALL JACKSON	KDDW	New Orleans	30	13	0	64	107
STRONG CAJUN	KALK	Norfolk	18	31	24	76	149
STRONG VIRGINIAN	KSPH	Oakland	0	208	0	0	208
SUCO DO BRASIL	ELAQ5	Baltimore	70	12	0	0	82
SUGAR ISLANDER	KCKB	Houston	0	3	0	0	3
SUN DANCE	3ETQ8	Seattle	14	15	6	22	57
SUNBELT DIXIE	D5BU	Baltimore	13	15	11	24	63
SUNDA	ELPB8	Houston	56	30	13	118	217

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
SUSAN W. HANNAH	WAH9146	Chicago	1	2	11	26	40
SVEN OLTMANN	V2JP	Miami	26	18	10	24	78
SWAN ARROW	C6CN8	Baltimore	6	3	5	30	44
TAI HE	BOAB	Long Beach	59	60	61	102	282
TAIHO MARU	3FMP6	Seattle	0	28	3	156	187
TAIKO	LAQT4	New York City	22	10	0	30	62
TAKAMINE	LACT5	Jacksonville	24	20	6	0	50
TAMPA	LMWO3	Long Beach	14	0	0	0	14
TAMPERE	LAOP2	Norfolk	0	52	22	0	74
TAPIOLA	LAOQ2	Norfolk	7	0	0	0	7
TASCO	LAON2	Norfolk	3	0	0	0	3
TEQUI	3FDZ5	Seattle	22	26	34	56	138
TEXAS	LMWR3	Baltimore	0	1	11	28	40
THORKIL MAERSK	MSJX8	Miami	0	0	10	144	154
THORNHILL	YJZU9	New Orleans	0	4	11	14	29
TMM MEXICO	XCMG	Houston	59	43	46	104	252
TMM OAXACA	ELUA5	Houston	61	48	61	56	226
TOBIAS MAERSK	MSJY8	Long Beach	10	36	18	70	134
TOKIO EXPRESS	9VUY	Long Beach	0	174	205	8	387
TONSINA	KJDG	Houston	0	0	0	56	56
TORBEN	V2TI	Norfolk	6	1	62	0	69
TORM FREYA	ELVY8	Norfolk	59	116	43	64	282
TOWER BRIDGE	ELJL3	Seattle	11	14	13	28	66
TRADE APOLLO	VRUN7	New York City	28	38	32	44	142
TRADE COSMOS	VRUQ2	Miami	24	16	28	24	92
TRANSWORLD BRIDGE	ELJJ5	Seattle	27	42	45	106	220
TRINITY	WRGL	Houston	3	19	7	0	29
TRITON	WTU2310	Chicago	190	93	51	374	708
TROJAN STAR	C6OD7	Baltimore	40	54	50	110	254
TROPIC FLYER	J8NV	Miami	0	38	35	78	151
TROPIC JADE	J8NY	Miami	21	0	0	0	21
TROPIC KEY	J8PE	Miami	19	6	16	0	41
TROPIC LURE	J8PD	Miami	33	22	18	38	111
TROPIC MIST	J8NZ	Miami	27	0	0	0	27
TROPIC PALM	J8PB	Miami	42	30	23	8	103
TROPIC REIGN	J8PG	Miami	0	14	0	0	14
TROPIC SUN	3EZK9	New Orleans	42	19	21	44	126
TROPIC TIDE	3FGQ3	Miami	64	82	79	132	357
TROPICALE	ELBM9	New Orleans	5	6	1	26	38
TUI PACIFIC	P3GB4	Seattle	60	208	46	104	418
TULSIDAS	ATUJ	Norfolk	1	2	4	8	15
TURMOIL	9VGL	New York City	21	47	2	2	72
USCGC ACACIA (WLB406)	NODY	Chicago	1	14	30	58	103
USCGC ACTIVE WMEC 618	NRTF	Seattle	48	0	0	0	48
USCGC ACUSHNET WMEC 167	NNHA	Oakland	7	4	24	0	35
USCGC ADAK	NZRW	New York City	22	2	0	8	32
USCGC ALERT (WMEC 630)	NZVE	Seattle	5	0	0	34	39
USCGC DEPENDABLE	NOWK	Baltimore	0	0	2	2	4
USCGC DURABLE (WMEC 628)	NRUN	Houston	1	0	0	0	1
USCGC EAGLE (WIX 327)	NRCB	Miami	2	0	0	0	2
USCGC ESCANABA	NNAS	Norfolk	0	0	0	78	78
USCGC HAMILTON WHEC 715	NMAG	Long Beach	0	0	1	6	7
USCGC KATMAI BAY	NRLX	Chicago	0	13	4	32	49
USCGC KUKUI (WLB-203)	NKJU	Seattle	0	8	0	0	8
USCGC LEGARE	NRPM	Norfolk	0	0	4	0	4
USCGC MIDGETT (WHEC 726)	NHWR	Seattle	0	0	0	4	4
USCGC MOHAWK WMEC 913	NRUF	Jacksonville	21	107	0	0	128
USCGC MORGENTHAU	NDWA	Oakland	0	6	0	0	6
USCGC POLAR SEA__(WAGB 1	NRUO	Seattle	1	0	99	286	386
USCGC POLAR STAR (WAGB 1	NBTM	Seattle	59	144	0	0	203
USCGC RELIANCE WMEC 615	NJPJ	Miami	2	11	0	44	57
USCGC SPENCER	NWHE	Norfolk	2	0	0	208	210
USCGC STEADFAST (WMEC 62	NSTF	Seattle	0	0	1	2	3
USCGC STORIS (WMEC 38)	NRUC	Seattle	96	7	0	114	217
USCGC SUNDEW (WLB 404)	NODW	Chicago	0	22	5	16	43
USCGC SWEETBRIER WLB 405	NODX	Seattle	19	13	3	0	35
USCGC TAHOMA	NCBE	Norfolk	0	90	19	0	109
USCGC THETIS	NYWL	Jacksonville	0	48	0	146	194
USCGC WOODRUSH (WLB 407)	NODZ	Seattle	0	2	1	2	5
USNS ALGOL	NAMW	Jacksonville	8	0	0	0	8

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SHIP NAME	CALL	PORT	SEP	OCT	NOV	DEC	TOTAL
USNS APACHE (T-ATF 172)	NIGP	Norfolk	0	58	0	38	96
USNS BELLATRIX	NHLL	Houston	11	0	0	0	11
USNS BOWDITCH	NWSW	New Orleans	68	77	0	0	145
USNS CONCORD	NACK	Norfolk	0	42	24	0	66
USNS DENEBOLA	NDSP	Newark	34	2	32	80	148
USNS GUADALUPE	NLUP	New Orleans	0	0	0	242	242
USNS GUS W. DARNELL	KCDK	Houston	0	11	16	4	31
USNS HENRY J. KAISER	NHJK	Norfolk	0	0	0	38	38
USNS HENSON	NENB	New Orleans	0	6	4	0	10
USNS KANAWHA T-AO 196	NPTD	Norfolk	0	139	96	94	329
USNS MOHAWK (T-ATF 170)	NCRP	Norfolk	0	0	0	338	338
USNS OBSERVATION ISLAND	NRPP	Oakland	0	6	0	0	6
USNS PATHFINDER T-AGS 60	NGKK	New Orleans	24	71	0	0	95
USNS PATUXENT	NPCZ	New Orleans	78	42	47	0	167
USNS REGULUS	NLWA	New Orleans	10	14	0	4	28
USNS SILAS BENT T-AGS 26	NNUD	Oakland	67	54	101	128	350
USNS SIOUX	NJOV	Oakland	4	52	12	0	68
USNS SPICA (T-AFS 9)	NMJG	Norfolk	0	0	263	46	309
USNS SUMNER	NZAU	New Orleans	60	80	72	136	348
USNS TIPPECANOE (TAO-199	NTIP	New Orleans	47	0	0	136	183
USNS YANO	NAQH	Norfolk	0	47	0	0	47
VASILTY BURKHANOV	UZHC	Seattle	1	0	0	0	1
VEENDAM	C6NL6	Miami	0	101	0	0	101
VEGA	9VJS	Houston	73	26	26	4	129
VICTORIA	GBBA	Miami	26	0	0	2	28
VIRGINIA	3EBW4	Seattle	17	115	11	46	189
VISION	LAKS5	Seattle	0	0	2	12	14
WAARDRECHT	S6BR	Seattle	18	29	39	6	92
WASHINGTON HIGHWAY	JKHH	Seattle	74	72	14	100	260
WECOMA	WSD7079	Seattle	41	5	0	0	46
WESTERN BRIDGE	C6JQ9	Baltimore	72	81	76	182	411
WESTWARD	WZL8190	Miami	38	222	95	66	421
WESTWARD VENTURE	KHJB	Seattle	71	78	64	150	363
WESTWOOD ANETTE	DVDM	Seattle	51	74	46	160	331
WESTWOOD BELINDA	C6CE7	Seattle	72	20	60	76	228
WESTWOOD CLEO	C6OQ8	Seattle	4	34	41	232	311
WESTWOOD JAGO	C6CW9	Seattle	20	41	41	80	182
WESTWOOD MARIANNE	C6QD3	Seattle	0	54	52	126	232
WIELDRECHT	S6BO	Seattle	55	74	48	54	231
WILFRED SYKES	WC5932	Chicago	16	44	18	80	158
WILLIAM E. CRAIN	ELOR2	Oakland	72	0	0	302	374
WILLIAM E. MUSSMAN	D5OE	Seattle	42	29	31	34	136
WILSON	WNPD	New Orleans	42	40	0	72	154
WOENSDRECHT	S6BP	Long Beach	27	22	50	106	205
WORLD ISLAND	3FDH4	Long Beach	0	0	0	426	426
YUCATAN	XCUY	Houston	55	30	32	100	217
YURIY OSTROVSKIY	UAGJ	Seattle	63	77	71	288	499
ZENITH	ELOU5	Miami	4	7	0	0	11
ZIM AMERICA	4XGR	Newark	30	77	32	42	181
ZIM ASIA	4XFB	New Orleans	63	30	52	88	233
ZIM ATLANTIC	4XFD	New York City	50	67	74	70	261
ZIM CANADA	4XGS	Norfolk	52	16	22	116	206
ZIM CHINA	4XFQ	New York City	12	19	57	80	168
ZIM EUROPA	4XFN	New York City	6	48	63	26	143
ZIM IBERIA	4XFP	New York City	68	65	32	52	217
ZIM ISRAEL	4XGX	New Orleans	23	54	24	48	149
ZIM ITALIA	4XGT	New Orleans	41	12	81	132	266
ZIM JAMAICA	4XFE	New York City	51	44	30	106	231
ZIM JAPAN	4XGV	Baltimore	36	30	34	120	220
ZIM KOREA	4XGU	Miami	52	29	8	52	141
ZIM MONTEVIDEO	V2AG7	Norfolk	15	8	4	10	37
ZIM PACIFIC	4XFC	New York City	13	32	24	22	91
ZIM SANTOS	ELRJ6	Baltimore	13	18	18	30	79
ZIM U.S.A.	4XFO	New York City	14	7	35	58	114

Totals	September	33102
	October	39457
	November	33175
	December	75730
Period Total		181464

Buoy Climatological Data Summary —

September through December 1998

Weather observations are taken each hour during a 20-minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one-third of the waves during the average period each hour. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0-minute averaging period each hour (moored buoys) and a 2.0-minute averaging period for fixed stations (C-MAN). Contact NDBC Data Systems Division, Bldg. 1100, SSC, Mississippi 39529 or phone (601) 688-1720 for more details.

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
August 1998													
41001	34.7N	072.6W	556	27.0	27.8	1.5	5.3	26/20	9.4	E	31.9	27/04	1017.5
41002	32.3N	075.2W	737	27.6	28.6	1.8	9.7	26/02	10.8	SW	41.2	26/03	1015.7
41004	32.5N	079.1W	710	26.9		1.3	6.2	26/04	10.4	NE	38.5	26/12	1015.3
41008	31.4N	080.9W	731	27.6	27.6	1.0	2.7	02/00	10.6	NE	24.5	02/08	1015.8
41009	28.5N	080.2W	1448	28.4	28.9	1.1	4.0	25/15	8.4	SE	27.4	20/17	1016.1
41010	28.9N	078.6W	1472	28.9	30.0	1.6	6.0	24/20	9.4	NE	26.8	25/18	1016.1
42001	25.9N	089.6W	738	29.3		0.7	2.8	31/22	9.4	E	31.7	20/14	1014.5
42002	25.9N	093.6W	743	29.5	30.5	0.8	3.1	31/22	9.2	E	27.2	20/19	1014.7
42003	25.9N	085.9W	738	29.0	30.2	0.5	1.6	20/08	8.1	E	24.5	05/19	1014.9
42007	30.1N	088.8W	734	28.9	30.1	0.4	1.9	21/16	8.3	E	29.0	14/17	1015.3
42019	27.9N	095.4W	741	28.8	29.8	0.7	4.4	22/04	9.1	SE	29.7	22/02	1014.3
42020	26.9N	096.7W	742	28.8	29.2	0.8	2.9	22/05	9.9	SE	26.6	21/13	1014.0
42035	29.2N	094.4W	736	29.3	30.7	0.6	3.0	21/23	8.8	S	27.8	22/01	1014.9
42036	28.5N	084.5W	738	28.9	29.9	0.5	2.0	21/03	7.3	E	26.6	20/16	1016.5
42039	28.8N	086.0W	737	28.9	30.2	0.5	2.1	21/11	7.7	E	31.3	19/12	1017.0
42040	29.2N	088.2W	734	29.0	30.3	0.6	3.0	21/18	7.9	E	26.6	19/16	1016.3
44004	38.5N	070.7W	742	23.4	23.4	1.6	6.8	29/01	11.4	NE	34.4	29/00	1017.8
44005	42.9N	068.9W	739	19.0	18.4	1.1	3.5	29/18	8.7	S	26.2	26/09	1016.9
44007	43.5N	070.1W	739	17.4	17.3	0.7	1.8	29/22	7.4	S	17.9	10/21	1017.3
44008	40.5N	069.4W	736	20.1	19.4	1.3	5.4	29/10	8.1	NE	23.9	29/13	1018.1
44009	38.5N	074.7W	738	23.8	24.4	1.2	3.6	28/17	10.9	NE	30.5	28/16	1017.1
44011	41.1N	066.6W	737	18.8	18.0	1.2	5.9	29/17	7.5	N	35.0	29/16	1018.4
44013	42.4N	070.7W	741	18.2	16.4	0.5	1.6	29/17	6.6	S	20.6	29/11	1016.7
44014	36.6N	074.8W	742	24.9	24.9	1.5	6.1	27/23	11.1	NE	37.3	28/01	1015.9
44025	40.3N	073.2W	737	22.5	22.7	1.1	3.1	29/01	8.8	S	28.0	19/06	1017.7
45001	48.1N	087.8W	733	18.8	18.9	0.5	1.7	16/20	10.3	SW	25.1	17/11	1016.0
45002	45.3N	086.4W	711	21.1	21.7	0.5	1.7	20/08	10.1	S	26.8	14/23	1015.9
45003	45.3N	082.8W	732	20.0	20.4	0.4	1.5	20/15	9.2	S	22.2	23/11	1017.0
45004	47.6N	086.5W	740	18.6	18.5	0.5	1.9	17/16	9.8	S	22.7	17/16	1016.9
45005	41.7N	082.4W	739	22.9	23.8	0.3	1.4	19/02	8.6	E	24.1	25/14	1017.0
45006	47.3N	089.9W	742	19.5	19.3	0.5	1.6	24/01	9.8	NE	29.1	29/07	1016.1
45007	42.7N	087.0W	736	22.6	23.2	0.5	2.0	16/00	9.1	S	19.6	15/23	1017.4
45008	44.3N	082.4W	740	21.0	21.1	0.4	1.9	18/08	9.0	N	24.1	18/07	1017.3

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BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
46001	56.3N	148.2W	735	12.4	13.2	2.1	8.2	31/22	12.8	W	29.3	31/04	1011.7
46002	42.5N	130.3W	741	17.2	18.1	1.5	2.6	30/19	10.5	N	20.4	23/07	1022.7
46003	51.8N	155.9W	741	11.1	11.6	2.1	5.6	31/16	15.0	W	31.7	31/14	1016.5
46005	46.1N	131.0W	735	16.2	16.9	1.5	2.5	09/07	9.6	NW	20.4	05/11	1022.8
46006	40.8N	137.5W	514	18.5	19.2	1.5	2.2	09/02	9.5	SW	18.1	02/12	1024.1
46011	34.9N	120.9W	744	15.6	17.1	1.9	3.3	08/00	11.2	NW	23.5	23/23	1014.0
46012	37.4N	122.7W	735	13.6	14.5	1.7	3.2	07/14	9.4	NW	20.0	23/02	1014.8
46013	38.2N	123.3W	733	12.4	12.5	2.0	3.6	06/22	15.4	NW	29.3	07/01	1014.7
46014	39.2N	124.0W	738	12.4	11.9	2.1	3.6	07/03	13.6	NW	27.2	17/00	1014.8
46022	40.7N	124.5W	738	13.0	12.4	1.7	3.2	08/04	9.3	N	20.8	08/10	1017.2
46023	34.7N	121.0W	738	15.4	17.1	1.9	3.0	07/22	13.8	NW	26.2	23/23	1014.6
46025	33.8N	119.1W	729	19.2	20.6	1.1	1.9	04/21	5.9	W	15.2	05/00	1013.5
46026	37.8N	122.8W	287	12.7	13.7	1.5	2.3	23/04	11.8	NW	23.7	23/04	1014.5
46027	41.8N	124.4W	360	12.1	11.9	1.7	3.4	08/00	6.9	NW	32.6	07/22	1016.8
46028	35.7N	121.9W	413	14.5	15.4	2.2	3.4	29/06	16.9	NW	28.0	23/04	1013.4
46029	46.1N	124.5W	743	15.8	16.0	1.3	2.3	30/23	9.0	N	21.0	31/06	1019.5
46030	40.4N	124.5W	733	12.2	10.9	1.8	3.0	15/04	14.4	N	25.1	05/13	1017.1
46035	56.9N	177.8W	718	8.3	8.6	1.9	5.5	16/11	14.9	SW	35.8	25/02	1012.0
46041	47.4N	124.5W	740	14.4	14.0	1.2	2.2	24/02	7.2	NW	20.0	13/02	1019.8
46042	36.7N	122.4W	741	14.2	15.2	1.9	3.2	17/06	12.9	NW	25.6	29/00	1014.9
46045	33.8N	118.5W	741	19.5	20.6	0.8	1.4	19/05	4.8	SW	11.9	18/22	1012.6
46050	44.6N	124.5W	743	15.6	14.4	1.5	2.7	31/06	11.7	N	21.4	30/07	1019.3
46053	34.2N	119.8W	687	17.7	19.4	0.9	1.8	24/03	9.6	W	20.8	18/03	1013.4
46054	34.3N	120.4W	735	16.3	17.3	1.7	2.7	07/23	17.3	NW	31.1	18/01	1012.7
46059	38.0N	130.0W	739	18.4		1.7	2.7	31/22	12.1	N	20.8	24/15	
46060	60.6N	146.8W	1479	12.6	14.0	0.5	1.9	31/21	9.8	E	31.3	31/20	1012.7
46061	60.2N	146.8W	1472	12.6	13.6	1.1	4.5	31/23	10.2	E	37.1	31/22	1012.0
46062	35.1N	121.0W	724	15.3	16.8	1.8	3.0	07/18	12.4	NW	24.9	23/19	1013.6
46063	34.2N	120.7W	739	15.8	16.8	2.0	3.1	23/16	16.0	NW	25.6	29/05	1013.0
51001	23.4N	162.3W	740	25.2	26.1	2.1	3.1	23/22	14.5	E	21.8	23/00	1018.4
51002	17.2N	157.8W	737	25.9	26.4	2.2	3.4	19/18	14.2	NE	22.2	21/02	1015.6
51003	19.1N	160.8W	574	26.0	26.7	1.8	2.8	24/02	11.4	NE	20.3	24/20	1016.3
51004	17.4N	152.5W	741	25.7	26.2	2.2	3.6	23/23	14.3	NE	20.9	24/20	1016.0
51028	00.0N	153.9W	713	23.2	23.0	2.1	3.0	04/16	10.7	E	19.4	18/10	1012.3
91204	09.9N	139.7E	512	49.5					6.4	NE	27.2	10/04	1010.0
91328	08.6N	149.7E	511	28.1					4.8	NE	21.3	27/06	1009.5
91343	07.6N	155.2E	503	28.2									1009.1
91352	06.2N	160.7E	464	27.9									1011.9
91374	08.7N	171.2E	737	27.3					4.5	NE	15.3	01/02	1010.5
91377	06.1N	172.1E	447	28.0									1013.1
91411	08.3N	137.5E	383	28.5									1009.6
91442	04.6N	168.7E	737						9.0	E	26.2	01/08	
ABAN6	44.3N	075.9W	741	20.6	21.4				3.8	S	14.1	18/19	1017.8
ALSN6	40.4N	073.8W	738	23.3		0.8	2.1	28/22	11.5	S	33.1	19/05	1018.0
BLIA2	60.8N	146.9W	1478	11.5					8.4	N	31.3	31/16	1013.4
BURL1	28.9N	089.4W	735	29.4					8.8	E	29.9	15/21	1015.3
BUZM3	41.4N	071.0W	735	20.8		0.5	2.1	26/08	10.4	S	30.0	19/07	1018.8
CARO3	43.3N	124.4W	736	13.2					6.6	NE	20.3	28/20	1019.3
CDRF1	29.1N	083.0W	741	28.0					7.4	NE	27.7	08/00	1016.4
CHLV2	36.9N	075.7W	742	24.6	24.4	1.0	3.5	28/15	13.4	NE	71.8	28/06	1017.4
CLKN7	34.6N	076.5W	713	26.3					13.1	NE	58.6	27/05	1017.3
CSBF1	29.7N	085.4W	734	28.3					6.1	NE	21.5	07/21	1016.7
DBLN6	42.5N	079.3W	741	22.1					7.2	SW	30.2	25/17	1018.0
DESW1	47.7N	124.5W	730	14.3					9.3	NW	31.9	13/01	1019.5
DISW3	47.1N	090.7W	732	19.8					10.0	SW	23.3	17/12	1016.3
DPIA1	30.2N	088.1W	737	28.7	30.8				8.2	E	22.1	21/15	1016.2
DRYF1	24.6N	082.9W	735	29.5	30.8				7.2	E	23.3	19/20	1014.6
DSLN7	35.2N	075.3W	737	25.8		1.0	3.5	26/01	14.9	NE	63.0	27/19	1015.8
DUCN7	36.2N	075.8W	726	25.4		0.9	2.9	27/20	12.4	NE	44.9	27/20	1018.5
FBIS1	32.7N	079.9W	738	27.1					8.4	SW	23.6	20/11	1016.8
FFIA2	57.3N	133.6W	671	11.8					8.3	SE	28.5	31/23	1016.4
FPSN7	33.5N	077.6W	731	26.9		1.6	8.7	26/12	14.2	NE	70.2	27/00	1014.4
FWYF1	25.6N	080.1W	734	29.3	30.7				9.9	E	25.5	20/23	1016.7
GDIL1	29.3N	089.9W	738	29.5	32.7				7.3	E	22.5	02/01	1015.9
GLLN6	43.9N	076.4W	738	21.7					9.6	SW	34.2	24/20	1017.5
IOSN3	43.0N	070.6W	740	18.6					10.9	S	25.1	12/12	1016.9
KTNF1	29.8N	083.6W	738	27.1					7.0	NE	17.3	20/18	1016.1
LKWF1	26.6N	080.0W	735	28.8	30.3				7.9	E	27.0	20/21	1016.1
LONF1	24.8N	080.9W	738	29.6	31.6				7.7	E	26.9	19/04	1015.2
MDRM1	44.0N	068.1W	739	15.4					11.7	SW	26.0	25/03	1016.8
MISM1	43.8N	068.8W	739	16.4					11.8	SW	50.4	24/22	1016.6
MLRF1	25.0N	080.4W	734	29.4	30.7				8.3	E	26.5	19/05	1015.7
MRKA2	61.1N	146.7W	1474	10.4					7.3	NE	22.2	17/14	1013.2
NWPO3	44.6N	124.1W	741	13.1					8.3	N	26.9	14/02	1019.7

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BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
PILM4	48.2N	088.4W	739	18.2					10.8	W	23.7	28/07	1017.5
POTA2	61.1N	146.7W	1473	10.5					8.4	NE	25.7	31/19	1012.7
PTAC1	39.0N	123.7W	734	12.1					11.2	N	24.6	16/12	1014.9
PTAT2	27.8N	097.1W	688	29.8	30.6				12.0	SE	31.1	22/08	1014.6
PTGC1	34.6N	120.6W	735	15.0					17.9	N	30.2	31/06	1014.7
ROAM4	47.9N	089.3W	740	18.4	16.4				11.5	SW	29.1	17/02	1016.2
SANF1	24.4N	081.9W	738	29.4	30.5				8.4	E	29.4	29/07	1015.4
SAUF1	29.8N	081.3W	736	27.4	28.1				8.4	NE	35.0	10/19	1016.8
SBIO1	41.6N	082.8W	735	23.1					7.0	SW	23.3	25/15	1017.0
SGNW3	43.8N	087.7W	284	21.5	18.6								

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41001	34.7N	072.6W	528	25.5	26.9	1.3	4.4	09/01					1015.0
41002	32.3N	075.2W	716	26.3	27.8	1.5	4.7	04/12	10.7	SW	27.2	04/06	1014.7
41004	32.5N	079.1W	711	26.1		1.1	5.7	04/01	9.4	NE	40.0	04/00	1014.3
41008	31.4N	080.9W	717	26.8		1.0	4.2	03/18	11.4	NE	41.8	03/21	1014.0
41009	28.5N	080.2W	1424	27.1	27.2	1.1	2.7	25/20	10.7	E	28.8	03/19	1014.2
41010	28.9N	078.6W	1432	27.7	29.0	1.4	3.4	22/19	11.5	E	28.4	19/23	1014.9
42001	25.9N	089.6W	702	1.9			5.4	01/22	16.3	SE	35.0	02/07	1009.0
42002	25.9N	093.6W	718	28.2	29.2	1.6	5.0	10/14	13.2	NE	37.7	11/05	1008.4
42003	25.9N	085.9W	714	28.3	29.0	1.6	7.2	26/12	16.2	SE	51.5	26/18	1010.1
42007	30.1N	088.8W	641	26.8	27.7	1.2	4.9	27/14	13.7	E	43.5	27/21	1011.4
42019	27.9N	095.4W	717	27.9	28.8	1.6	5.4	10/06	12.1	E	34.0	09/17	1008.3
42020	26.9N	096.7W	715	28.1	28.9	1.4	5.1	10/00	10.6	NE	31.3	09/19	1008.3
42035	29.2N	094.4W	716	28.1	28.9	1.2	4.1	10/16	12.6	E	35.8	11/00	1009.4
42036	28.5N	084.5W	714	27.6	28.1	1.6	6.0	03/03	13.6	E	35.6	03/02	1012.7
42039	28.8N	086.0W	713	27.1	27.6	1.9	9.3	02/21	14.8	E	44.7	03/00	1011.9
42040	29.2N	088.2W	710	26.9	27.8	2.0	10.9	27/18	16.4	E	54.2	27/18	1010.5
44004	38.5N	070.7W	718	22.1	23.1	1.5	4.0	01/21	10.6	SW	25.8	23/07	1013.7
44005	42.9N	068.9W	715	15.7	14.5	1.1	2.4	23/15	10.0	S	24.3	23/01	1011.3
44007	43.5N	070.1W	713	15.7		0.7	1.6	04/07	8.9	S	21.0	06/09	1011.5
44008	40.5N	069.4W	718	18.0	17.6	1.2	3.4	02/05	9.3	S	24.3	23/08	1013.0
44009	38.5N	074.7W	717	22.1	23.0	1.0	3.0	23/12	11.1	S	27.4	23/12	1013.5
44011	41.1N	066.6W	712	16.3	15.2	1.4	3.5	23/19	9.0	SW	25.8	23/12	1012.8
44013	42.4N	070.7W	717	17.3	16.3	0.5	1.5	23/14	9.1	S	20.4	09/18	1011.2
44014	36.6N	074.8W	711	23.4	23.7	1.2	3.6	04/21	10.0	SW	24.9	23/10	1013.5
44025	40.3N	073.2W	707	20.6	21.2	0.9	2.0	02/08	10.3	SW	27.0	23/11	1013.2
45001	48.1N	087.8W	714	15.8	17.0	0.9	2.5	24/09	13.0	SW	26.0	30/21	1011.8
45002	45.3N	086.4W	507	19.0	20.0	0.7	2.6	11/01	12.3	S	26.2	10/22	1012.4
45003	45.3N	082.8W	709	16.7	17.6	0.7	2.2	22/01	11.5	NW	25.6	21/23	1012.8
45004	47.6N	086.5W	719	15.9	16.7	0.9	2.5	24/08	11.6	NW	20.0	06/01	1012.5
45005	41.7N	082.4W	716	20.6	22.2	0.4	1.4	09/00	9.7	SW	22.2	02/08	1013.8
45006	47.3N	089.9W	717	16.0	15.9	0.7	2.6	19/13	10.6	SW	28.0	19/11	1012.4
45007	42.7N	087.0W	705	20.2	21.8	0.6	2.3	08/21	9.9	S	22.7	30/23	1014.6
45008	44.3N	082.4W	715	18.3	19.4	0.7	2.3	07/23	11.9	NW	27.8	07/22	1013.2
46001	56.3N	148.2W	715	10.5	10.9	2.6	7.4	01/06	11.5	W	27.6	29/04	1006.4
46002	42.5N	130.3W	587	17.8	18.5	2.4	5.1	22/14	12.9	N	28.2	17/16	1016.5
46003	51.8N	155.9W	715	10.3	10.7	2.9	8.2	20/04	16.3	SW	34.0	10/13	1011.1
46005	46.1N	131.0W	712	16.3	17.4	2.4	4.6	22/13	12.9	N	24.1	06/11	1017.8
46006	40.8N	137.5W	625	17.7	18.9	2.4	5.6	16/11	13.4	N	31.1	16/06	1020.6
46011	34.9N	120.9W	718	16.1	16.8	1.8	3.8	10/04	8.6	NW	25.8	18/23	1011.0
46012	37.4N	122.7W	716	14.4	15.1	1.8	4.0	09/09	8.0	NW	22.0	19/03	1011.1
46013	38.2N	123.3W	712	13.1	13.1	2.1	4.2	09/10	10.0	NW	29.0	20/00	1011.5
46014	39.2N	124.0W	713	12.8	12.8	2.2	4.7	09/02	9.4	NW	27.4	09/04	1011.3
46022	40.7N	124.5W	718	12.6	12.3	2.2	4.4	13/03	9.6	N	23.5	27/23	1012.3
46023	34.7N	121.0W	715	16.0	16.9	1.8	3.6	10/04	10.5	NW	29.7	18/23	1011.5
46025	33.8N	119.1W	710	19.1	20.8	0.9	1.6	10/03	6.5	W	17.3	24/02	1010.8
46026	37.8N	122.8W	713	13.9	14.4	1.7	3.5	09/12	8.7	NW	24.5	09/12	1011.6
46027	41.8N	124.4W	714	12.1	11.6	2.1	4.2	13/02	9.7	NW	30.3	13/01	1011.8
46028	35.7N	121.9W	716	15.3	16.2	2.0	3.7	20/10	10.4	NW	28.2	20/03	1011.0
46029	46.1N	124.5W	716	14.2	14.2	1.9	4.0	22/22	9.6	N	22.5	18/09	1014.6
46030	40.4N	124.5W	712	12.2	11.6	2.2	4.3	13/05	12.2	N	25.6	27/22	1012.6
46035	56.9N	177.8W	700	7.1	7.7	2.2	7.1	23/16	14.7	SW	40.0	23/00	1008.7
46041	47.4N	124.5W	716	12.7	12.4	1.8	3.3	12/16	7.2	NW	18.8	12/02	1015.1
46042	36.7N	122.4W	717	14.9	15.7	1.9	3.6	09/12	9.1	NW	24.7	20/01	1011.6
46045	33.8N	118.5W	719	19.5	20.6	0.7	1.3	10/08	4.3	SW	9.9	09/23	1010.0
46050	44.6N	124.5W	687	13.9	13.2	2.2	4.0	02/05	11.1	N	26.0	18/09	1014.5
46053	34.2N	119.8W	160	17.7	19.1	1.1	1.7	18/23	8.1	W	19.8	24/01	1011.9
46054	34.3N	120.4W	688	16.4	17.4	1.6	3.3	10/01	13.6	NW	32.1	10/01	1010.2
46059	38.0N	130.0W	719	19.2		2.4	4.3	22/04	13.9	N	23.3	12/03	
46060	60.6N	146.8W	1423	10.4	11.7	0.6	2.7	01/07	10.5	E	36.7	20/01	1008.8
46061	60.2N	146.8W	1433	10.5	11.7	1.5	5.3	01/08	11.7	E	38.3	01/00	1008.1

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BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
46062	35.1N	121.0W	704	15.9	16.7	1.7	3.9	10/05	9.3	NW	27.8	19/01	1010.6
46063	34.2N	120.7W	709	16.3	16.7	1.9	4.1	10/07	11.6	NW	26.8	10/05	1010.2
51001	23.4N	162.3W	689	25.4	26.2	1.9	4.5	21/19	13.1	E	21.3	15/09	1017.5
51002	17.2N	157.8W	714	26.1	27.0	2.0	3.0	30/18	14.2	NE	21.5	30/17	1014.7
51004	17.4N	152.5W	709	25.8	26.8	2.0	3.0	21/14	13.8	NE	21.2	17/14	1015.1
51028	00.0N	153.9W	700	24.7	24.9	1.8	2.6	29/19	11.5	E	17.9	22/18	1012.0
ABAN6	44.3N	075.9W	720	16.9	19.8				3.8	S	15.7	16/13	1013.0
ALSN6	40.4N	073.8W	711	20.8		0.7	1.5	15/02	13.1	S	28.3	23/14	1013.6
BLIA2	60.8N	146.9W	1431	9.4					8.7	N	34.9	20/08	1009.7
BURL1	28.9N	089.4W	710	27.3					18.9	E	54.1	27/22	1009.8
BUZM3	41.4N	071.0W	711	18.6					12.6	SW	31.9	28/02	1013.7
CARO3	43.3N	124.4W	715	12.0					7.2	NE	28.2	18/15	1014.5
CDRF1	29.1N	083.0W	713	26.6					11.5	E	36.5	03/09	1013.7
CHLV2	36.9N	075.7W	715	23.3	24.0	0.9	2.5	23/13	12.0	SW	30.1	23/11	1014.7
CLKN7	34.6N	076.5W	710	25.2					9.8	SW	37.1	04/07	1016.1
CSBF1	29.7N	085.4W	714	26.6					9.1	NE	43.8	03/05	1012.9
DBLN6	42.5N	079.3W	713	19.2					9.7	SW	27.7	11/16	1014.1
DESW1	47.7N	124.5W	713	12.5					9.1	NW	28.8	03/23	1014.8
DISW3	47.1N	090.7W	716	16.5					10.9	SW	34.2	19/13	1012.6
DPIA1	30.2N	088.1W	711	26.4	27.8				15.2	E	58.8	28/07	1011.3
DRYF1	24.6N	082.9W	715	28.7	29.6				12.8	SE	59.1	26/00	1011.4
DSLN7	35.2N	075.3W	713	24.1		1.2	3.0	23/20	12.3	SW	35.0	04/13	1013.9
DUCN7	36.2N	075.8W	708	23.8		0.7	2.3	23/14	10.2	SW	29.3	04/20	1016.1
FBIS1	32.7N	079.9W	714	25.9					8.5	E	36.5	03/20	1015.4
FFIA2	57.3N	133.6W	716	10.1					8.6	SE	27.9	07/15	1013.3
FPSN7	33.5N	077.6W	714	26.3		1.1	5.2	04/04	10.8	SW	53.3	04/05	1013.6
FWYF1	25.6N	080.1W	713	28.5	29.2				13.9	SE	44.9	25/10	1014.7
GDIL1	29.3N	089.9W	663	27.2	30.7				13.6	E	40.1	27/23	1010.7
GLLN6	43.9N	076.4W	716	18.3					11.8	S	28.6	28/06	1012.8
IOSN3	43.0N	070.6W	715	16.7					12.0	S	25.4	10/21	1011.2
KTNF1	29.8N	083.6W	712	25.7					9.2	NE	38.6	03/11	1013.2
LKWF1	26.6N	080.0W	710	27.9	28.9				10.8	SE	29.9	25/19	1014.2
LONF1	24.8N	080.9W	715	28.6	29.5				11.1	SE	47.1	25/14	1013.0
MDRM1	44.0N	068.1W	717	13.3					12.6	SW	26.1	27/13	1010.7
MISM1	43.8N	068.8W	686	14.0					12.2	S	28.0	27/13	1010.9
MLRF1	25.0N	080.4W	716	28.5	29.3				12.1	SE	45.9	25/15	1013.6
MRKA2	61.1N	146.7W	1426	8.3					6.5	NE	22.1	30/14	1009.5
NWPO3	44.6N	124.1W	713	11.8					8.3	N	28.6	18/14	1014.9
PILM4	48.2N	088.4W	716	15.3					12.9	NW	33.3	05/21	1013.3
POTA2	61.1N	146.7W	1426	8.4					9.1	NE	26.1	30/08	1008.9
PTAC1	39.0N	123.7W	709	12.7					8.3	N	24.1	19/15	1011.1
PTAT2	27.8N	097.1W	712	27.9	29.3				10.9	E	33.5	10/09	1008.8
PTGC1	34.6N	120.6W	717	15.7					13.1	N	35.5	10/04	1009.4
ROAM4	47.9N	089.3W	715	15.5	15.9				13.0	SW	34.5	19/11	1012.2
SANF1	24.4N	081.9W	718	28.5	29.1				13.3	SE	56.0	25/22	1012.5
SAUF1	29.8N	081.3W	711	26.7	27.8				10.3	E	28.8	03/04	1014.7
SBIO1	41.6N	082.8W	718	20.6					8.7	SW	23.8	28/01	1013.8
SGNW3	43.8N	087.7W	718	18.8	18.2				9.4	SW	23.1	02/01	1013.7
SISW1	48.3N	122.8W	709	13.0					8.0	W	29.1	08/01	1014.9
SMKF1	24.6N	081.1W	715	28.8	29.6				13.9	SE	81.5	25/15	1013.2
SPGF1	26.7N	079.0W	717	28.0					8.8	E	25.1	25/09	1014.0
SRST2	29.7N	094.0W	716	27.5					12.2	NE	41.1	11/12	1011.1
STDM4	47.2N	087.2W	715	16.6					14.2	NW	32.9	21/02	1012.3
SUPN6	44.5N	075.8W	715	17.1	20.3				8.7	S	24.3	27/16	1012.1
THIN6	44.3N	076.0W	715	16.9									
TPLM2	38.9N	076.4W	711	23.1	24.3				10.6	S	22.7	23/09	1014.7
TTIW1	48.4N	124.7W	710	12.3									

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BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
41001	34.7N	072.6W	675	22.0	25.4	1.5	4.6	23/04	10.9	N	28.4	02/07	1019.1
41002	32.3N	075.2W	735	24.1	26.8	1.5	6.3	23/05	11.5	NE	30.7	02/02	1018.5
41004	32.5N	079.1W	736	23.2		1.1	3.0	23/07	10.7	NE	25.6	23/09	1018.9
41008	31.4N	080.9W	736	24.0		1.1	2.5	23/06	11.4	NE	26.6	23/02	1018.7
41009	28.5N	080.2W	1472	26.3	27.2	1.3	2.9	23/09	10.9	E	25.3	23/03	1017.7
41010	28.9N	078.6W	1465	26.2	27.9	1.6	4.2	23/20	11.8	NE	25.8	23/02	1018.1
42001	25.9N	089.6W	730	1.6			4.0	23/03	15.4	E	33.8	23/00	1015.9
42002	25.9N	093.6W	735	27.1	28.0	1.8	4.6	22/07	15.7	E	33.8	22/02	1015.7
42003	25.9N	085.9W	735	26.8	28.1	1.3	4.0	23/15	13.6	E	29.9	23/07	1015.9
42007	30.1N	088.8W	734	23.7	25.2	0.6	2.0	23/16	5.0	SW	7.8	30/23	1018.7
42019	27.9N	095.4W	735	26.0	27.6	1.5	3.4	22/18	13.9	SE	26.2	06/14	1015.8
42020	26.9N	096.7W	735	26.3	27.3	1.6	3.6	22/17	13.4	SE	24.1	06/16	1015.2
42035	29.2N	094.4W	735	24.8	26.3	1.1	2.5	05/03	12.9	SE	30.3	05/02	1017.5

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BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
42036	28.5N	084.5W	737	25.5	26.8	0.8	2.9	23/06	10.5	NE	26.2	23/09	1018.5
42039	28.8N	086.0W	736	25.2	26.7	1.0	3.4	23/04	10.6	NE	27.2	23/00	1018.6
42040	29.2N	088.2W	737	24.6	26.2	1.1	3.8	23/12	10.9	E	27.2	22/12	1019.2
44004	38.5N	070.7W	736	18.0	22.2	1.8	4.4	10/02	14.9	NW	26.6	02/02	1018.7
44005	42.9N	068.9W	735	11.0	11.2	1.6	4.0	30/21	15.5	NW	33.8	01/22	1015.9
44007	43.5N	070.1W	736	10.5		0.9	3.1	10/16	13.4	W	32.3	01/20	1016.6
44008	40.5N	069.4W	736	13.5	13.9	1.7	4.3	30/14	13.9	NW	29.5	29/15	1017.3
44009	38.5N	074.7W	735	16.7	18.7	1.1	2.6	02/05	13.2	NW	29.5	02/01	1019.1
44011	41.1N	066.6W	736	12.1	11.8	1.9	5.5	31/01	13.2	W	32.3	29/23	1016.4
44013	42.4N	070.7W	737	12.1	12.0	0.9	2.5	11/04	13.3	W	27.6	31/00	1016.1
44014	36.6N	074.8W	732	18.7	20.0	1.1	3.1	02/11	11.2	NW	26.6	22/16	1019.0
44025	40.3N	073.2W	734	14.8	16.1	1.0	2.3	09/23	13.3	NW	27.2	01/19	1016.8
45001	48.1N	087.8W	498	9.4	11.3	1.5	4.3	06/15	16.5	SE	37.5	18/11	1017.2
45002	45.3N	086.4W	737	11.7	14.2	1.0	4.2	18/08	14.5	S	31.1	18/13	
45003	45.3N	082.8W	735	10.7	12.9	1.0	3.2	06/16	13.5	W	29.0	01/19	1019.1
45004	47.6N	086.5W	492	9.3	10.4	1.4	4.9	18/17					1018.0
45005	41.7N	082.4W	735	13.8	16.6	0.5	1.8	04/12	11.7	W	25.8	01/06	1020.3
45006	47.3N	089.9W	504	9.4	10.4	1.1	3.0	18/14	14.6	E	31.3	18/11	1017.6
45007	42.7N	087.0W	734	13.5	16.0	0.9	2.7	01/05	13.0	W	26.4	18/12	1020.4
45008	44.3N	082.4W	736	12.2	14.8	1.0	3.3	01/09	14.7	NW	31.5	18/18	1019.4
46001	56.3N	148.2W	742	8.0	8.7	2.9	7.0	13/04	13.9	NW	30.3	15/21	1001.0
46003	51.8N	155.9W	728	8.0	8.9	3.6	10.2	28/09	18.8	W	33.8	27/19	1006.3
46005	46.1N	131.0W	741	13.9	15.3	3.1	6.4	24/15	15.2	W	29.7	23/17	1015.3
46006	40.8N	137.5W	710	15.4	16.6	3.0	6.7	24/13	15.0	NW	28.0	10/21	1020.2
46011	34.9N	120.9W	742	14.9	15.2	2.1	4.5	30/02	12.2	NW	29.1	10/00	1014.7
46012	37.4N	122.7W	737	13.8	13.9	2.1	4.5	29/23	10.4	NW	26.0	29/23	1015.7
46013	38.2N	123.3W	718	13.1	12.7	2.2	4.7	30/00	11.2	NW	30.9	16/00	1016.6
46014	39.2N	124.0W	736	13.0	13.1	2.3	5.1	25/06	10.5	NW	28.4	15/22	1016.7
46022	40.7N	124.5W	726	12.7	12.6	2.4	5.0	25/03	9.3	N	24.7	15/05	1017.4
46023	34.7N	121.0W	744	14.9	15.2	2.2	4.3	30/05	15.2	NW	34.2	10/02	1015.3
46025	33.8N	119.1W	719	17.7	18.7	1.1	2.3	26/02	6.4	W	18.7	25/02	1014.1
46026	37.8N	122.8W	743	13.3	13.3	1.9	4.0	25/10	11.9	NW	26.0	15/06	1016.4
46027	41.8N	124.4W	8	11.9	12.2	1.6	1.8	01/00	3.0	E	5.6	01/06	1014.4
46028	35.7N	121.9W	743	14.1	14.4	2.3	5.3	30/10	14.2	NW	29.3	14/22	1015.1
46029	46.1N	124.5W	743	13.2	13.6	2.4	5.1	24/14	11.7	S	32.6	08/06	1016.1
46030	40.4N	124.5W	739	12.3	11.7	2.3	5.2	25/05	10.6	N	29.0	24/06	1017.7
46035	56.9N	177.8W	712	3.7	6.2	2.6	5.3	10/23	18.1	N	34.2	10/21	1008.4
46041	47.4N	124.5W	744	12.2	12.6	2.2	4.7	24/17	10.7	SE	27.0	31/09	1016.4
46042	36.7N	122.4W	739	13.9	14.3	2.2	5.8	30/07	11.2	NW	27.0	30/01	1016.1
46045	33.8N	118.5W	744	17.6	18.2	0.9	1.8	26/03	3.7	W	9.5	25/04	1013.3
46050	44.6N	124.5W	743	13.3	13.1	2.6	4.9	25/08	10.7	S	27.4	12/11	1017.4
46053	34.2N	119.8W	83	15.9	16.8	1.8	2.9	30/04	10.5	W	22.3	30/02	1012.9
46054	34.3N	120.4W	735	15.3	15.3	2.1	5.1	30/18	16.5	NW	30.9	10/03	1013.6
46059	38.0N	130.0W	741	18.1		2.7	5.6	24/19	14.1	NW	30.9	23/22	
46060	60.6N	146.8W	1480	7.6	9.5	0.7	3.2	16/01	10.3	E	39.8	16/00	1003.8
46061	60.2N	146.8W	1487	7.7	9.6	1.8	6.5	15/23	13.5	E	43.5	15/23	1003.0
46062	35.1N	121.0W	729	14.7	15.2	2.0	4.4	30/01	12.9	NW	31.3	10/01	1014.5
46063	34.2N	120.7W	743	15.1	15.1	2.3	4.7	30/17	15.3	NW	27.0	10/07	1013.8
51001	23.4N	162.3W	744	25.1	25.9	2.2	4.7	29/02	13.5	E	26.8	11/06	1018.5
51002	17.2N	157.8W	742	25.7	26.2	2.3	3.3	04/15	16.2	NE	21.9	01/12	1015.4
51003	19.2N	160.7W	407	26.0	26.8	2.1	3.7	29/07	12.6	NE	19.2	27/00	1016.4
51004	17.4N	152.5W	739	25.6	26.6	2.5	3.8	15/19	15.5	NE	22.6	03/06	1015.9
51028	00.0N	153.9W	727	23.7	23.6	1.7	2.6	01/14	11.4	E	17.1	03/04	1011.5
ABAN6	44.3N	075.9W	724	10.8	14.8				4.7	N	17.4	09/08	1019.5
ALSN6	40.4N	073.8W	735	14.5	0.7		1.9	08/22	15.8	NW	39.0	01/20	1019.3
BLIA2	60.8N	146.9W	1486	6.8					13.3	N	36.0	24/18	1004.7
BURL1	28.9N	089.4W	676	24.5					12.2	NE	32.9	22/14	1018.1
BUZM3	41.4N	071.0W	735	13.1					16.7	NW	34.9	30/14	1018.7
CARO3	43.3N	124.4W	691	13.0					9.0	S	30.1	08/01	1017.7
CDRF1	29.1N	083.0W	738	24.0					7.9	NE	21.4	23/18	1018.6
CHLV2	36.9N	075.7W	736	18.3	20.7	0.9	2.2	02/06	12.5	N	30.4	22/13	1020.5
CLKN7	34.6N	076.5W	738	20.4					10.1	N	26.3	02/06	1021.6
CSBF1	29.7N	085.4W	742	23.4					5.4	NE	13.1	07/17	1019.5
DBLN6	42.5N	079.3W	735	12.8					11.3	W	34.4	23/23	1020.4
DESW1	47.7N	124.5W	741	12.0					12.6	SE	35.0	31/12	1016.1
DISW3	47.1N	090.7W	737	9.9					14.1	E	36.2	18/15	1018.0
DPIA1	30.2N	088.1W	739	23.0	24.2				10.3	N	27.7	22/22	1019.5
DRYF1	24.6N	082.9W	735	26.9	27.3				12.3	NE	28.6	23/08	1015.4
DSLN7	35.2N	075.3W	736	20.3		1.2	3.8	22/23	13.1	N	40.8	22/20	1019.3
DUCN7	36.2N	075.8W	732	18.6		0.7	2.1	02/08	10.8	N	33.9	22/15	1021.8
FBIS1	32.7N	079.9W	737	21.5					8.6	NE	23.0	06/20	1020.3
FFIA2	57.3N	133.6W	743	7.6					12.5	N	34.8	18/14	1008.1
FPSN7	33.5N	077.6W	728	22.9		1.1	2.8	02/09	11.5	N	34.3	02/08	1018.5
FWYF1	25.6N	080.1W	735	27.2	28.2				14.2	NE	33.7	23/04	1017.8

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BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
GDIL1	29.3N	089.9W	682	24.1	24.3				9.9	NE	27.6	23/04	1018.6
GLLN6	43.9N	076.4W	737	11.9					15.3	W	38.4	01/14	1019.3
IOSN3	43.0N	070.6W	737	11.2					15.6	W	31.0	30/15	1016.4
KTNF1	29.8N	083.6W	735	22.4					6.2	NE	23.7	01/00	1018.6
LKWF1	26.6N	080.0W	738	26.7	27.6				11.1	NE	29.3	23/02	1017.3
LONF1	24.8N	080.9W	735	27.3	28.2				10.5	NE	28.8	23/10	1016.0
LPOI1	48.1N	116.5W	565	9.2	13.5				7.0	NE	20.2	14/17	1020.5
MDRM1	44.0N	068.1W	734	9.5					18.5	NW	42.4	30/15	1015.1
MISM1	43.8N	068.8W	737	9.9					18.5	W	42.2	30/13	1015.4
MLRF1	25.0N	080.4W	730	27.4	28.3				12.6	E	31.5	23/06	1016.5
MRKA2	61.1N	146.7W	1484	4.9					8.6	NE	20.9	08/09	1005.2
NWPO3	44.6N	124.1W	742	12.3					9.2	S	28.7	24/23	1018.0
PILM4	48.2N	088.4W	731	8.9					16.6	E	39.1	06/02	1019.4
POTA2	61.1N	146.7W	1482	5.0					18.1	NE	31.4	23/04	1004.2
PTAC1	39.0N	123.7W	741	12.6					9.2	N	24.6	16/03	1016.3
PTAT2	27.8N	097.1W	740	24.9	26.3				13.1	SE	28.7	06/13	1016.1
PTGC1	34.6N	120.6W	12	15.2					18.9	N	22.4	01/03	
ROAM4	47.9N	089.3W	736	9.0	10.3				16.1	E	33.3	18/10	1018.0
SANF1	24.4N	081.9W	730	27.3	27.9				13.7	E	32.1	23/07	1016.0
SAUF1	29.8N	081.3W	728	24.9	26.1				11.1	NE	28.9	01/04	1018.9
SBIO1	41.6N	082.8W	736	13.5					10.8	NW	34.7	01/06	1020.3
SGNW3	43.8N	087.7W	735	11.8	12.6				12.0	W	35.0	06/02	1019.6
SISW1	48.3N	122.8W	743	10.7					9.1	SE	36.5	31/17	1017.3
SMKF1	24.6N	081.1W	723	27.5	28.5				13.3	E	34.2	23/11	1016.4
SPGF1	26.7N	079.0W	735	26.3					10.6	NE	27.2	23/05	1017.0
SRST2	29.7N	094.0W	744	23.2					11.9	SE	40.1	05/03	1019.0
STDM4	47.2N	087.2W	736	9.9					17.5	SE	46.2	18/17	1018.2
SUPN6	44.5N	075.8W	736	10.8	15.2				10.5	N	28.2	23/18	1018.5
THIN6	44.3N	076.0W	734	10.9									
TPLM2	38.9N	076.4W	736	15.9	18.3								

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41001	34.7N	072.6W	719	19.6	23.1	1.8	4.6	06/10	13.6	NW	31.5	26/13	1018.5
41002	32.3N	075.2W	719	22.1	25.0	1.5	5.6	06/07	11.8	S	27.4	06/03	1018.9
41004	32.5N	079.1W	706	20.7	23.7	1.1	2.8	05/19	10.8	NE	28.2	05/19	1018.8
41008	31.4N	080.9W	719	20.5		0.9	2.3	05/16	9.7	NE	25.3	05/14	1018.9
41009	28.5N	080.2W	1437	24.3	26.0	1.1	4.1	05/22	10.1	SE	33.2	05/20	1018.7
41010	28.9N	078.6W	1429	24.0	25.9	1.3	5.1	06/03	9.6	E	37.1	05/18	1019.2
42001	25.9N	089.6W	716			1.1	3.3	05/02	11.5	E	27.4	05/01	1017.1
42002	25.9N	093.6W	718	24.8	26.0	1.2	3.1	05/19	13.3	SE	27.4	10/07	1016.8
42003	25.9N	085.9W	718	24.7	26.4	1.0	4.5	05/04	11.4	SE	34.6	04/23	1017.1
42007	30.1N	088.8W	719	19.7	21.6	0.6	2.1	10/15	10.1	N	26.2	11/12	1018.5
42019	27.9N	095.4W	718	22.9	25.2	1.3	3.4	10/13	13.7	SE	26.0	05/10	1016.3
42020	26.9N	096.7W	718	23.5	24.9	1.7	3.4	05/12	13.2	SE	28.4	05/11	1015.8
42035	29.2N	094.4W	719	19.9	21.7	0.9	2.4	10/09	11.1	SE	25.8	10/14	1018.1
42036	28.5N	084.5W	716	22.8	24.1	0.7	2.3	05/09	9.4	SE	25.6	05/11	1018.7
42039	28.8N	086.0W	717	23.0	25.0	0.8	2.5	10/19	9.9	SE	23.5	05/03	1019.4
42040	29.2N	088.2W	719	22.1	24.6	0.9	2.6	10/12	12.2	S	22.5	10/05	1019.1
44004	38.5N	070.7W	718	13.6	17.5	1.8	4.4	27/02	14.0	NW	29.1	27/17	1018.2
44005	42.9N	068.9W	717	6.9	8.3	1.6	4.5	11/16	14.6	W	33.8	26/21	1014.9
44007	43.5N	070.1W	719	6.2		0.9	4.9	26/23	12.3	W	31.9	11/12	1015.1
44008	40.5N	069.4W	717	9.8	11.2	1.7	4.6	27/06	14.2	NW	29.1	27/00	1016.3
44009	38.5N	074.7W	718	11.6	13.9	1.0	3.2	11/13	13.1	NW	26.6	11/07	1018.8
44011	41.1N	066.6W	718	9.0	9.4	2.0	4.8	27/07	13.4	W	28.8	26/21	1015.9
44013	42.4N	070.7W	719	7.5	8.8	0.8	3.3	26/21	13.1	NW	28.0	26/19	1014.9
44014	36.6N	074.8W	719	13.9	15.6	1.1	2.8	11/15	11.6	NW	23.9	11/17	1018.5
44025	40.3N	073.2W	713	10.0	12.0	1.1	3.0	11/17	13.8	NW	29.7	11/12	
45002	45.3N	086.4W	109	5.2	12.0	1.2	1.8	04/01	17.5	N	24.5	02/23	
45003	45.3N	082.8W	132	3.9	10.8	0.8	1.3	03/00	14.1	N	20.6	03/01	1021.0
45005	41.7N	082.4W	717	7.8	9.5	0.6	3.0	11/10	13.7	SW	36.9	11/08	1017.3
45007	42.7N	087.0W	719	6.9	9.6	1.2	6.2	11/03	14.6	S	41.2	10/22	1016.6
45008	44.3N	082.4W	379	6.1	10.8	1.3	5.0	11/07	16.6	NW	39.2	11/04	1016.6
46001	56.3N	148.2W	719	5.6	7.0	3.1	8.5	28/03	11.6	E	27.6	03/06	997.2
46003	51.8N	155.9W	699	5.6	6.8	4.3	11.0	29/05	19.0	W	40.0	27/10	999.2
46005	46.1N	131.0W	716	11.2	12.7	4.4	9.3	25/19	17.8	SW	45.1	23/19	1006.4
46006	40.8N	137.5W	697	13.0	14.5	4.5	10.6	25/14	19.0	W	43.3	23/10	1013.7
46011	34.9N	120.9W	720	13.4	13.8	2.7	6.0	23/09	12.1	NW	26.8	06/01	1017.8
46012	37.4N	122.7W	717	12.6	12.9	2.8	7.8	24/13	10.2	NW	31.5	30/13	1018.2
46013	38.2N	123.3W	717	11.9	11.9	3.0	7.6	24/09	10.1	NW	30.1	30/11	1018.6
46014	39.2N	124.0W	715	12.0	12.5	3.3	8.5	30/20	11.1	SE	38.5	30/10	1017.8
46022	40.7N	124.5W	717	11.8	12.1	3.5	8.6	30/22	13.4	SE	43.5	30/09	1016.1
46023	34.7N	121.0W	719	13.3	13.7	2.7	5.7	26/20	14.9	NW	30.7	06/01	1018.4

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BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
46025	33.8N	119.1W	705	15.8	16.8	1.5	3.0	29/04	8.2	NW	25.8	07/01	1017.1
46026	37.8N	122.8W	720	12.1	12.2	2.4	5.4	24/12					1018.7
46028	35.7N	121.9W	720	12.7	13.1	2.9	7.1	26/19	12.4	NW	27.8	05/20	1018.2
46029	46.1N	124.5W	715	11.2	12.1	3.9	9.5	24/07	16.6	S	42.2	25/02	1009.6
46030	40.4N	124.5W	706	11.7	12.0	3.3	9.6	30/21	13.4	SE	43.1	30/10	1016.8
46035	56.9N	177.8W	680	1.4	4.4	3.8	8.7	12/10	20.8	NW	40.8	13/14	995.5
46041	47.4N	124.5W	717	10.4	11.9	3.3	7.9	24/06	16.6	SE	41.2	25/01	1009.0
46042	36.7N	122.4W	715	12.7	13.2	2.9	7.4	24/13	10.8	NW	29.9	30/16	1018.8
46045	33.8N	118.5W	719	15.2	16.0	1.2	2.3	29/05	4.6	E	14.0	09/21	1016.3
46050	44.6N	124.5W	715	11.6	12.6	4.0	10.8	25/22	16.8	S	46.2	25/19	1011.9
46053	34.2N	119.8W	717	14.7	15.2	1.7	3.8	25/05	9.3	W	29.0	28/11	1016.7
46054	34.3N	120.4W	687	13.6	13.9	2.7	6.0	26/21	16.4	NW	32.1	06/03	1016.7
46059	38.0N	130.0W	717	16.0		3.9	10.9	23/22	15.7	W	36.7	30/10	
46060	60.6N	146.8W	1403	4.5	7.3	0.6	1.6	03/19	10.6	E	36.7	28/09	1000.4
46061	60.2N	146.8W	1438	4.7	7.9	1.8	6.9	28/12	14.1	NE	41.4	28/19	999.7
46062	35.1N	121.0W	708	13.1									

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BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
41001	34.7N	072.6W	737	18.9	22.1	2.2	6.7	17/00	14.8	SW	34.6	30/19	1019.7
41002	32.3N	075.2W	738	21.2	23.5	2.0	5.6	30/19	14.0	SW	35.8	16/18	1020.0
41004	32.5N	079.1W	723	17.8	22.2	1.5	3.3	15/02	13.9	NE	30.7	30/12	1020.1
41008	31.4N	080.9W	739	16.7		1.1	2.5	15/07	11.0	N	28.4	30/13	1021.0
41009	28.5N	080.2W	1479	22.4	24.4	1.3	3.3	15/17	10.7	SE	28.0	15/16	1020.6
41010	28.9N	078.6W	1475	23.1	24.8	1.6	4.6	16/00	10.5	E	29.3	15/20	1020.7
42001	25.9N	089.6W	735			1.2	2.6	13/01	11.9	E	27.8	26/09	1019.5
42002	25.9N	093.6W	559	23.2	25.0	1.3	2.8	12/05	13.6	SE	27.2	18/22	1019.6
42003	25.9N	085.9W	738	23.4	25.9	1.3	2.6	14/12	13.1	E	33.4	26/13	1019.1
42007	30.1N	088.8W	736	16.3	19.7	0.7	1.8	12/20	11.2	N	25.8	22/15	1021.1
42019	27.9N	095.4W	558	19.7	22.9	1.5	3.9	18/23	13.8	SE	28.2	22/09	1019.4
42020	26.9N	096.7W	737	19.5	23.1				13.1	SE	29.1	18/16	1019.2
42035	29.2N	094.4W	738	15.5	18.6	0.9	2.4	10/20	11.6	N	30.3	10/19	1021.2
42036	28.5N	084.5W	739	20.6	23.0	0.9	2.8	30/11	11.2	SE	23.5	30/08	1020.1
42039	28.8N	086.0W	738	20.9	23.7	1.1	2.8	12/09	12.4	SE	25.3	30/05	1021.1
42040	29.2N	088.2W	740	19.8	23.3	1.1	3.0	12/17					1021.3
44004	38.5N	070.7W	738	12.8	17.1	1.9	6.6	31/02	14.7	W	33.0	30/20	1019.5
44005	42.9N	068.9W	737	4.5	6.7	1.6	4.9	23/04	15.2	W	34.8	22/21	1016.4
44007	43.5N	070.1W	740	2.8		0.8	2.6	22/10	12.9	SW	30.7	01/19	1016.8
44008	40.5N	069.4W	735	7.7	9.4	1.8	5.6	31/04	15.0	NW	33.2	31/01	1018.1
44009	38.5N	074.7W	739	8.7	11.6	1.1	3.2	14/16	13.0	NW	31.5	30/15	1020.7
44011	41.1N	066.6W	738	6.9	7.1	2.1	6.5	18/20	14.6	W	38.7	31/04	1017.4
44013	42.4N	070.7W	740	4.9	7.0	0.8	2.2	18/15	13.7	SW	34.2	31/00	1016.6
44014	36.6N	074.8W	737	11.2	12.9	1.4	4.1	16/16	12.9	N	34.8	16/14	1019.9
44025	40.3N	073.2W	602	8.3	9.9	1.0	3.1	22/12	13.0	SW	31.1	22/18	
45005	41.7N	082.4W	149	10.4	7.8	0.4	1.3	01/07	11.3	S	22.9	01/08	1014.3
45007	42.7N	087.0W	233	7.2	7.5	0.8	2.5	07/01	12.2	S	28.2	07/00	1016.6
46001	56.3N	148.2W	738	2.9	5.3	3.8	8.9	07/02					1002.2
46003	51.8N	155.9W	137	4.4	5.6	5.9	12.9	06/10	25.8	W	37.5	06/07	1005.6
46005	46.1N	131.0W	740	8.8	10.1	4.5	9.5	08/02	18.6	SW	33.2	05/18	1019.2
46006	40.8N	137.5W	721	11.3	12.2	4.1	9.1	03/20	18.4	SW	34.2	03/20	1024.7
46011	34.9N	120.9W	737	11.3	12.4	3.1	6.5	09/13	11.7	NW	28.0	06/12	1021.9
46012	37.4N	122.7W	733	10.4	11.7	2.8	6.6	01/04	10.6	N	28.4	06/03	1023.3
46013	38.2N	123.3W	738	10.0	11.2	3.2	7.7	01/01	10.9	NW	31.5	20/18	1024.3
46014	39.2N	124.0W	736	9.7		3.6	7.9	01/00	11.2	NW	30.5	20/18	1024.3
46022	40.7N	124.5W	714	9.3	10.9	3.7	7.3	01/00	14.6	N	38.9	05/21	1024.2
46023	34.7N	121.0W	740	11.3	12.5	3.2	6.8	09/15	14.5	NW	31.7	06/13	1022.5
46025	33.8N	119.1W	740	13.7	14.2	1.5	3.2	01/10	9.3	NW	29.9	06/13	1020.7
46026	37.8N	122.8W	737	10.1	11.3	2.4	5.7	01/01	9.5	NW	32.3	20/20	1024.0
46028	35.7N	121.9W	738	11.0	12.1	3.5	7.5	09/10	13.2	NW	28.8	20/21	1022.4
46029	46.1N	124.5W	480	9.6	10.8	4.6	8.5	03/21	17.3	SW	37.3	01/19	1018.0
46030	40.4N	124.5W	709	9.3	10.5	3.5	7.0	20/22	15.7	N	35.8	20/17	1024.6
46035	56.9N	177.8W	660	-.6	2.8	3.2	9.7	04/01	18.4	N	45.9	04/06	1006.7
46041	47.4N	124.5W	9	9.3	10.6	4.0	4.6	01/06	7.9	S	17.7	01/07	1001.8
46042	36.7N	122.4W	708	10.5	11.8	3.1	7.3	01/03	11.5	NW	28.0	20/21	1023.5
46045	33.8N	118.5W	738	13.1	13.9	1.2	2.7	21/06	5.8	E	20.2	21/09	1019.9
46050	44.6N	124.5W	736	8.4	10.8	4.1	8.0	03/12	16.9	S	38.7	01/17	1022.3
46053	34.2N	119.8W	739	12.5	13.4	1.7	3.7	02/03	8.5	NW	26.8	06/16	1020.8
46054	34.3N	120.4W	724	11.8	12.5	2.8	5.8	01/05	15.9	NW	33.8	06/13	1020.6
46059	38.0N	130.0W	739	13.9		3.8	8.7	04/08	15.8	N	32.6	04/12	
46060	60.6N	146.8W	1467	2.1	6.6				11.7	E	36.9	04/15	1004.3
46061	60.2N	146.8W	1476	2.3	6.8	2.0	5.3	07/13	14.6	E	36.5	04/13	1003.4
46062	35.1N	121.0W	726	11.2	12.3	3.0	6.8	09/14	13.1	NW	31.3	21/01	1021.7
46063	34.2N	120.7W	740	11.6	12.4	3.1	6.5	09/14	15.6	NW	29.1	06/13	1020.7
51001	23.4N	162.3W	733	23.5	24.7	3.3	9.2	31/22	14.6	E	28.5	28/11	1018.8
51002	17.2N	157.8W	737	24.5									

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