Mariners Weather Log

Vol. 44, No. 3 December 2000

Giant rogue wave as seen from the bridge wing aboard the *SS Spray* in February 1986. The height of eye was 56 feet and the wave broke over the head of the photographer. It bent the foremast (shown) back 20 degrees. The vessel was in the Gulf Stream off Charleston, South Carolina. A long 15-foot swell was moving south from a gale over Long Island.

See http://www.ifremer.fr/metocean/conferences/freak/_waves.htm.

Courtesy Captain Andy Chase, Maine Maritime Academy

Mariners Weather Log

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From the Editorial Supervisor

Publication of the Mariners Weather Log is coming under the National Data Buoy Center (NDBC) in Bay St. Louis, Mississippi, and my role as Editorial Supervisor will end during early 2001. I am leaving the marine program to serve as the new NOAA Weather Wire Program Leader. My successor will be announced in the next issue (April 2001). There should be no interruption to the printing schedule.

Managing the production effort for the past six years has been very rewarding. I am particularly gratified at having brought the Log back under direct National Weather Service (NWS) control. Although the Log started out in 1957 as an NWS publication, it had been produced by the National Oceanographic Data Center (another NOAA agency) for many years. As a restored NWS publication, I wanted to include more meterological information and related support materials to make it more useful. I hope this effort has been of value.

I thank the many people who contributed manuscripts, photographs, and other materials for publication. Special thanks go to Dr. Jack Beven, Dr. Bruce Parker, George Bancroft, Skip Gilham, Ramona Schreiber, Rick Kenney, and Robert Wagner, who provided articles for just about every issue. The gold medal is reserved for Mary Ann Burke, who provides editing and layout services. The production effort these past six years would not have been possible without her dedication and outstanding support.

Martin S. Baron⚓

Some Important Webpage Addresses

NOAA	http://www.noaa.gov
National Weather Service	http://www.nws.noaa.gov
AMVER Program	http://www.amver.com
VOS Program	http://www.vos.noaa.gov
SEAS Program	http://seas.nos.noaa.gov/seas/
Mariners Weather Log	http://www.nws.noaa.gov/om/mwl/mwl.htm
Marine Dissemination	http://www.nws.noaa.gov/om/marine/home.htm

See these webpages for further links.

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Dave Miller
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October 1970: President Richard M. Nixon was on his way to the Middle East when Egyptian President Nassar died. The Pittsburgh Steelers were putting a lot of faith in their new rookie quarterback, Terry Bradshaw. The top grossing movie of the month was Tora! Tora! Tora! And the National Oceanic and Atmospheric Administration, a new federal agency to observe, predict, and protect our environment, was born.

In a July 1970 statement to Congress, President Nixon proposed creating NOAA to serve a national need "…for better protection of life and property from natural hazards…for a better understanding of the total environment…[and] for exploration and development leading to the intelligent use of our marine resources…" On October 3, NOAA was established under the Department of Commerce.

Thirty years later, NOAA still works for America every day. From providing timely and precise weather, water, and climate forecasts, to monitoring the environment, to managing fisheries and building healthy coastlines, to making our nation more competitive through safe navigation, and examining changes in the oceans, NOAA is on the front lines for America.

In hours of crisis, NOAA employees have been found issuing the tornado warnings that saved hundreds of lives from a deadly storm, flying into the eyes of hurricanes to gather information about possible landfall, fighting to free three grey whales trapped in the ice, fielding a massive scientific operation on the shores to guide the comeback from an oil spill, and monitoring by satellites the movement of hurricanes and other severe storms, volcanic ash, and wildfires that threaten communities.

NOAA is most proud of its people. "The people of NOAA make it a great, great agency!" said D. James Baker, NOAA's seventh administrator. "We cannot accomplish our mission without the creative energies of all people who bring with them different approaches, solutions, and innovations."

19th Century Beginnings

Separate pieces, each with a rich history, joined together to make NOAA the original whole earth agency. In fact, many of NOAA's components have 19th century origins.

NOAA's charting piece, which evolved into the National Ocean Service, began at the turn of the 19th century when President Thomas Jefferson, a true NOAA pioneer, established the first science agency of the United States: the Survey of the Coast. The Survey of the Coast changed

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Our Earth and Our Sky

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its name to the Coast and Geodetic Survey in 1878 to reflect the role of geodesy. Today NOS still helps people find their position on the planet by managing the National Geodetic Survey, which specifies latitude, longitude, height, scale, gravity, and orientation throughout the nation. Aviation safety, in particular the orientation of runways, depends on this system. When the Washington Monument was covered in scaffolding for renovations in 1999, NGS surveyors confirmed the height and stability of the structure. NOS has been a leader in the introduction of electronic nautical charts which, together with GPS, has enhanced the safety and efficiency of navigation on the nation's waterways.

More than a century later, NOS has evolved into the nation's principal advocate for coastal and ocean stewardship. As the trustee for 12 marine protected areas, NOAA protects National Marine Sanctuaries, which are akin to national underwater parks. Each sanctuary has a unique goal. While one may protect the breeding ground of humpback whales, for example, another preserves the remains of historical shipwrecks, and still another protects thriving coral reef colonies. Through the sanctuary program, a growing number of partners and volunteers embrace NOAA's ocean ethic—to preserve, protect, and respect our nation's marine environment.

Environmental Data and Satellite Images

Before the Revolutionary War, Thomas Jefferson acted as an unofficial weather bureau, collecting records from such distant points as Quebec and from as far west as the Mississippi. Perhaps Jefferson's data collection work inspired the Surgeon General of the Army to order hospital surgeons during the War of 1812 to take observations and keep climatological records.

OUR SEAS AND OUR SKIES
30 Years
OF EXCELLENCE AT NOAA

Today, NOAA's cooperative weather observers, comprising a network of more than 10,000 National Weather Service volunteers across the country, continue the tradition of taking daily weather measurements that become part of our climate records. These records, along with other records from the NWS, U.S. Navy, U.S. Air Force, the Federal Aviation Administration, and meteorological services around the world, are housed at the National Climatic Data Center in Asheville, North Carolina. The center, the largest active archive of climate data in the world, is part of NOAA's National Environmental Satellite, Data, and Information Service. In addition to the climate center, NESDIS also operates the National Geophysical Data Center in Boulder, Colorado, and the National Oceanographic Data Center in Silver Spring, Maryland. Scientists from around the world use data from these centers to study our environment.

NOAA's satellite operations grew out of the space program and the desire to study our earth from a vantage point high in the sky. As NOAA entered its 30th year, its satellite program celebrated the 40th anniversary of Tiros-1, the first weather satellite. In the past 40 years, NOAA's satellites have evolved from weather satellites to environmental satellites. Data are used for applications related to the oceans, coastal regions, agriculture, detection of forest fires, detection of volcanic ash, monitoring the ozone hole over the South Pole, and the space environment.

From Weather Bureau to Weather Service

When Congress transferred weather services from the Army to the new Department of Agriculture in 1890, the Weather Bureau, a new civilian weather service and ancestor of NOAA's NWS, was born. By the end of the century, the Weather Bureau published its first Washington, D.C., weather map (1895), established the first hurricane warning service (1896), and began regular kite observations (1898). Today's NWS uses complex technologies such as weather satellites, Doppler radar, automated surface observing

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systems, sophisticated computer models, high-speed communications systems, flying meteorological platforms, and a highly-trained and skilled workforce to issue more than 734,000 weather and 850,000 river and flood forecasts, and between 45,000 and 50,000 potentially life-saving severe weather warnings annually. Last summer, the weather service deployed the Advanced Weather Interactive Processing System, the final piece of technology in a $4.5 billion modernization program to improve climate, water, and weather products and services that help protect life and property and enhance the economy. One estimate is that the NWS's highly accurate long-range predictions for the 1997-98 El Niño episode helped California avert about $1 billion in losses.

NWS data is a national resource. Government agencies, private companies, the media, universities, and the public all use NWS data.

Protecting Fisheries and Marine Mammals

The fishing industry has been important to the United States since its earliest days. NOAA's National Marine Fisheries Service, or NOAA Fisheries, is the direct descendant of the U.S. Commission of Fish and Fisheries, the nation's first federal conservation agency, initiated in 1871 to protect, study, manage, and restore fish. Woods Hole, Massachusetts, became home to the first marine fisheries research lab and is still home to one of NOAA's five fisheries science centers.

More than a century later, NOAA Fisheries is committed to taking a rational, scientific approach to the difficult, contentious issues of living marine resource management. As stewards, NOAA Fisheries manages for the sustainable use of living marine resources, striving to balance competing public needs and interests in the use and enjoyment of those resources while preserving their biological integrity. Two recent examples include international and domestic actions to rebuild swordfish stocks, working with both industry and conservationists; and developing an innovative, long-term strategy for restoring threatened and endangered salmon in the Pacific Northwest.

NOAA Research

In 1882 the **U.S.S. Albatross**, the first government research vessel built exclusively for fisheries and oceanographic research, launched both a future for NOAA's research programs and a fleet of research vessels. Today, the scientists of NOAA's Office of Oceanic and Atmospheric Research, or NOAA Research, along with their university partners, work to better understand the world in which we live. NOAA Research is where much of the work is done that results in better weather forecasts, longer warning lead times for natural disasters, new products from the sea, and a greater understanding of our climate, atmosphere, and oceans. NOAA research is done not only in what many would consider traditional laboratories, but also aboard ships, aloft in planes, and beneath the sea in the world's only undersea habitat. NOAA research tools can be as high-tech as supercomputers or as basic as rain gauges. Officers of the NOAA Corps, the smallest of the seven uniformed services of the United States, operate NOAA's fleet of research vessels and aircraft.

Legacy Continues

NOAA 30th birthday celebrations began in January at the 80th AMS Annual Meeting in Long Beach, California, and have continued throughout the year. From 19th century beginnings to 30 years as a Federal agency, NOAA has evolved into a science agency with conservation management and regulatory responsibilities. The agency looks forward to the challenges ahead while continuing to observe, monitor, and collect information about our world in a quest to both protect the environment and improve the human condition.

"As NOAA celebrates its 30th anniversary, we are thinking globally, providing the sound science and service essential to measuring, managing, and solving many of the nation's and the world's difficult environmental challenges. The choices made by society and our agency today will profoundly shape America's economic and environmental future," said Baker.⚓

Waves and the Mariner

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Several famous ocean storms in the last decade have inflicted serious tragic loss of lives and ships. They have a common denominator: Waves! In the Halloween storm of 1991, made famous in the "Perfect Storm" saga, the loss of the **F/V Andrea Gail** and its six-man crew was from massive waves verified to be near 100 feet. In 1998, two simultaneous late October storms, one known as the APL China "Bomb" in the north Pacific, involved serious damage and loss of hundreds of containers impacting five commercial ships and was also attributed to extreme waves. Damage estimates were in the hundreds of millions of dollars. At the same time, Category 5 Hurricane Mitch in the Caribbean caused the capsizing of the tall sailing ship **Fantome** and the loss of its 31 hands on board.

Oceanic waves fall into three categories: ripples, seas, and swells.

Waves form from energy imparted to the sea from wind force. They do not undergo deflecting forces such as the earth's rotation or the Coriolis effect. They begin as ripples when wind begins blowing across the ocean's surface. Wind force, direction, and length of time determine how waves will evolve and how large they become. As ripples form, they disappear if wind ceases, or grow into seas (wind energy producing waves that will continue even if the wind drops off). Seas will then mature as swells (seas that have moved away from their area of origin and are not related to local wind effects). Thus, wave formation and growth are dependent on:

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Waves and the Mariner

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1. Wind Strength, measured in knots using the Beaufort scale.

2. Duration, the time in hours that wind blows over an area of the ocean.

3. Fetch, the distance in nautical miles over which the wind blows.

There is a maximum wave height for each combination of wind strength, duration, and fetch. These wave conditions, when reached, are called "Fully Developed Seas" or FDS. The largest waves are frequently found in the Southern Hemisphere Oceans, where strong winds can blow over vast expanses of exposed ocean for extended periods.

Waves have four components: height, length, period, and velocity (or speed). These components are directly or indirectly related to one another.

See Figure 1 for typical wave shape. Wave tops are called crests and bottoms are called troughs. Thus wave height is the distance from trough to crest and wavelength is the distance from crest to crest or five times its period squared. The wave period is the time interval between the passage of successive crests in seconds. Wave velocity (or speed) is three times its period. Waves are not symmetrical in shape. Crests are by nature steeper and narrow than troughs, with normal sea level slightly below one-half a wave's height. For an FDS, there is a relationship between wavelength, period, and velocity (or speed). For example, an individual wave with a period of 5 seconds will have a length of 125 feet (5x5x5=125) and a speed of 15 knots (3x5=15).

Wave height is not specifically related to wave period or speed; however, its steepness (wave height divided by length or its rise over the run) is an important factor in understanding wave height. Waves will typically break when its steepness exceeds 1/7 in the open ocean. This is even more critical in ocean currents such as the Gulf Stream or the Kuroshio Current. As all mariners are aware, wave heights are not uniform. The most visible waves that the naked eye observes are Significant Wave Height (SWH). SWH is the average height of the highest one-third of the waves present in any given area. SWH for a given value in open ocean conditions allows determination or other critical wave heights:

Average Wave Height = 0.64% of SWH

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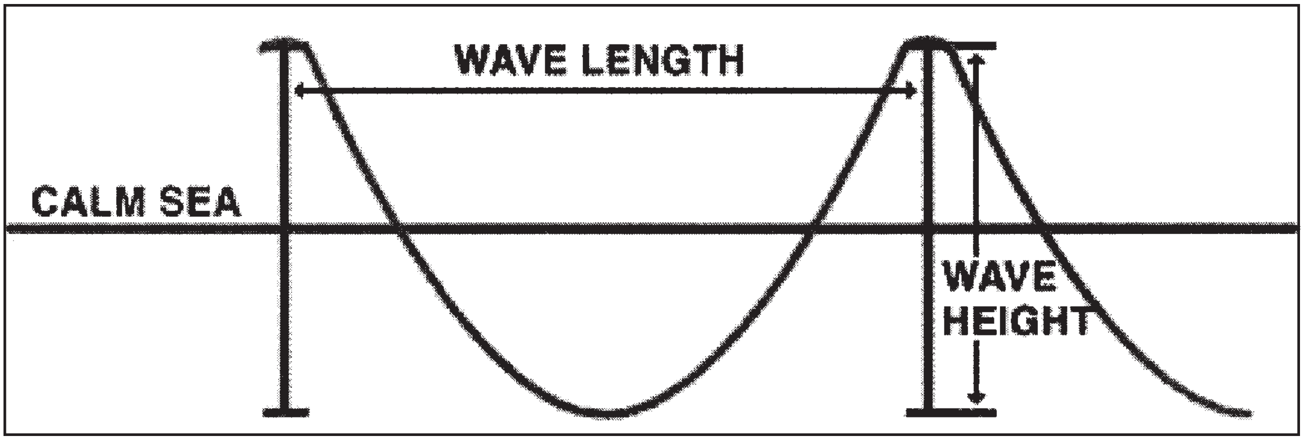


Figure 1. The four components of a wave: length, height, period, and speed. As winds produce waves over the open ocean, the larger waves will continue to grow until a Fully Developed Sea (FDS) is produced.

BEAUFORT NUMBER 3–6

Fetch	3 T	3 H	3 P	4 T	4 H	4 P	5 T	5 H	5 P	6 T	6 H	6 P
10	4.4	1.8	2.1	3.7	2.6	2.4	3.2	3.5	2.8	2.7	5.0	3.1
20	7.1	2.0	2.5	6.2	3.2	2.9	5.4	4.9	3.3	4.7	7.0	3.8
30	9.8	2.0	2.8	8.3	3.8	3.3	7.2	5.8	3.7	6.2	8.0	4.2
40	12.0	2.0	3.0	10.3	3.9	3.6	8.9	6.2	4.1	7.8	9.0	4.6
50	14.0	2.0	3.2	12.4	4.0	3.8	11.0	6.5	4.4	9.1	9.8	4.8
60	16.0	2.0	3.5	14.0	4.0	4.0	12.0	6.8	4.6	10.2	10.3	5.1
70	18.0	2.0	3.7	15.8	4.0	4.1	13.5	7.0	4.8	11.9	10.8	5.4
80	20.0	2.0	3.8	17.0	4.0	4.2	15.0	7.2	4.9	13.0	11.0	5.6
90	23.6	2.0	3.9	18.8	4.0	4.3	16.5	7.3	5.1	14.1	11.2	5.8
100	27.1	2.0	4.0	20.0	4.0	4.4	17.5	7.3	5.3	15.1	11.4	6.0
120	31.1	2.0	4.2	22.4	4.1	4.7	20.0	7.8	5.4	17.0	11.7	6.2
140	36.6	2.0	4.5	25.8	4.2	4.9	22.5	7.9	5.8	19.1	11.9	6.4
160	43.2	2.0	4.9	28.4	4.2	5.2	24.3	7.9	6.0	21.1	12.0	6.6
180	50.0	2.0	4.9	30.9	4.3	5.4	27.0	8.0	6.2	23.1	12.1	6.8
200				33.5	4.3	5.6	29.0	8.0	6.4	25.4	12.2	7.1
220				36.5	4.4	5.8	31.1	8.0	6.6	27.2	12.3	7.2
240				39.2	4.4	5.9	33.1	8.0	6.8	29.0	12.4	7.3
260				41.9	4.4	6.0	34.9	8.0	6.9	30.5	12.6	7.5
280				44.5	4.4	6.2	36.8	8.0	7.0	32.4	12.9	7.8
300				47.0	4.4	6.3	38.5	8.0	7.1	34.1	13.1	8.0
320							40.5	8.0	7.2	36.0	13.3	8.2
340							42.4	8.0	7.3	37.6	13.4	8.3
360							44.2	8.0	7.4	38.8	13.4	8.4
380							46.1	8.0	7.5	40.2	13.5	8.5
400							48.0	8.0	7.7	42.2	13.5	8.6
420							50.0	8.0	7.8	43.5	13.6	8.7
440							52.0	8.0	7.9	44.7	13.7	8.8
460							54.0	8.0	8.0	46.2	13.7	8.9
480							56.0	8.0	8.1	47.8	13.7	9.0
500							58.0	8.0	8.2	49.2	13.8	9.1
550										53.0	13.8	9.3
600										56.3	13.8	9.5
650												
700												
750												
800												
850												
900												
950												
1000												

BEAUFORT NUMBER 7–11

Fetch	7 T	7 H	7 P	8 T	8 H	8 P	9 T	9 H	9 P	10 T	10 H	10 P	11 T	11 H	11 P	Fetch
10	2.5	6.0	3.4	2.3	7.3	3.9	2.0	8.0	4.1	1.9	10.0	4.2	1.8	10.0	5.0	10
20	4.2	8.6	4.3	3.9	10.0	4.4	3.5	12.0	5.0	3.2	14.0	5.2	3.0	16.0	5.9	20
30	5.8	10.0	4.6	5.2	12.1	5.0	4.7	15.8	5.5	4.4	18.0	6.0	4.1	19.8	6.3	30
40	7.1	11.2	4.9	6.5	14.0	5.4	5.8	17.7	5.9	5.4	21.0	6.2	5.1	22.5	6.7	40
50	8.4	12.2	5.2	7.7	15.7	5.6	6.9	19.8	6.3	6.4	23.0	6.7	6.1	25.0	7.1	50
60	9.6	13.2	5.5	8.7	17.0	6.0	8.0	21.0	6.5	7.4	25.0	7.0	7.0	27.5	7.5	60
70	10.5	13.9	5.7	9.9	18.0	6.4	9.0	22.5	6.8	8.3	26.5	7.3	7.8	29.5	7.7	70
80	12.0	14.5	6.0	11.0	18.9	6.6	10.0	24.0	7.1	9.3	28.0	7.7	8.6	31.5	7.9	80
90	13.0	15.0	6.3	12.0	20.0	6.7	11.0	25.0	7.2	10.2	30.0	7.9	9.5	34.0	8.2	90
100	14.0	15.5	6.5	12.8	20.5	6.9	11.9	26.5	7.6	11.0	32.0	8.1	10.3	35.0	8.5	100
120	15.9	16.0	6.7	14.5	21.5	7.3	13.1	27.5	7.9	12.3	33.5	8.4	11.5	37.5	8.8	120
140	17.6	16.2	7.0	16.0	22.0	7.6	14.8	29.0	8.3	13.9	35.5	8.8	13.0	40.0	9.2	140
160	19.5	16.5	7.3	18.0	23.0	8.0	16.4	30.5	8.7	15.1	37.0	9.1	14.5	42.5	9.6	160
180	21.3	17.0	7.5	19.9	23.5	8.3	18.0	31.5	9.0	16.5	38.5	9.5	16.0	44.5	10.0	180
200	23.1	17.5	7.7	21.5	23.5	8.5	19.3	32.5	9.2	18.1	40.0	9.8	17.1	46.0	10.3	200
220	25.0	17.9	8.0	22.9	24.0	8.8	20.9	34.0	9.6	19.1	41.5	10.1	18.2	47.5	10.6	220
240	26.8	17.9	8.2	24.4	24.5	9.0	22.0	34.5	9.8	20.5	43.0	10.3	19.5	49.0	10.8	240
260	28.0	18.0	8.4	26.0	25.0	9.2	23.5	34.5	10.0	21.8	44.0	10.6	20.9	50.5	11.1	260
280	29.5	18.0	8.5	27.7	25.0	9.4	25.0	35.0	10.2	23.0	45.0	10.9	22.0	51.5	11.3	280
300	31.5	18.0	8.7	29.0	25.0	9.5	26.3	35.0	10.4	24.3	45.0	11.1	23.2	53.0	11.6	300
320	33.0	18.0	8.9	30.2	25.0	9.6	27.6	35.5	10.6	25.5	45.5	11.2	24.5	54.0	11.8	320
340	34.2	18.0	9.0	31.6	25.0	9.8	29.0	36.0	10.8	26.7	46.0	11.4	25.5	55.0	12.0	340
360	35.7	18.1	9.1	33.0	25.0	9.9	30.0	36.5	10.9	27.7	46.5	11.6	26.6	55.0	12.2	360
380	37.1	18.2	9.3	34.2	25.5	10.0	31.3	37.0	11.1	29.1	47.0	11.8	27.7	55.5	12.4	380
400	38.8	18.4	9.5	35.6	26.0	10.2	32.5	37.0	11.2	30.2	47.5	12.0	28.9	56.0	12.6	400
420	40.0	18.7	9.6	36.9	26.5	10.3	33.7	37.5	11.4	31.5	47.5	12.2	29.6	56.5	12.7	420
440	41.3	18.8	9.7	38.1	27.0	10.4	34.8	37.5	11.5	32.5	48.0	12.3	30.9	57.0	12.9	440
460	42.8	19.0	9.8	39.5	27.5	10.6	36.0	37.5	11.7	33.5	48.5	12.5	31.8	57.5	13.1	460
480	44.0	19.0	9.9	41.0	27.5	10.8	37.0	37.5	11.8	34.5	49.0	12.6	32.7	57.5	13.2	480
500	45.5	19.1	10.1	42.1	27.5	10.9	38.3	38.0	11.9	35.5	49.0	12.7	33.9	58.0	13.4	500
550	48.5	19.5	10.3	44.9	27.5	11.1	41.0	38.5	12.2	38.2	50.0	13.0	36.5	59.0	13.7	550
600	51.8	19.7	10.5	47.7	27.5	11.3	43.6	39.0	12.5	40.3	50.0	13.3	38.7	60.0	14.0	600
650	55.0	19.8	10.7	50.3	27.5	11.6	46.4	39.5	12.8	43.0	50.0	13.7	41.0	60.0	14.2	650
700	58.5	19.8	11.0	53.2	27.5	11.8	49.0	40.0	13.1	45.4	50.5	14.0	43.5	60.5	14.5	700
750				56.2	27.5	12.1	51.0	40.0	13.3	48.0	51.0	14.2	45.8	61.0	14.8	750
800				59.2	27.5	12.3	53.8	40.0	13.5	50.6	51.5	14.5	47.8	61.5	15.0	800
850							56.2	40.0	13.8	52.5	52.0	14.6	50.0	62.0	15.2	850
900							58.2	40.0	14.0	54.6	52.0	14.9	52.0	62.5	15.5	900
950										57.2	52.0	15.1	54.0	63.0	15.7	950
1000										59.3	52.0	15.3	56.3	63.0	16.0	1000

Figure 2. Table for calculating variables for wave height: the time in Hours (T) that wind must blow to generate waves of Significant Wave Height (SWH) or (H) in feet and Period (P) in seconds. Fetch is area is in nautical miles (NM).

Waves and the Mariner

Continued from Page 8

Highest 10% of Waves = 1.29% of SWH

Extreme or Highest Waves = 1.87% of SWH

For example if SWH is 10 feet in a given area, the Average Wave Height is 6.4 feet, the highest 10% of the waves is 12.9 feet, and the Extreme or Highest Waves will be 18.7 feet.

Waves generally develop slowly and for any given wind speeds it take hours for an SWH to develop. For example, in Figure 2 (from Marine Weather, Nathaniel Bowditch, Ocean Waves section p. 116 Beaufort number), Beaufort force 8 wind (34-40 knots) requires 40 hours to generate its SWH, with unlimited fetch, of 27.5 feet. Changing any combination of wave components will increase or decrease wave height proportionally. If, for example, a Beaufort force 8 has a fetch less than 10 nautical miles, the SWH will be 7.3 feet, regardless how long the wind blows. It becomes apparent that limiting fetch is a key to limiting wave height. It is also important to note that waves rarely obtain their FDS because of the changing wind direction and speed at any given fixed point from a moving ocean storm system. The 1991 "Halloween Storm" was an exception, as it was essentially stationary for days at a time. Normal time for a wind speed and direction coming from the same direction is 27 hours. However, a change in wind direction does not alter waves already in motion to change their direction. A wave will continue along the same path until it is refracted by shoaling (see below) or perhaps an island.

Continued on Page 19

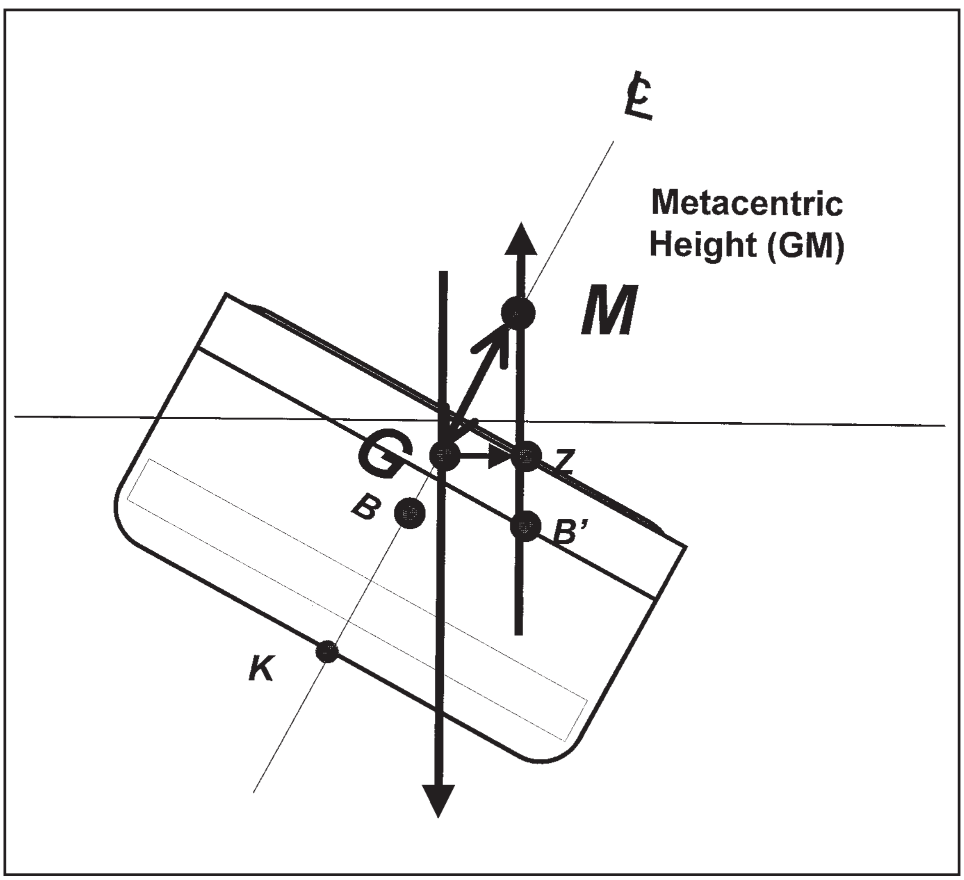


Figure 3. Waves are the limiting factor in ship motion when integrated with physical aspects of ship stability. These are Roll Period (seconds), which is a ship's stability indicator, determined prior to heading out to sea by the formula: P (period) = .44 x B (ships beam)/ (square root of GM). GM being the distance between a vessel's center of gravity (G) and its metacenter (M). Both G and M can be found in a ship's stability book. However, it is important to note that any change in ballasting, cargo shift, or rigging will effect GM, which in turn effects P, and a vessel's overall stability. (Reference: Formulae for the Mariner by Richard Plant)

The Six Degrees of Freedom for Ship Motion

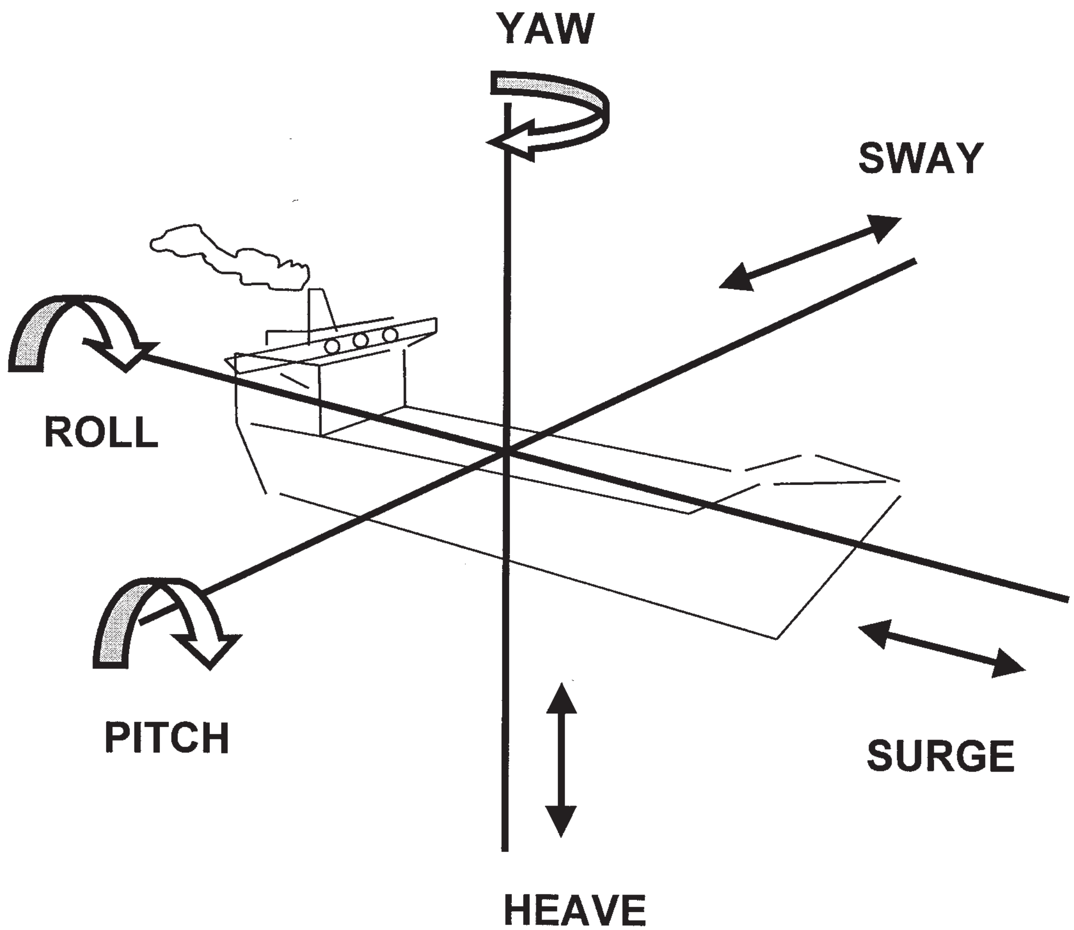
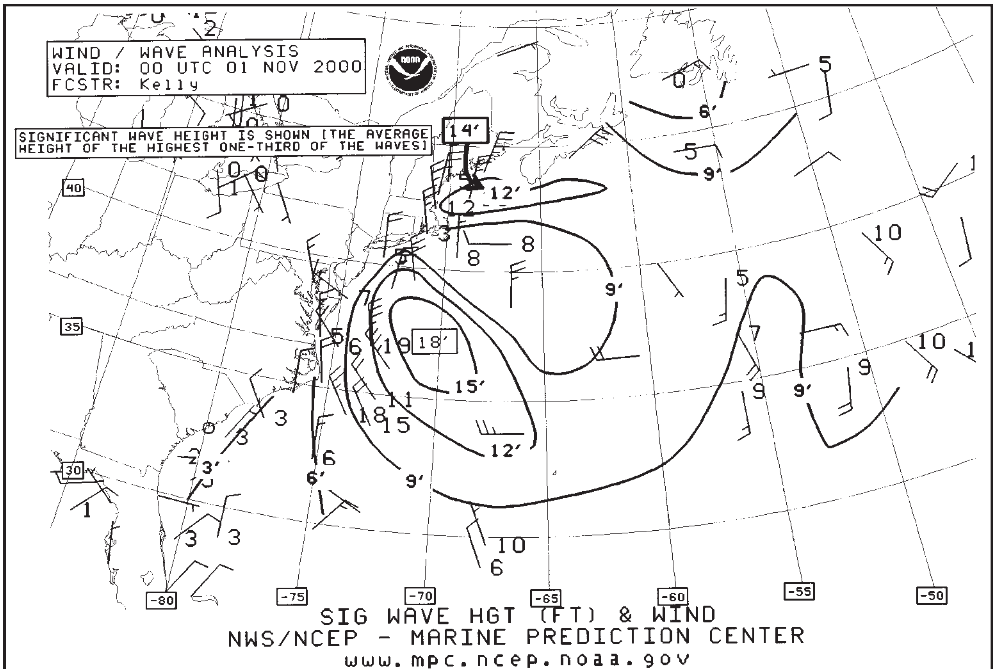


Figure 4. There are six degrees of motion for a vessel as shown. The one motion most critical is roll because it is largely influenced by cargo loading and shifting, as well as Sea State conditions. Excessive rolling will overload fittings and cause containers to be lost overboard and quickly fatigue a crew. A ship's rolling period, measured in seconds, is a direct indicator of stability. When wave period is half of a ship's roll period, synchronous rolling may occur and in rough seas this extreme rolling, in combination with a loss of water plane area and surfing, may lead to excessive vessel motion such as snap rolling or capsizing.



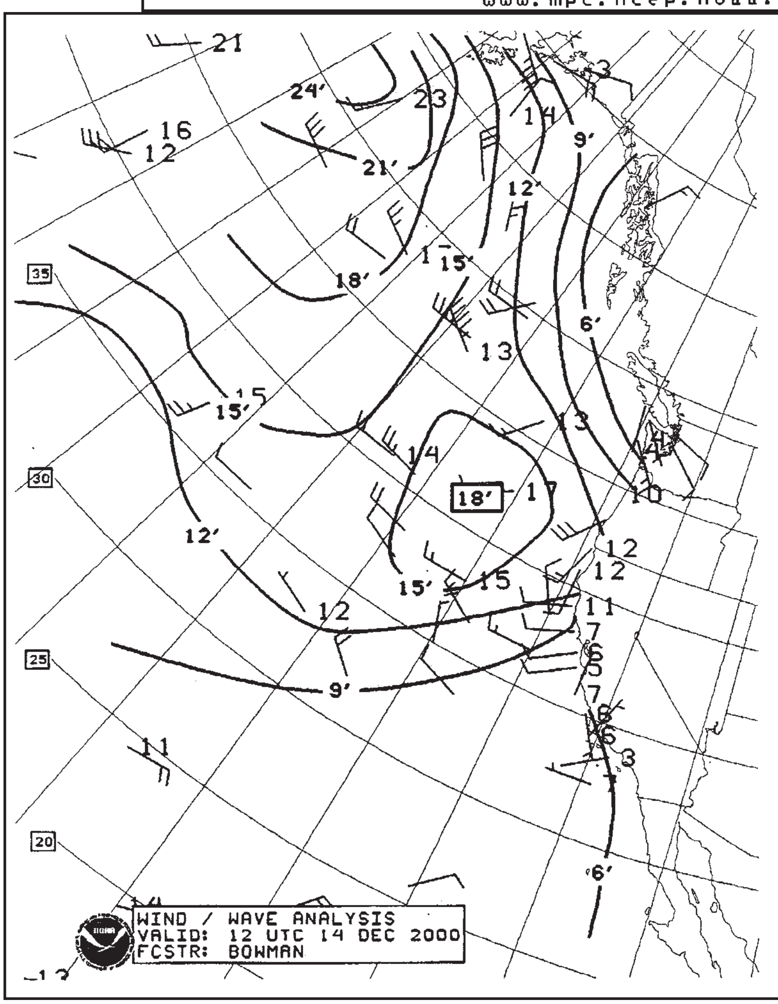
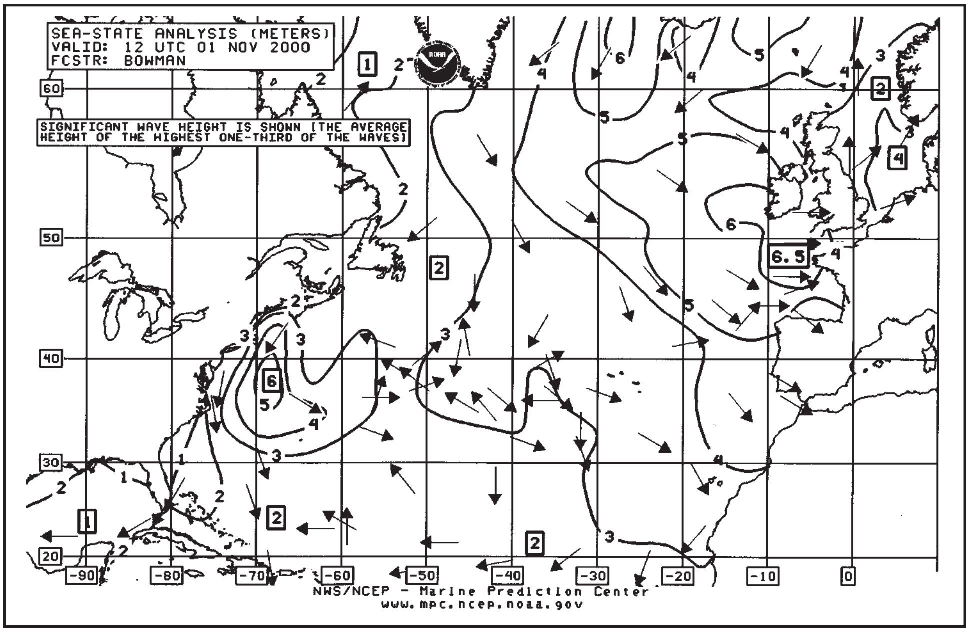


Figure 5. Regional Sea State Analysis - The Regional Seat State Analysis is broadcast on the High Frequency (HF) and Single Side Band (SSB) radio-facsimile program twice a day per ocean at 0315 UTC and 1515 UTC for the Western Atlantic and 1510 UTC and 2149 UTC for the eastern Pacific Oceans. This product is issued every three hours and available for Internet viewing. For example, the top figure is for the 0000 UTC 01 NOV 2000 western Atlantic ([TIF|GIF|B/W GIF] for Internet access) with analysis of ship synoptic reports and automated weather stations such as CMANs or buoys for sea state coded in "feet"and observed wind speed in "knots." The Regional Sea State Analysis analyzes significant wave heights (approximately 1/3 the highest waves present) as solid three feet "isopleth" or significant wave height contour intervals. Relative maximum and minimum significant wave height values are centrally depicted inside the highest "isopleth" or wave height contour.



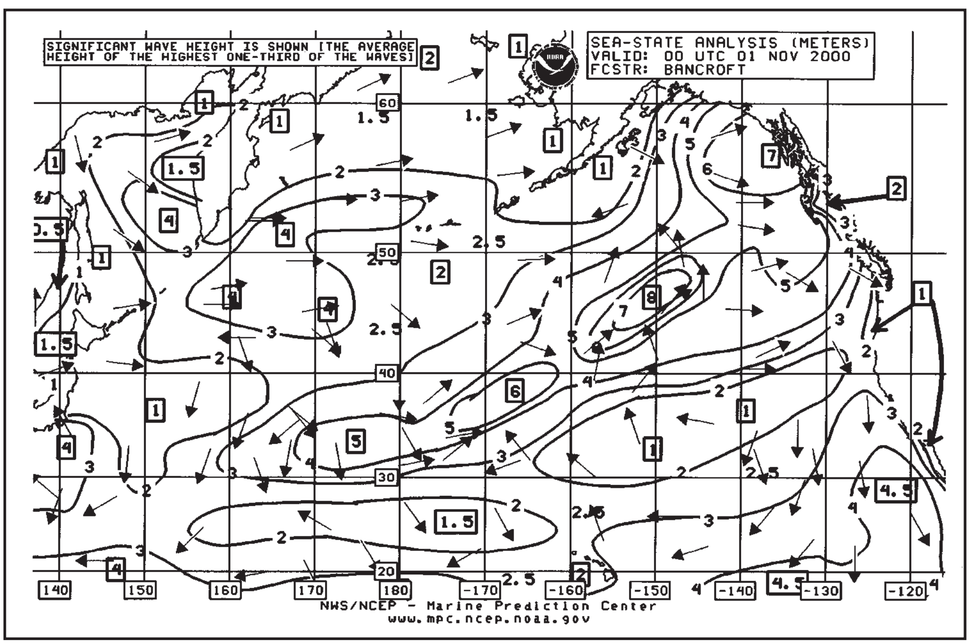
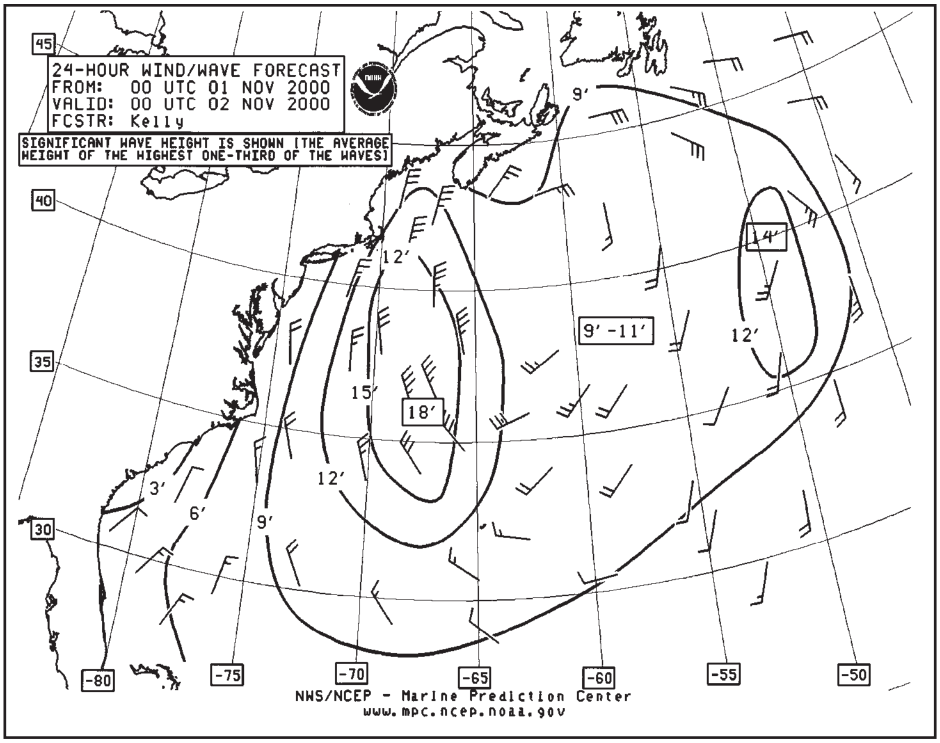


Figure 6 A and B. Sea State Analysis - This product is produced twice a day per ocean at 0310 UTC and 1759 UTC for the North Atlantic, and 0310 UTC and 1500 UTC for the North Pacific Oceans. Transmission is via HF and SSB from the U.S. Coast Guard Communications Stations at Boston, MA and Pt Reyes, CA, respectively (TIF|GIF|B/W GIF for Internet access). These products are full oceanic coverage with analysis of ship synoptic reports and automated weather stations such as CMANs for significant wave height in “meters” (the highest one-third of the waves present). The sea state analysis product depicts solid “one” meter significant wave height “isopleths” or wave height contour intervals of significant wave height. Relative maximum and minimum significant wave height values are centrally depicted and inside or adjacent to the highest “isopleth” or significant wave height contour. Primary swell direction arrows are also depicted as reported from ships participating in the Voluntary Observation Program. When viewed together with the surface analyses, the user should have a complete picture of surface weather conditions in a very timely manner.



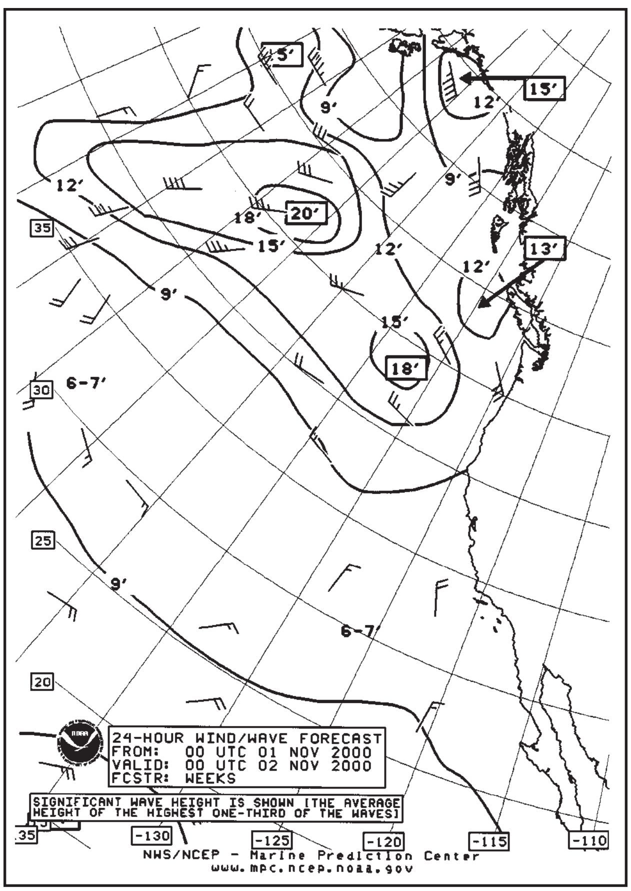


Figure 7 A and B. 24 Hour Wind/Wave Forecast - These Charts are produced twice a day from 0000 UTC and 1200 UTC forecast models for both the Atlantic and Pacific Oceans. The products are broadcast at 0815 UTC and 1915 UTC in the Atlantic and 0818 and 1943 UTC in the Pacific Oceans via HF and SSB from the U.S. Coast Guard Communications Stations at Boston, Massachusetts, and and Pt. Reyes, California, respectively (TIF|GIF|B/W GIF for Internet access). The products depict 24-hour forecasts of wind (increments of 5 knots) superimposed over significant wave heights depicted as "isopleths" of or wave height contours of "3 feet" intervals. Relative maximum and minimum significant wave height values are centrally depicted and inside or adjacent to the highest "isopleth" or significant wave height contour. During appropriate weather conditions, such as "North Wall" episodes occurring along the northern wall of the Gulf Stream in the western Atlantic, substantially higher wind/wave height values are highlighted. Arrows will point to a superimposed hatched area of the Gulf Stream. The "North Wall" event is normally confined to the adjacent areas of the northern edge of the Gulf Stream. Another item that may be highlighted on the forecast is "Swell fronts" which may originate from tropical systems. These "Swell fronts" can be hazardous conditions to marine operations and those in coastal areas. A scalloped line is used to depict the front and is labeled appropriately such as "SWELL FRONT FROM HURRICANE "DEBBY." Arrows will be from the text to the leading edge of the "Swell front." Additionally, depiction of superstructure icing, displayed by a half moon with one or two lines crossing through the center, will depend on the forecast for light or heavy accumulation.

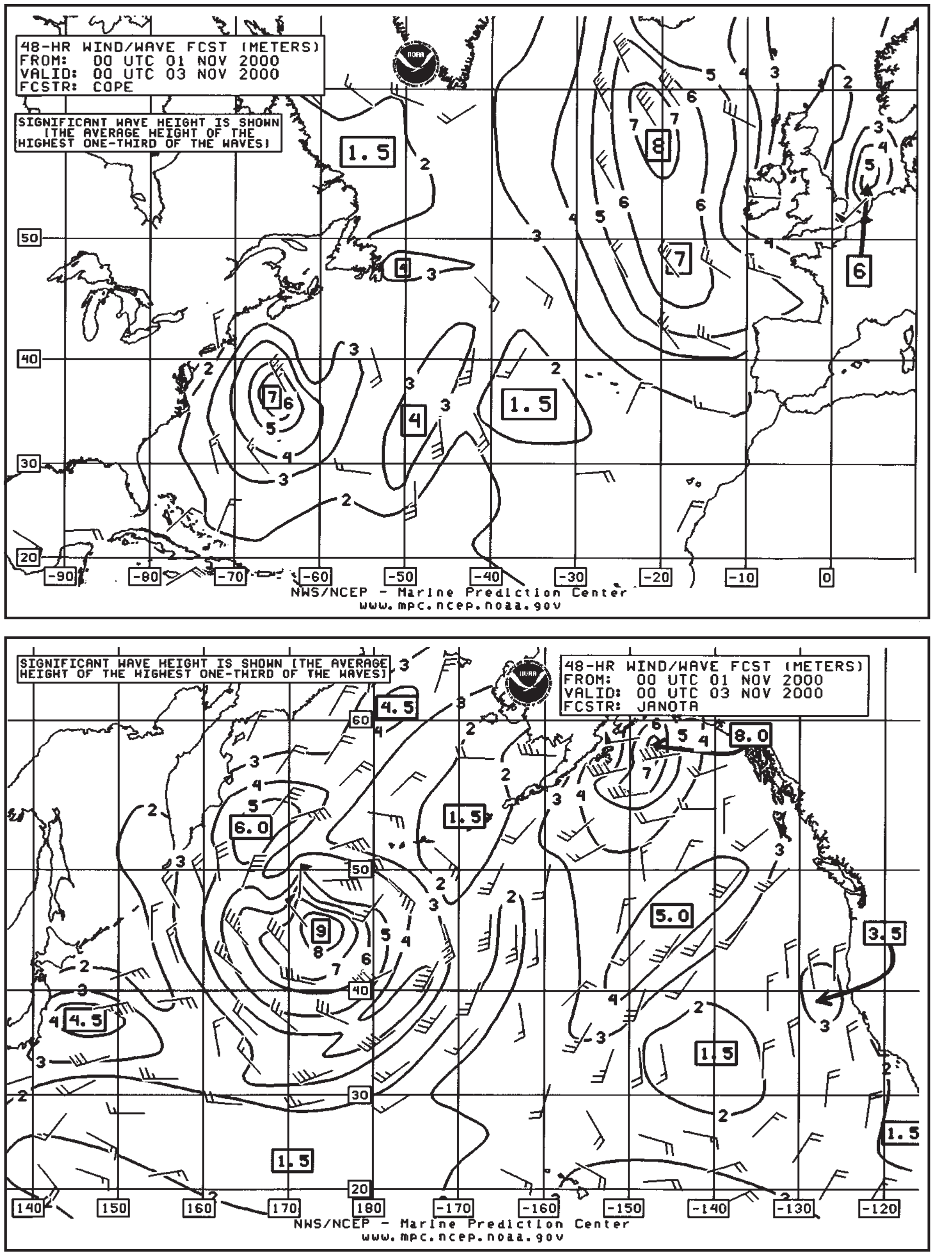
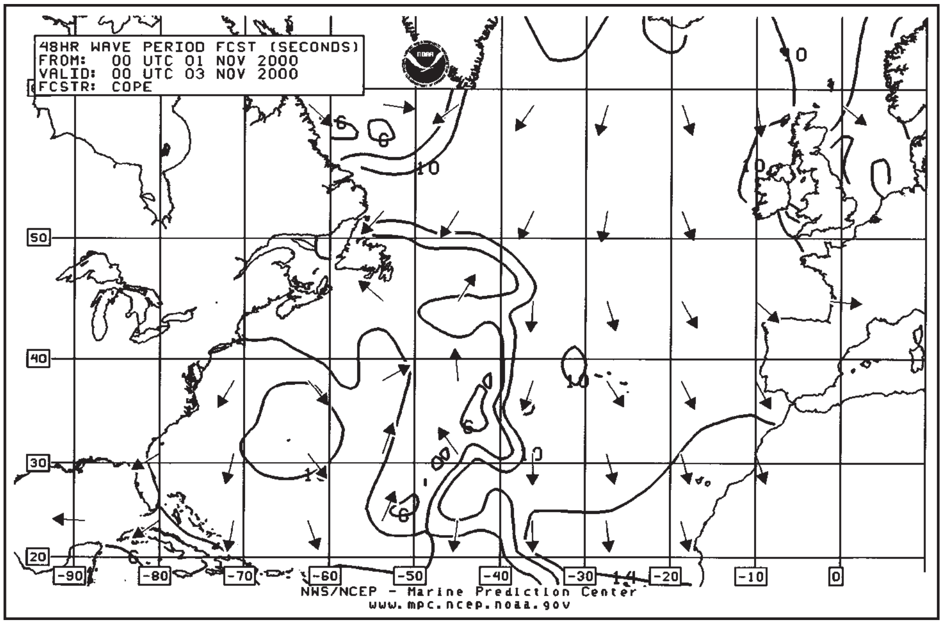


Figure 8 A and B. 48 Hour Wind/Wave Forecasts - These forecast products are generated twice daily for both the Atlantic and Pacific Oceans. The forecasts are valid at 0000 UTC and 1200 UTC for each respective forecast cycle. They are transmitted at 0905 UTC and 2005 UTC for the Atlantic and 0848 UTC and 2013 UTC for the Pacific Oceans from the U.S. Coast Guard Communications Stations at Boston, Massachusets, and Pt. Reyes, California, respectively (TIF|GIF|B/W GIF for Internet access). The products are based on the significant wave height forecast model runs from NCEP (WaveWATCH 111) and the U.S. Navy. The significant wave heights (the highest one-third of the highest waves present) are forecast cycle. The wave heights are depicted in "isopleths" or solid contours of one meter increments with relative maximum or minimum significant sea state values enclosed inside under or adjacent to the highest wave height contour. Also, the ice edge is displayed as a bold jagged line during the winter months. These products will provide a complete picture of forecast surface conditions when used in conjunction with the 48-hour surface forecasts. The 48-hour wind/wave forecasts highlight where the most significant combined sea heights prevail. Also, forecast wind speeds in five-knot increments are plotted on this chart.



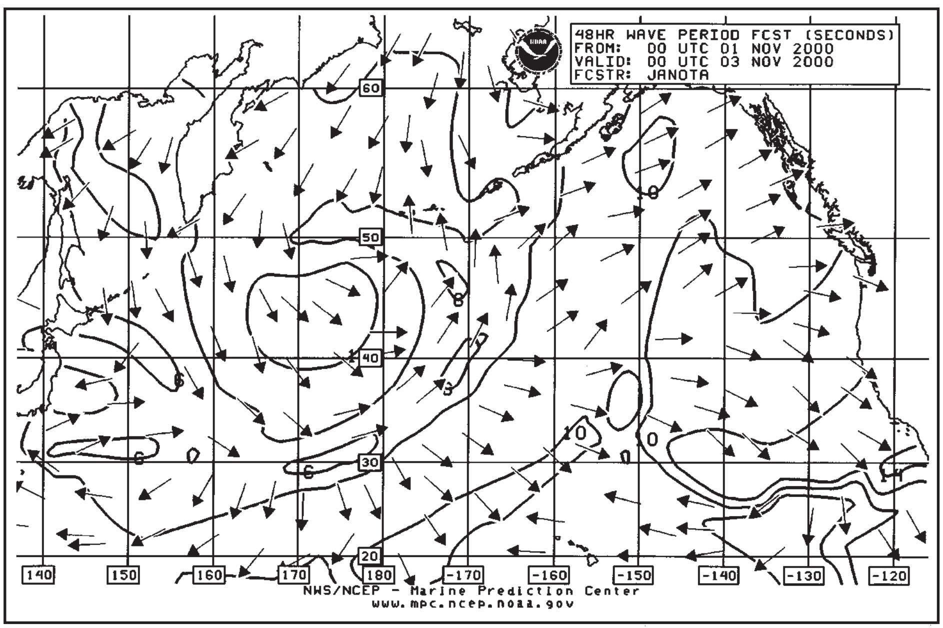
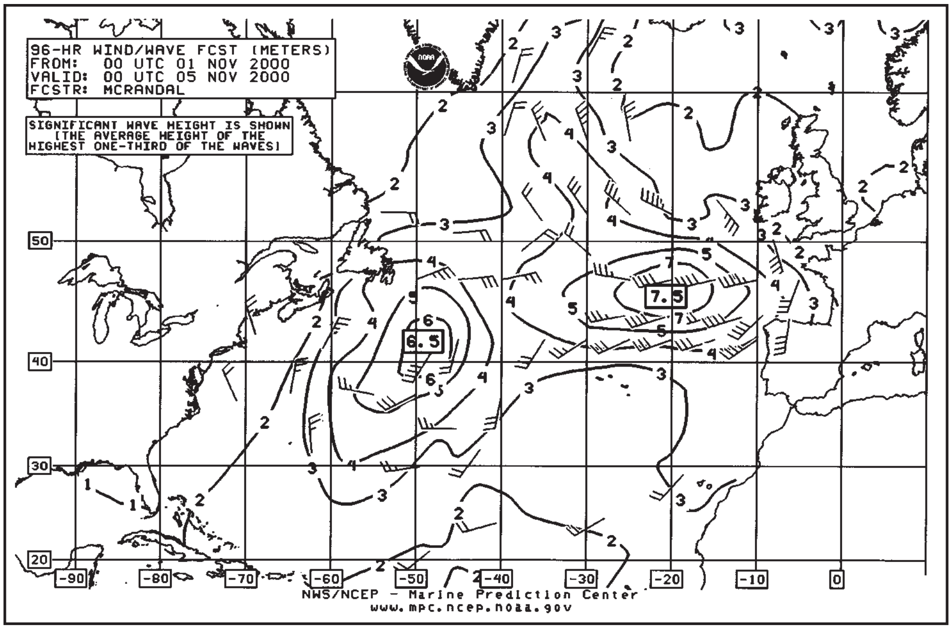


Figure 9 A and B. 48 Hour Wave Period Forecasts - These are computer-generated products and are issued twice a day from the 0000 UTC and 1200 UTC WaveWATCH 111 model forecast for both the Atlantic and Pacific Oceans. These products are transmitted at 0915 UTC and 2015 UTC in the Atlantic and 0848 UTC and 2023 UTC in the Pacific Oceans respectively via HF and SSB broadcasts (TIF|GIF|B/W GIF for Internet access). The 48-hour Wave Period and Direction (Peak Period and Direction) Forecasts are manually edited, and represent "peak period" from either locally generated "wind wave" (" sea," in cases with strong local winds) or the dominant wave system ("swell") that are generated elsewhere as a "wind wave." Note that the peak period field shows discontinuities. These discontinuities can loosely be interpreted as swell fronts, although in reality many swell systems overlap at most locations and times. A swell front is the leading edge of wave periods with higher energy that typically originates and moves away from a storm center. Arrows on the 48 Hour Wave Period Forecast chart point toward the prevailing or dominate swell direction. Swell fronts that can also originate from individual wave trains that can converge along a narrow band of differing periods. The wave trains themselves travel at different speeds and thus can converge from different directions.



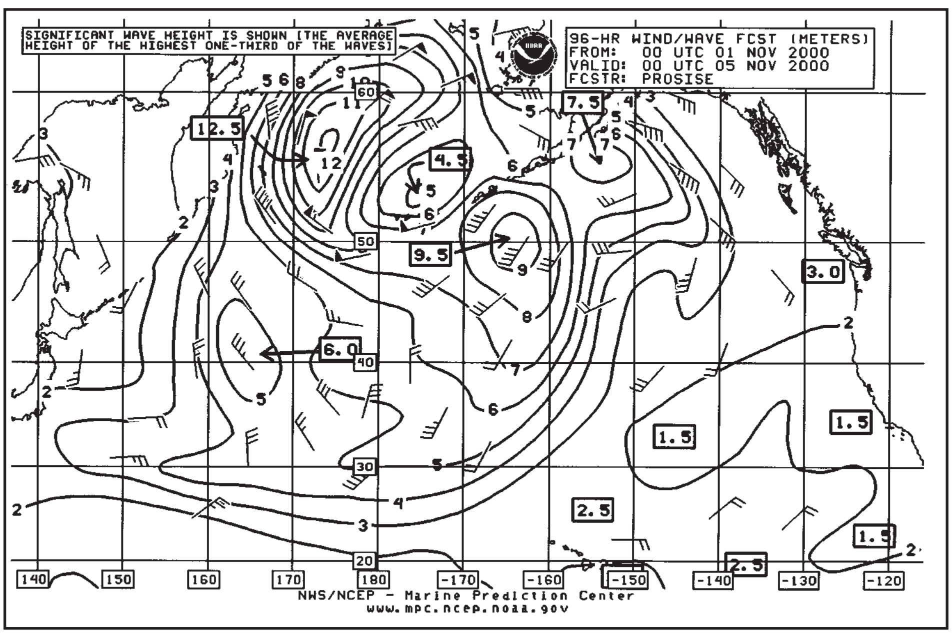


Figure 10 A and B. 96 Hour Wind/Wave Forecasts - These forecast products are generated once daily for both the Atlantic and Pacific Oceans. They are transmitted at 2055 UTC for the Atlantic and 2053 UTC for the Pacific Oceans from the U.S. Coast Guard Communications Stations at Boston, Massachusetts, and Pt. Reyes, California, respectively (TIF|GIF|B/W GIF for Internet access). The products are based on the significant wave height forecast model runs from NCEP (WaveWATCH 111) and the U.S. Navy. The “isolpleths” or wave height contours of significant wave (the average one-third of the highest waves present) are depicted in solid contours of one-meter increments with relative maximum or minimum sea state values enclosed inside or adjacent to the area of interest. Forecast wind speed in five-knot increments of 25 knots or more are superimposed on the significant wave height “isopleths” or wave height contours on this chart. Also, the ice edge is displayed as a bold jagged line during the winter months. These products will provide a complete picture of forecast surface conditions when used in conjunction with the 96-hour surface forecasts. The 96-hour wind/wave forecasts highlight where the most significant sea state heights prevail.

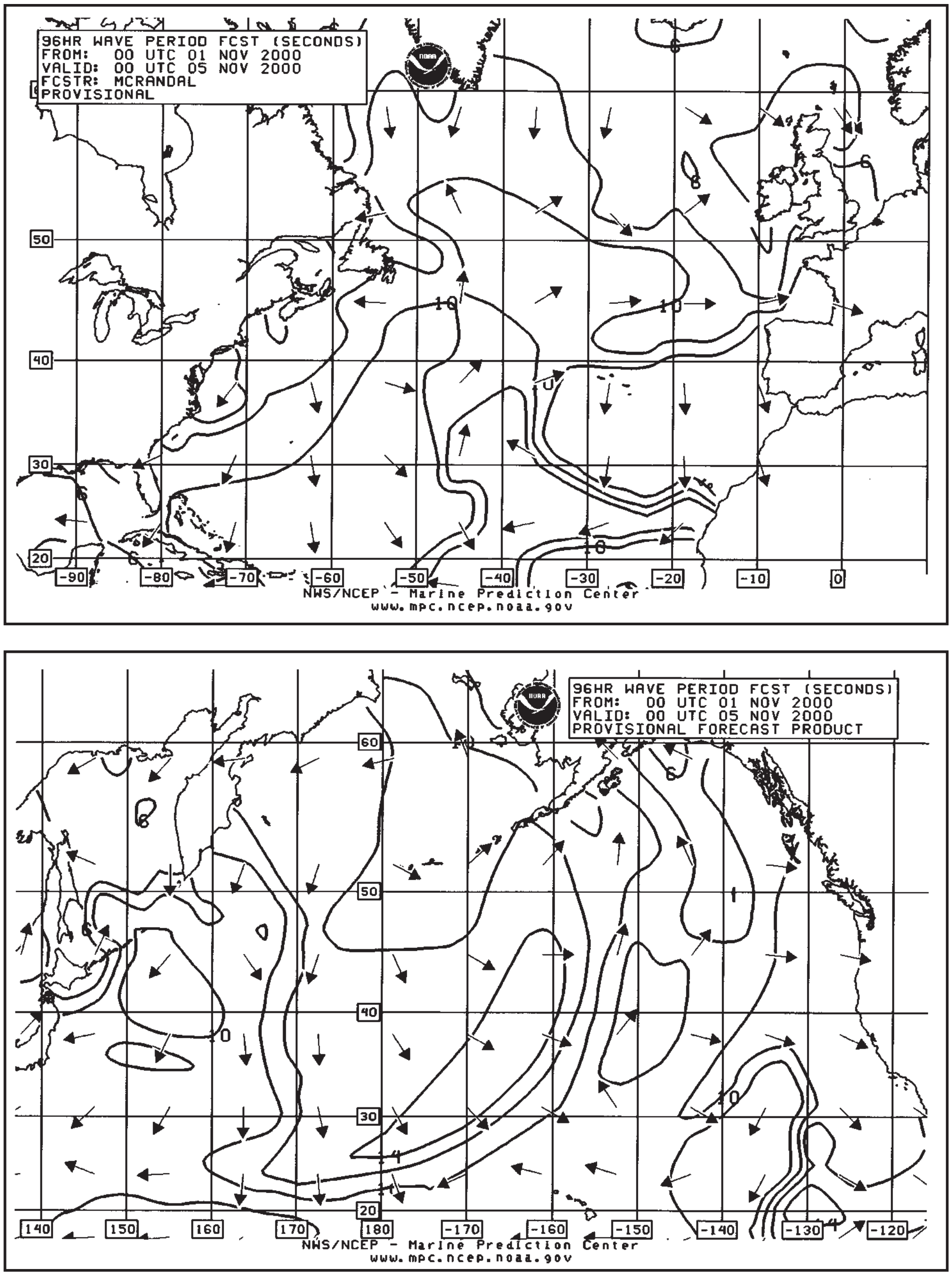


Figure 11 A and B. 96 Hour Wave Period Forecasts - These peak period and direction products are produced directly from the same computer output as the 48 Hour Wave Period Forecasts with no manual editing. The 96-hour products are experimental products. As of 20 December 2000 this 96-hour product will be produced operationally from the 1200 UTC NCEP (WaveWATCH 111) forecast model for both the Atlantic and Pacific Oceans. These forecast products are generated once daily for both the Atlantic and Pacific Oceans. They are transmitted at 2105 UTC for the Atlantic and 2103 UTC for the Pacific Oceans from the U.S. Coast Guard Communications Stations at Boston, Massachusetts and Pt. Reyes, California, respectively (TIF|GIF|B/W GIF for Internet access).

Waves and the Mariner

Continued from Page 10

When waves enter shallow water, which is defined as a depth less than one-half of a wave's length, movement is slowed by contact with the bottom, thus increasing its height. This is called shoaling, and when a wave is slowed it becomes unstable and breaks. The normal ratio is 5/3 for waves to break (three feet of seas in five feet of water). A continual line of breakers is called surf. Ocean waves will often pass over a shoal and increase dramatically in size without breaking. These are called ground swells and often occur after the passage of large storms. If waves encounter an island, then its refractive effects can lead to confused, steep, and breaking waves on its lee side. It is believed that the tall ship **Fantome** experienced such waves in the lee of Roaton Island, off the coast of Honduras, while trying to shelter from Mitch. It is important also to note that a ship's stability and motion and response issues factor very much for safety and performance decision making (Figures 3 and 4).

MPC produces Wind and Wave Analyses and Forecasts charts available via radio facsimile High Frequency (HF) or Single Side Band (SSB) radio broadcasts from the U.S Coast Guard, Boston Massachusetts, and Point Reyes, California, as well as the website: (http://www.mpc.ncep.noaa.gov). The wave heights depicted by the MPC are SWH (Figures 5 A/B, 6 A/B, 7 A/B, 8 A/B, and 10 A/B). These are the core products available for mariners. However, in open water it is important to remember that waves and swells travel in Great Circle paths (following the earth's curvature, not straight lines or Rhumblines). Thus waves or swells will arrive at angles that are as much as 30 degrees from a direct Rhumbline from it origins. Hurricane waves are difficult to forecast because their initiating wind fields are often not well known and they frequently have a changing fetch and direction of movement (Steve Lyons, Wave Relationship Notes: Western Region National Weather Service Workshop, Naval Postgraduate School, Monterey CA, May 2000). Thus, a mariner should realize that the direction of swells arriving at his location does not mean the direction to the storm that caused them. Wave systems often travel in wave trains or groups, which travel at half the speed of their individual waves. This is because leading waves tend to slow as they propagate out from their origins, thus allowing wave trains behind them to catch up and absorb their energy. The MPC Peak Wave Period and Direction charts (Figures 9 A/B and 11 A/B) will sometimes depict "wave front" regions. This is significant because the potential for waves in the one-tenth of the highest Waves or Extreme Waves range could possibly occur. This would not be depicted on the MPC Wind and Wave Forecast Charts (Figures 8 A/B and 10 A/B) for the same period, as it would show SWH only.

There is also a website for National Data Buoy Center Marine Observations (http://www.ndbc.noaa.gov) which can provide real time buoy information via a telephone service called Dial-A-Buoy (1-228-688-1948). Data taken within the last hour is available for some 119 moored and Coastal-Marine Automated Network (C-MAN) buoys and stations inside and nearby offshore and territorial waters of U.S. Buoys provide SWH. Period information for each buoy is also available. Using SWH and period, it is possible to determine wavelength, velocity (or speed), average wave height, the highest 10 percent, and the highest or extreme waves. Buoy reports provide additional information such as swell height, swell period, wind wave height, wind wave period, wave steepness, and average period. Steep and very steep waves have the potential of damaging or capsizing vessels. Important safety decisions can be made using this real-time accurate information. Mariners who have an interest in further improving their skills in wave height analysis and forecasting and integrating their safety decision-making are invited to inquire about the Heavy Weather Avoidance course at MITAGS with Michael Carr at 443-989-3254 or mcarr@mitags.org.⚓

Olympia: Symbol of an Age

Paul DeOrsay
Vice-President of Operations
Independence Seaport Museum
Philadelphia, Pennsylvania

Olympia epitomizes the emergence of the United States and its Navy as a significant global force, at the dawn of the "American Century." Like the Statue of Liberty, she is an icon of this nation's history and present strength.

Launched in November 5, 1892, the Cruiser **Olympia** was one of the nation's first steel warships. **Olympia** played a pivotal role in many crucial world events, but she is perhaps best remembered for her role in the Battle of Manila Bay. It was onboard **Olympia** that Commodore Dewey gave the famous order, "You may fire when you are ready, Gridley."

Olympia's active career came to a close in 1921 when she sailed to France and brought the body of the Unknown Soldier home to its final resting place at Arlington National Cemetery. **Olympia** is the only vessel remaining from the Spanish-American War and the nation's "New Navy" of the 1880s and 1890s.

More than a century later, **Olympia** remains in its original 1890s condition. The careful and responsible preservation of this uniquely important piece of history is a noble and worthwhile goal; the Independence Seaport Museum considers it a privilege to have been entrusted with the preservation of **Olympia**.

Olympia lay at the Philadelphia Naval Shipyard from 1923 until 1958, when a group of Philadelphians created the Cruiser Olympia Association to turn the ship into a museum and memorial, available to the visiting public. By 1995, the Association was experiencing financial difficulties and asked the Independence Seaport Museum to assume responsibility for the continued preservation of the ship.

Independence Seaport Museum (formerly Philadelphia Maritime Museum) had just completed a $15 million capital campaign, culminating in its major expansion and move to the banks of the Delaware River. In 1996, the Museum assumed responsibility for **Olympia** and **Becuna**, a World War II vintage submarine. The Museum, a private, non-profit corporation, receives no financial support for the ships from the Navy or any other branch of government.

Initial assessment showed **Olympia** to be amazingly complete and authentic in many ways, but also seriously deteriorated in critical areas. An additional problem presented itself in the form of numerous "restorations" carried out over the years without adequate documentation or research. The Museum has found it necessary to examine all aspects of the

Continued on Page 21

Olympia

Continued from Page 20

ship carefully to differentiate between authentic historic fabric and sometimes fanciful reconstruction. Toward this end, a comprehensive Historic Structure Report was completed in 1999. Further, more detailed surveys of structure, fittings, furnishings, plans, photographs, and artifacts are ongoing.

The Museum's highest priority to date has been the protection of the ship: prevention of fire and flooding, new electrical and alarm systems, mooring improvements, stopping deck leaks, visitor safety measures, and the like. Artifacts have been removed from the ship to the Museum for protection and cataloging. Spaces have been cleaned and painted, and clearly alien elements (such as plywood partitions) removed. An interim interpretive program has been installed aboard, consistent with the philosophy "let the ship be the ship;" i.e., the visitor experience should be of the ship herself, not exhibitry or artifacts which were not aboard during her active career. She is again attracting and hosting visitors at the rate of nearly 100,000 per year.

Olympia needs significant repairs. Her hull plates are dangerously thin in places (she was last drydocked in 1946.) Her wood decks are completely deteriorated, and must be replaced. Her deck structures and rig are wasted, and must at the least be strengthened in order to survive. Her boilers

Admiral Dewey's 1892 cruiser *Olympia*, the sole survivor of the Spanish American War fleets and of the "New Navy" of the 1880s and 1890s. Photo courtesy of Paul DeOrsay.

and fire rooms are in very bad shape and their preservation will be problematic and expensive. The Museum is now developing estimates and defining the scope of these projects, so that the search for funding can begin.

Once the critical preservation of structure has been completed, work will proceed on the interior spaces. It is here that **Olympia** truly shines; extraordinary amounts of original equipment and fittings remain intact. It is the ultimate goal of the Museum to preserve and repair the ship so that she can truly be presented as **Olympia**, the cruiser of 1895; not a reconstruction or restoration. Current, incomplete estimates indicate that the full preservation and repair process will cost in excess of $20 million and take nearly a decade to complete. Happily, the Independence Seaport Museum is sincerely committed to this project and fully capable of achieving these ambitious goals.

For more information on **Olympia** contact:

Independence Seaport Museum
211 S. Columbus Blvd.
Philadelphia, PA 19106

Tel: 215-925-5439

www.Libertynet.org/seaport
(Museum website.)

www.spanam.simplenet.com
(Website with virtual tour of **Olympia.**)⚓

Idaho Was the Worst Loss of 1897

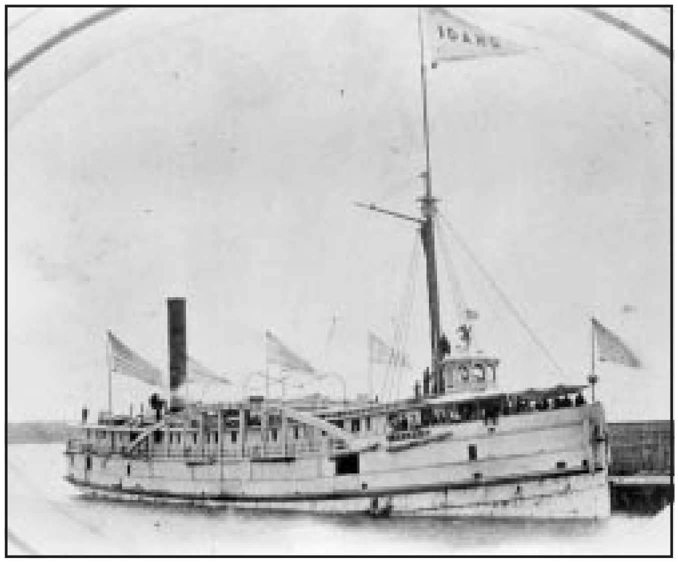
Skip Gillham
Vineland, Ontario, Canada

In hindsight, the wooden steamer **Idaho** had no business being out on Lake Erie during a fall storm. It was old and had only recently been reactivated and should have been in a sheltered location.

The ship had been built at Cleveland in 1863 and operated for many years in the package freight trade for the Western Transit Company, a subsidiary of the New York Central and Hudson Railroad. It is shown earlier in its career in a photo from the collection of the Milwaukee Public Library.

Idaho had survived many previous storms and a grounding near the Portage Ship Canal on June 8, 1891. A lack of business left her tied up at Buffalo in 1893 and the hull was reconditioned in 1897 to serve as a floating hotel for an area convention.

Due to the upgrading, **Idaho** sailed later in the year and on November 5, 1897, departed Buffalo on what proved to be the final voyage. On board was a crew of 21 sailors and about $100,000 worth of freight for Milwaukee.



Winds of close to 60 miles per hour whipped up 25 foot waves, but the Captain pushed the old carrier past the shelter of Long Point Bay and down the lake.

Some twelve miles past the last refuge, the ship began to leak and the pumps were activated. This was only a short-term solution and, when they cut out, a bucket brigade had to keep the rising water in check. This was not the answer.

The Captain tried to turn back but was caught in the vicious trough of the seas and this put great stress on the hull, opening the seams. The anchors failed to hold the doomed laker and it drifted ashore, eventually sinking stern first.

Most of the crew abandoned ship or were washed overboard. Two elected to climb to the safety of the Crow's Nest and when the hull settled on the bottom, they remained above water. A superb display of seamanship by the crew of the passing steamer **Mariposa** plucked the two tired sailors from their perch the next afternoon. All others were lost in what proved to be the worst Great Lakes tragedy of 1897.

Skip Gillham is the author of 22 books, most related to Great Lakes ships and shipping.⚓

We Routinely Observe the Tropical Pacific

To Forecast El Niño/La Niña and Their Influence on Climate

Dr. W. Stanley Wilson
Deputy Chief Scientist, NOAA
Danica Starks
Office of the Chief Scientist, NOAA

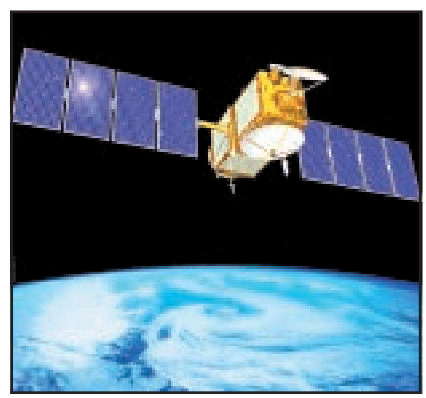
Argo is the name being used for a proposed program which will depoloy a global array of 3,000 profiling floats to observe the ocean's upper layer. The name Argo stresses the close connection between observations from the floats and the Jason-1 satellite. Jason was a mythological Greek hero and Argo his ship. Together, the modern Argo and Jason will improve the scientific basis for climate observation and forecasting.

Forecasting the strength and duration of El Niño and La Niña requires advance knowledge of conditions in the Tropical Pacific, particularly sea surface temperatures. Since changes in sea surface temperature depend not only on surface atmospheric conditions (such as the wind field), but also on the ocean's subsurface characteristics (such as currents, temperature, and salinity), it is necessary to have advance knowledge of those oceanic variables. The ENSO Observing System, illustrated in the chart on the next page, collects such data.

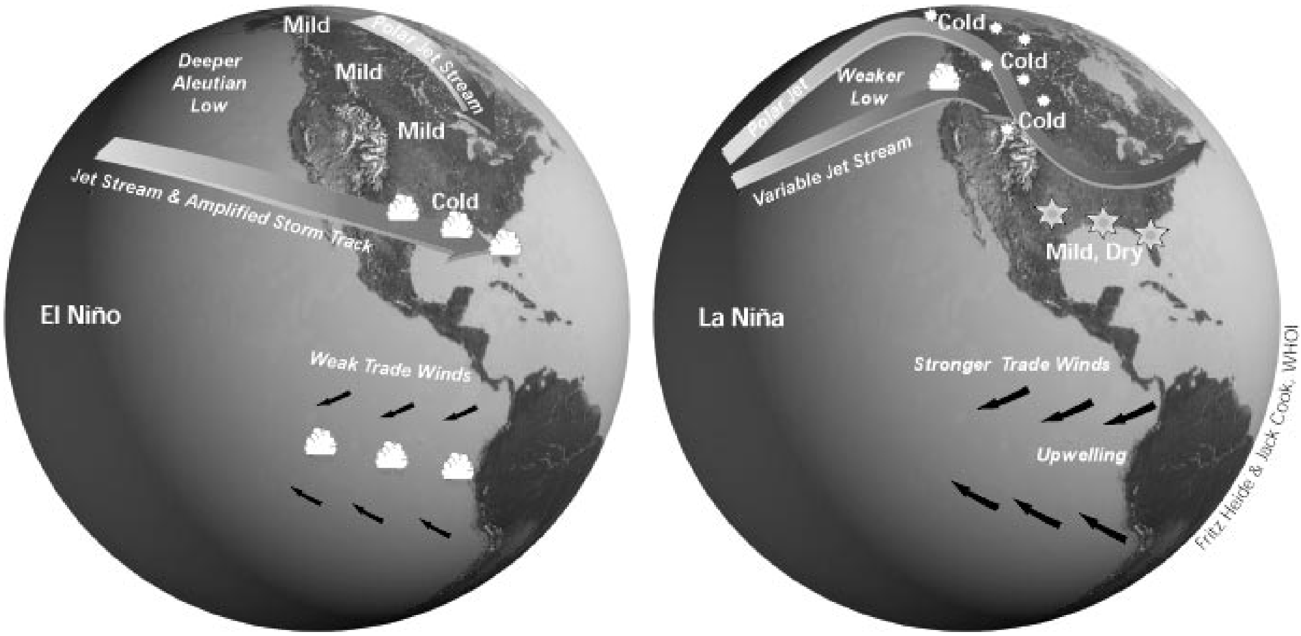
Collated and fed into computer models of the ocean, these data enabled NOAA's Climate Prediction Center to forecast the temperature of the sea surface in the Eastern Pacific half a year ahead. These predicted surface temperatures were key to the Center's corresponding forecasts of extreme weather conditions associated with the 1997/98 El Niño event. While El Niño caused losses of $15 billion in the U.S., the advance warning helped to save an estimated $1 billion in California alone.

The U.S. is not alone in experiencing such extreme weather. El Niño's effects in 1997/98 ranged from violent hurricanes off Mexico's West Coast to crop-destroying rains in East Africa and widespread fires in Indonesia. Worldwide, more than $30 billion in damage occurred during the 1997/98 event. Thus, a reliable means of predicting El Niños and La Niñas has global implications.

A global monitoring network that includes Argo will enable scientists not only to extend their El Niño/La Niña forecasts, but also to predict the effects of other phenomena. This will improve the overall accuracy of climate forecasts, and thus will contribute to the economic well-being of the world.⚓



Jason 1, an altimetric satellite scheduled for launch in 2000, will measure global sea level, continuing the observations begun by TOPEX/ Poseidon in 1992. These data will complement measurements collected by the ENSO Observing System. Both are joint NASA/CNES missions.



El Niño, La Niña, and American winters. A typical El Niño involves a weakening of the Trade Winds and warming of the waters of the eastern Tropical Pacific with associated heavy rainfall. There is a more intense Aleutian Low, and the Pacific Jet Stream directs storms toward Southern California, bringing wetter, colder than normal conditions to the southern tier of the states. The region from the Great Lakes to Alaska experiences a milder winter than usual. La Niña, on the other hand, involves stronger Trade Winds, cooler waters in the eastern Tropical Pacific, and a weakened Aleutian Low. The Jet Stream crosses into the U.S. farther north, bringing wetter than normal weather to the Pacific Northwest. The region from the prairie states to Alaska experiences colder weather, while the southern tier states are warmer and drier than usual.

The ENSO Observing System collects observations of the atmosphere, the sea surface, and the upper ocean to help forecast short-term climate changes associated with El Niño and La Niña. It consists of moored buoys, coastal sea level stations, surface drifting buoys, and expendable bathythermographs deployed along the routes take by volunteer observing ships.

Marine Effects of the Memorial Day 2000 Storm in Virginia and the Northern Outer Banks of North Carolina

Neil A. Stuart
Meteorologist
NOAA/National Weather Service
Wakefield, Virginia

An unexpectedly intense storm affected the Virginia and North Carolina coasts on 29-30 May 2000. Upper-level energy dropped southeast from the Ohio Valley on 28 May, tracking offshore Virginia and North Carolina on 29 May. As the upper-level and surface system tracked southeast, offshore Virginia and North Carolina, the surface low pressure deepened rapidly. The rapid cyclogenesis was not forecast by computer models or area National Weather Service Forecast Offices until the evolution became apparent during the morning of 29 May, when the deepening of the surface low pressure was already occurring, and the winds were rapidly increasing.

This storm was very unusual because it rapidly strengthened while tracking southeast, through Virginia and the southern Chesapeake Bay, not northeast along the Gulf Stream, which is more typical of strong nor'easters. At 1215 UTC 28 May, water vapor satellite imagery showed the center of the upper-level energy in the Midwest U.S. (Figure 1). By 1815 UTC 28 May, visible imagery showed a comma-shaped cloud mass, associated with the upper-level energy, had tracked east to the Ohio Valley (Figure 2). Water vapor imagery indicated the upper-level energy crossed the Appalachians by 1215 UTC 29 May (Figure 3), tracked southeast and was centered over eastern Virginia and North Carolina by 1815 UTC 29 May (Figure 4). Visible Imagery showed a well-developed comma-shaped system at 1815 UTC 29 May just offshore Duck, North Carolina (Figure 5). By 1215 UTC 30 May, the storm was well east of Cape Hatteras, North Carolina, seen in water vapor imagery (Figure 6).

The storm produced a wide range of effects along the coast of Virginia and northern Outer Banks of North Carolina, including tidal flooding, high seas, and storm-force winds, gusting to near hurricane force. Two fatalities were attributed to the storm, both in the James River. A 17-foot fishing boat capsized east of Hopewell, resulting in one drowning and one injury. A 16-foot fishing boat off Isle of Wight County capsized, resulting in one

Continued on Page 32

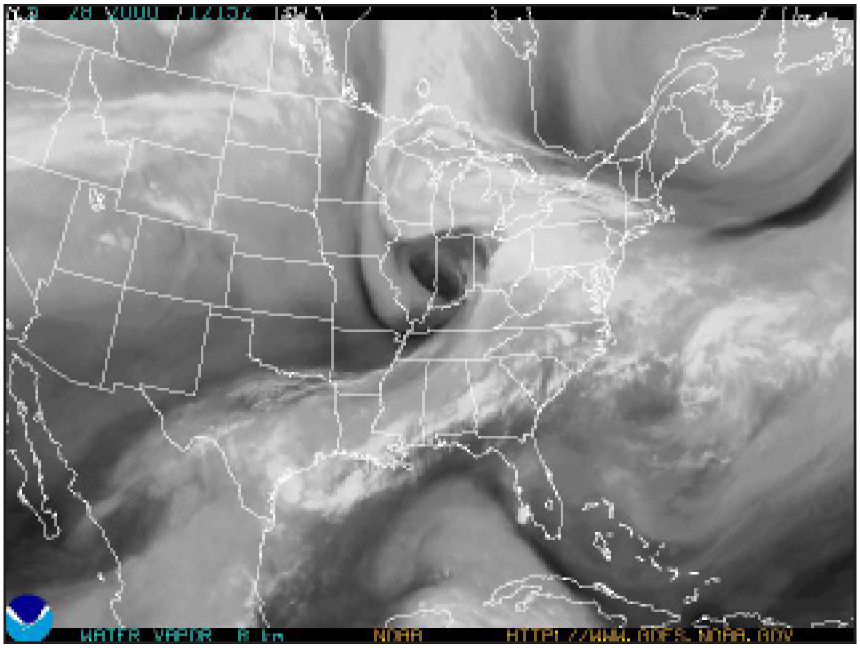


Figure 1. 28 May 2000 1215 UTC water vapor.

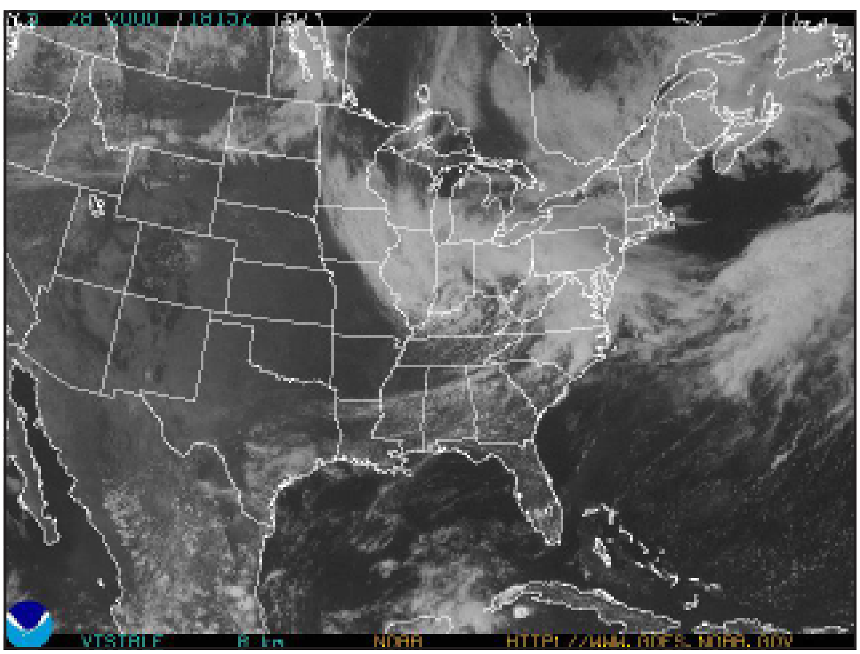


Figure 2. 28 May 2000 1815 UTC visible.

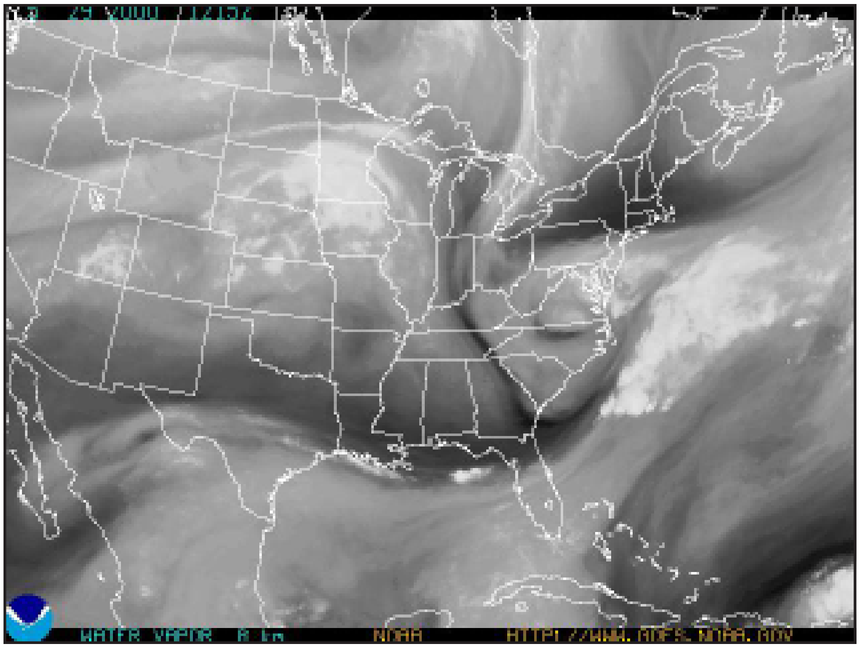


Figure 3. 29 May 2000 1215 UTC water vapor.

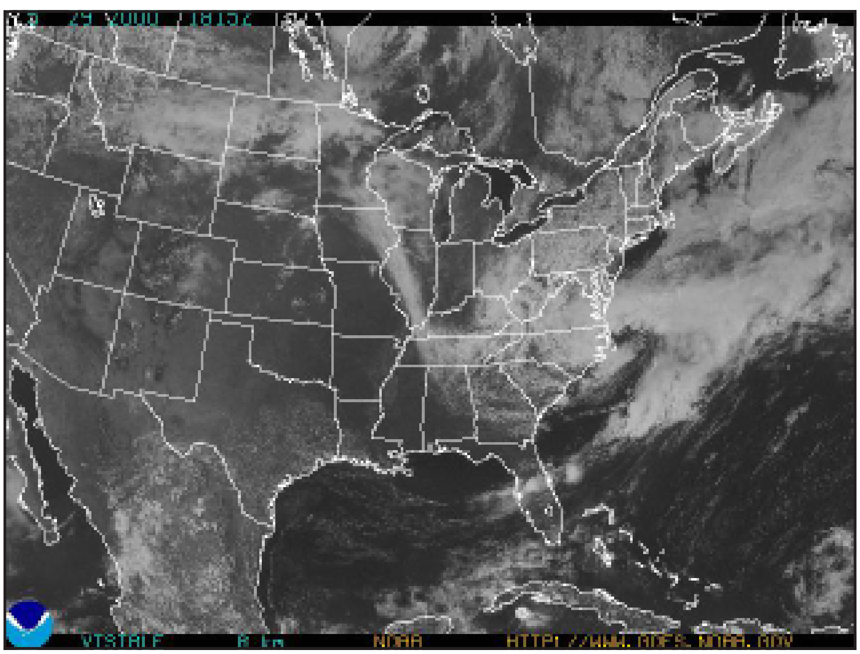


Figure 4. 29 May 2000 1815 UTC water vapor.

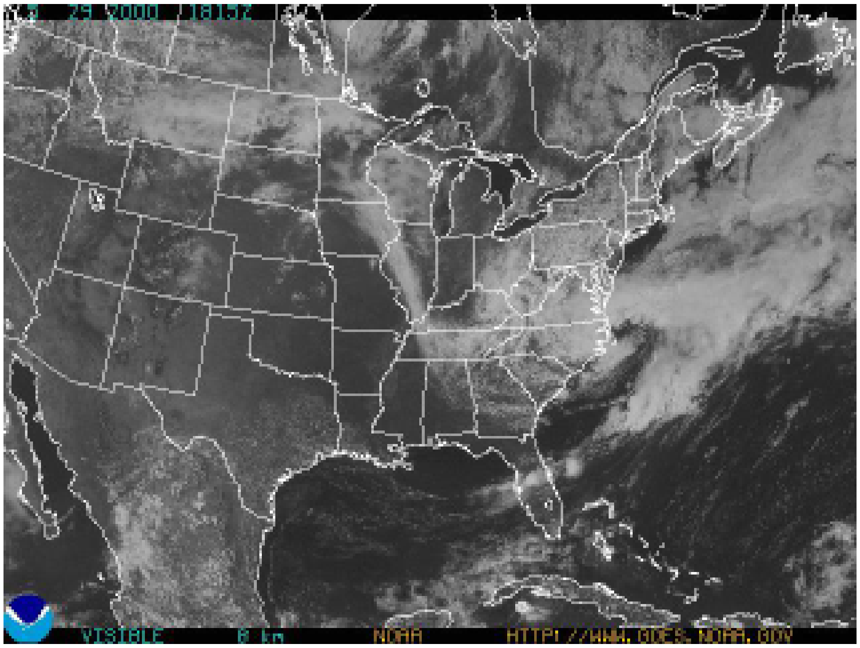


Figure 5. 29 May 2000 1815 UTC visible.

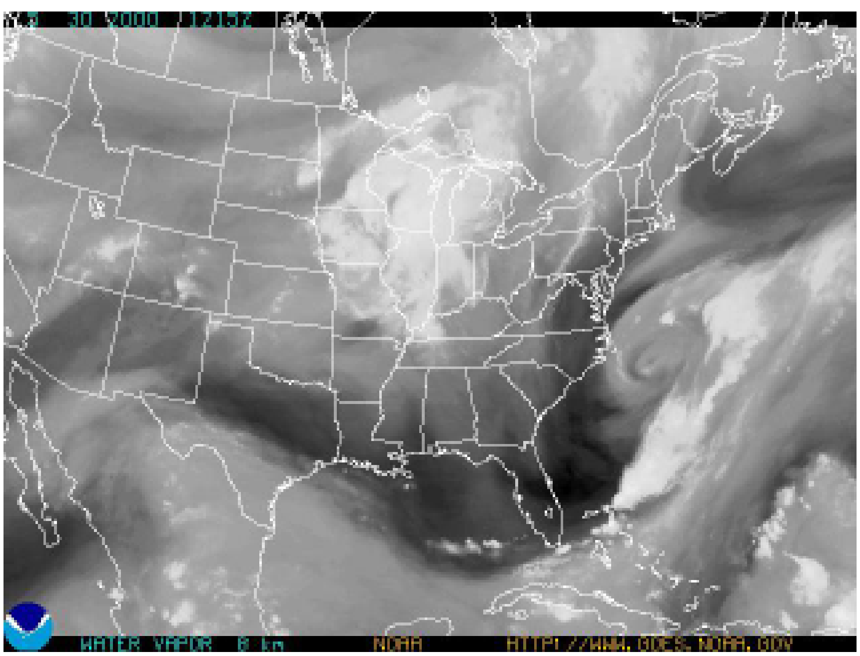


Figure 6. 30 May 2000 1215 UTC water vapor.

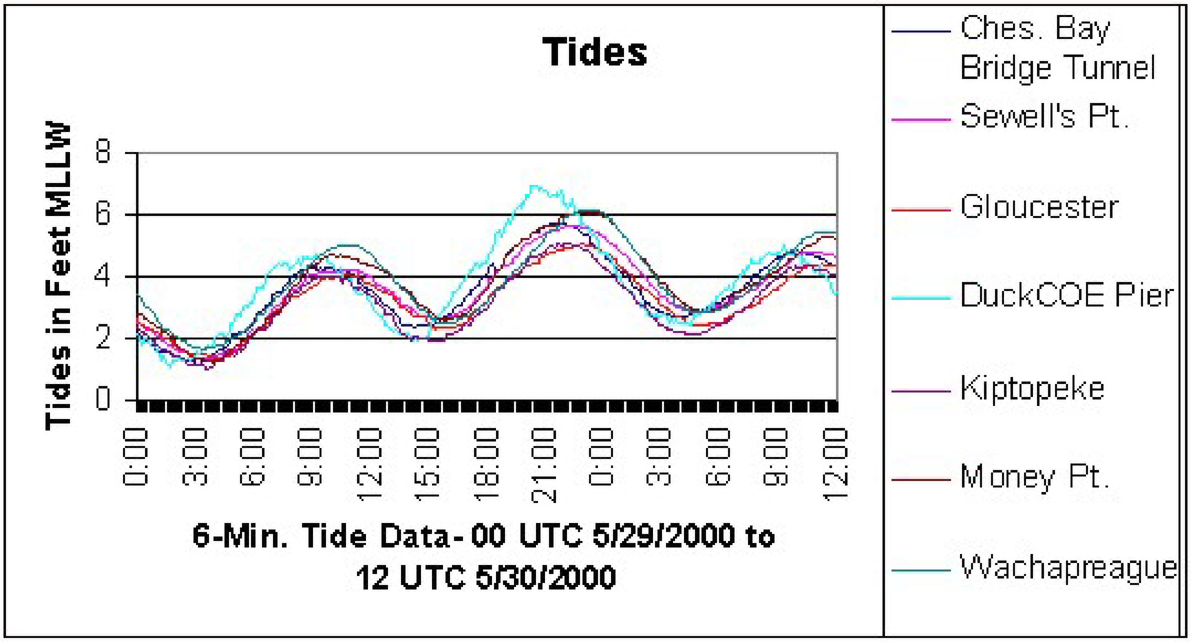


Figure 7. Tides.

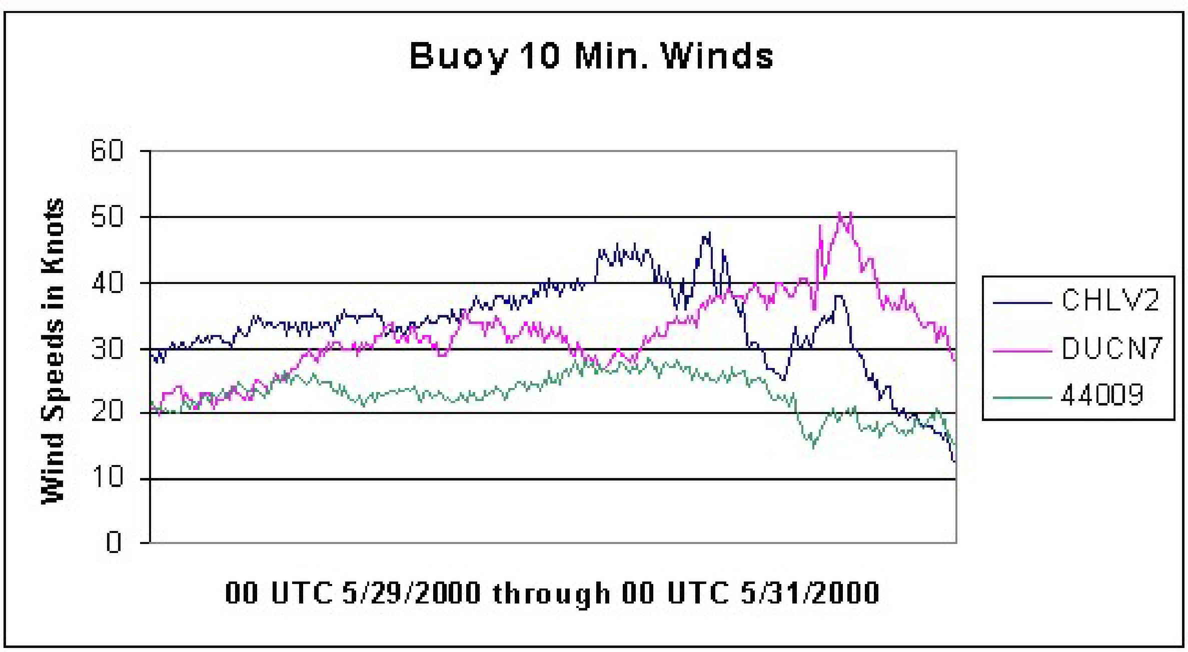


Figure 8. Buoy 10 minute winds.

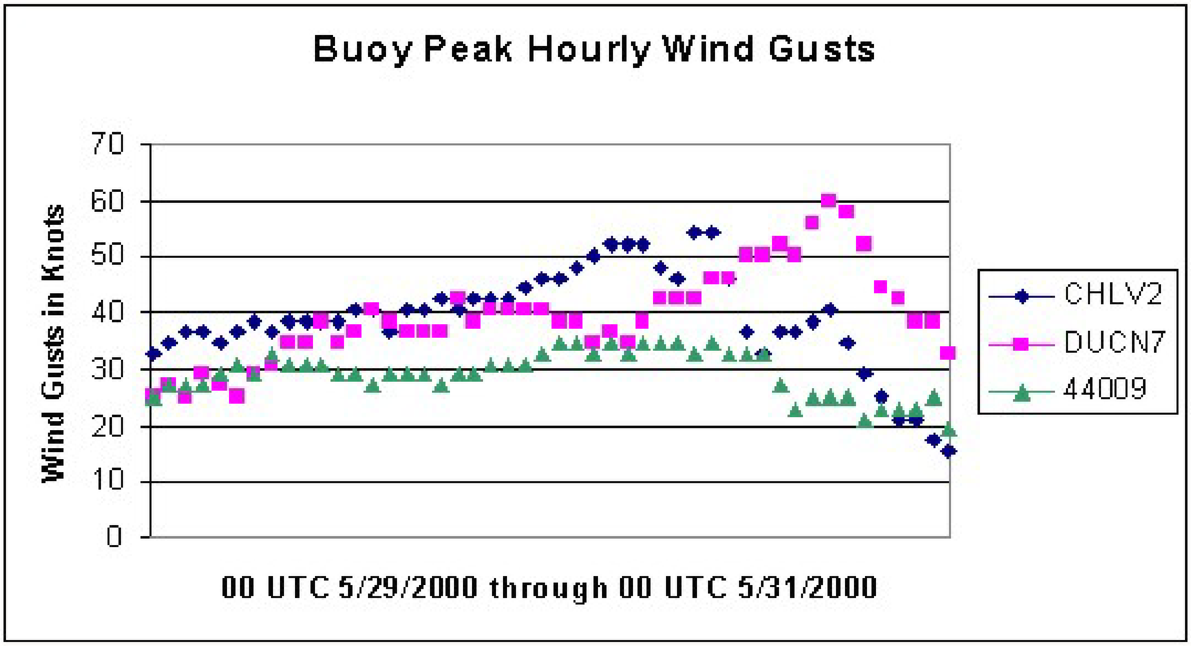


Figure 9. Buoy peak hourly winds.

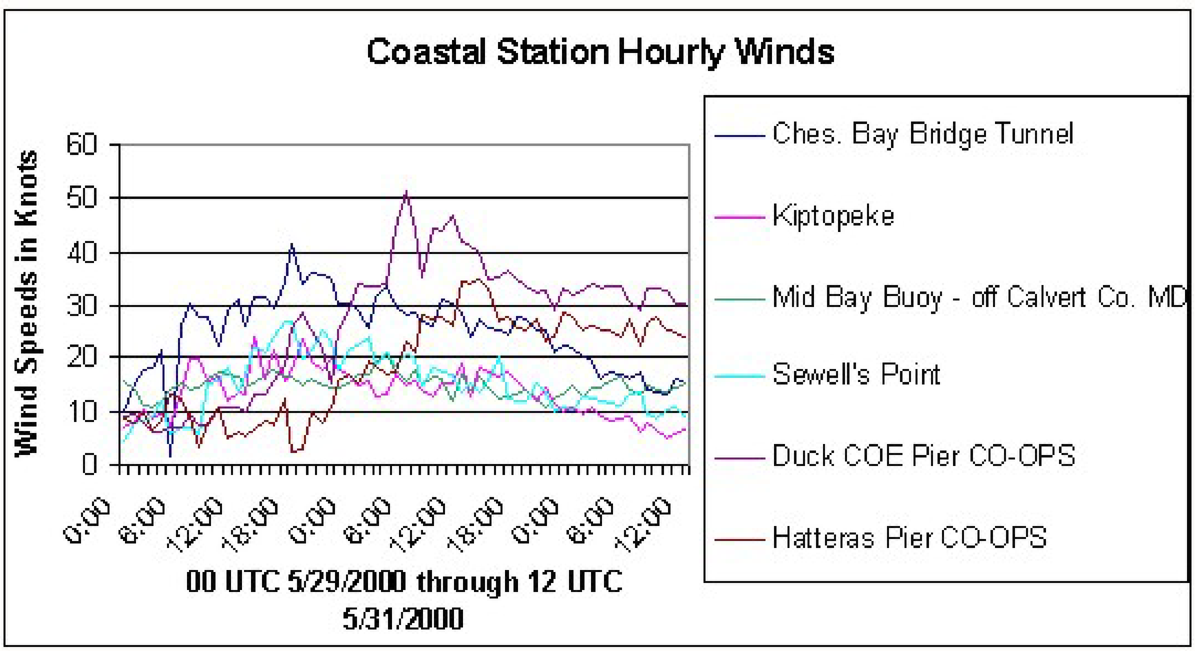


Figure 10. Coastal station hourly winds.

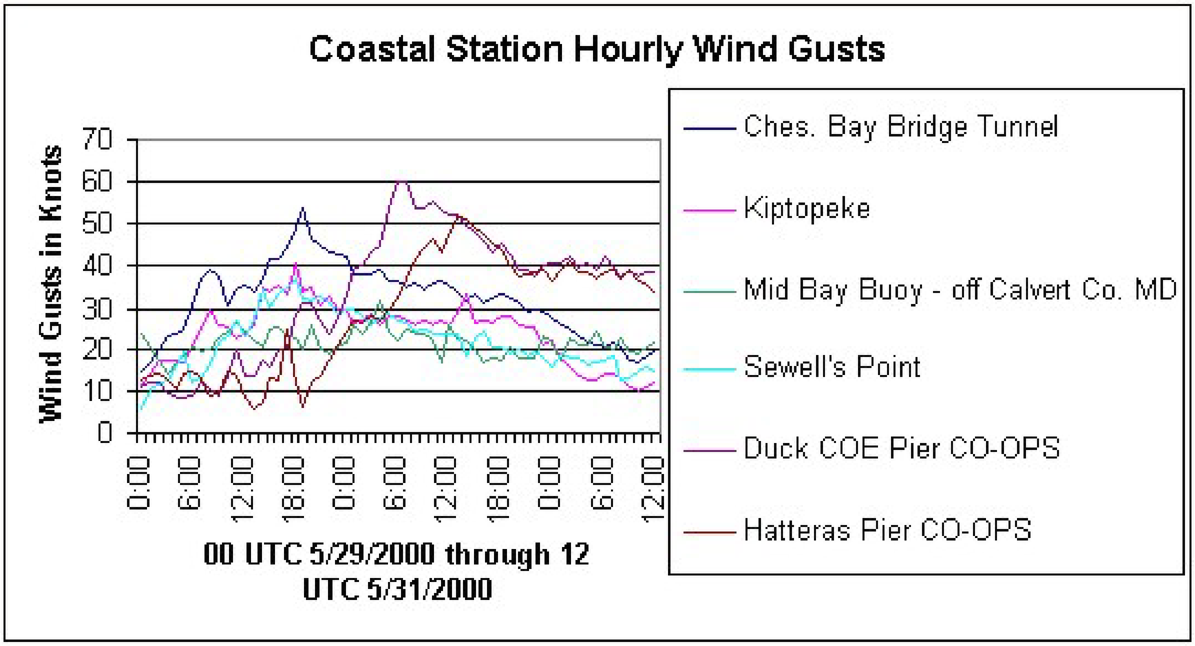


Figure 11. Coastal station hourly wind gusts.

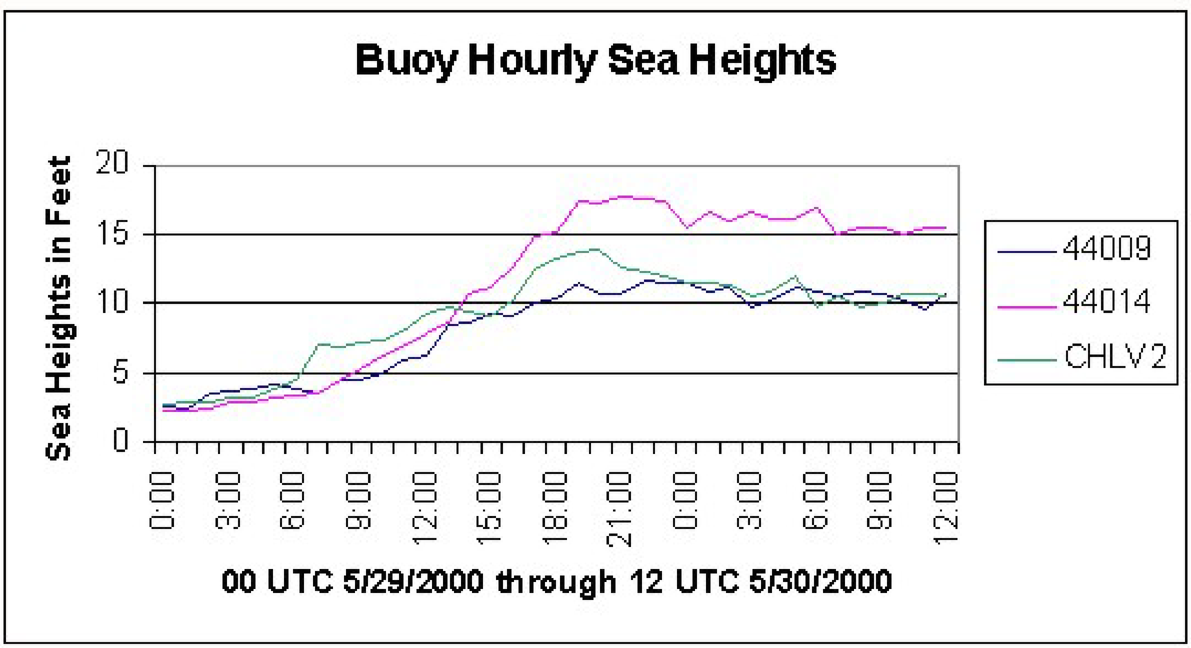


Figure 12. Buoy hourly sea heights.

Memorial Day 2000 Storm

Continued from Page 25

drowning, and three treated for hypothermia. In Virginia Beach, a tree fell onto a house trailer, missing the occupant by only a few feet.

Tides across southeastern Virginia and the northern Outer Banks of North Carolina peaked between 5.1 ft MLLW at Gloucester, Virginia and 7.0 ft MLLW at Duck COE Pier (C-MAN DUCN7), North Carolina. Flood stage at Hampton Roads (5 ft MLLW) was exceeded, with Chesapeake Bay Bridge Tunnel, Sewell's Point, and Money Point peaking at 5.8 ft MLLW, 5.7 ft MLLW, and 6.1 ft MLLW, respectively (Figure 7). Wave Heights observed at Chesapeake Light Tower, Virginia Beach Buoy (44014 - False Cape), and Fenwick Island, Delaware (44009), peaked at 17.7 ft, 13.8 ft, and 11.7 ft respectively (Figure 8).

Winds associated with the storm were unusually strong. Peak 10 minute winds equaled or exceeded storm force (48 kts) at Chesapeake Light Tower (48 kts) and Duck COE Pier (C-MAN DUCN7), North Carolina (51 kts), but not Fenwick Island, Delaware, which peaked at 28 kts (Figure 9). Peak Gusts at the buoys were 54 kts, 60 kts and 35 kts, respectively (Figure 10). Sustained hourly winds along the coast ranged from 20 kts at Mid Bay Buoy, just off Calvert County, Maryland, to 42 kts and 52 kts at Chesapeake Bay Bridge Tunnel and Duck Pier (NOS CO-OPS), North Carolina, respectively (Figure 11). Peak hourly wind gusts at coastal locations ranged from 32 kts at Mid Bay Buoy, to 52 kts at Hatteras Pier (NOS CO-OPS), North Carolina, 54 kts at Chesapeake Bay Bridge Tunnel, and 60 kts at Duck Pier (NOS CO-OPS), North Carolina (Figure 12).

The center of the storm tracked closest to the Virginia Beach Buoy (44014 - False Cape), and Duck COE Pier (C-MAN DUCN7), North Carolina; hence, the lowest sea level pressures (Figure 13) were observed at these two buoys (1001mb and 1003 mb, respectively). Hatteras Pier (NOS CO-OPS), North Carolina, observed the lowest sea-level pressure at a coastal station, with 1,002 mb (Figure 14).

Diamond Shoals Light Tower (C-MAN DSLN7) was reporting winds and sea level pressure every three hours, hence, it was not used in this storm summary. Peak 3 hourly winds were 50 kts, with gusts over 55 kts. Sea level pressure reached a minimum of 1,002 mb.⚓

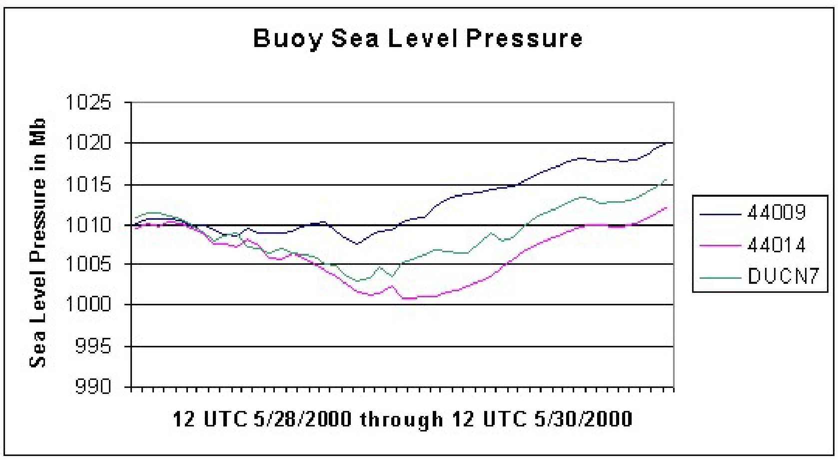


Figure 13. Buoy sea level pressure.

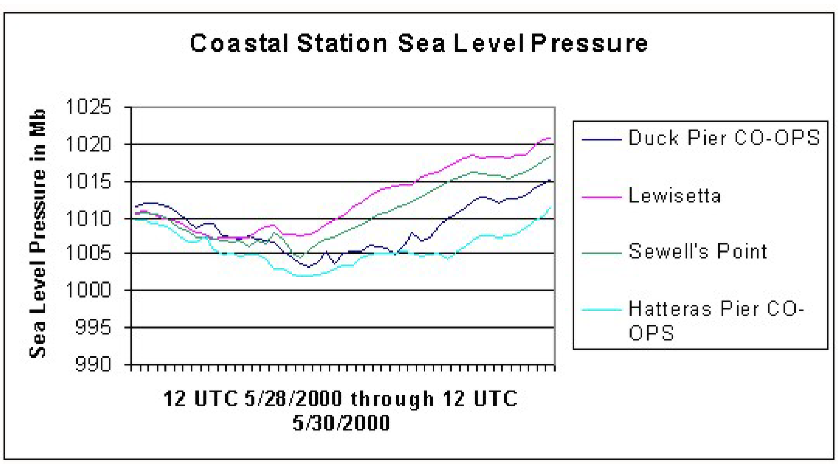


Figure 14. Coastal station sea level pressure.

An Exchange in the Weather?

AMVER Looks to International SeaKeepers Society for "Eyes And Ears" and a Hand on the Oceans

Rick Kenney
AMVER Maritime Relations Officer
United States Coast Guard

The International SeaKeepers Society was established (in cooperation with ShowBoats International Magazine) as a nonprofit organization to actively involve the yachting community in monitoring and protecting the health of the world's oceans. It has assisted in the development and deployment on private yachts, cruise ships, and other vessels of an autonomous ocean sensing and weather monitoring module to provide scientific organizations, government agencies, and vessel captains with critically important, real-time data, and to provide early detection and warning of potentially hazardous marine and weather conditions.

In partnership with the University of Miami's Rosenstiel School of Marine and Atmospheric Science (RSMAS), SeaKeepers has constructed an unobtrusive ocean and meteorological monitoring console to provide data on: current weather conditions, sea surface temperature, salinity, phytoplankton levels (ocean color), water clarity, and emerging climactic change (such as El Niño or La Niña phenomena). The equipment can also monitor and provide early warning of toxic algae blooms.

The benefits to mankind are obvious: more timely and accurate weather forecasting; improved monitoring and detection of climate change, particularly in light of global warming; improved management of global fisheries; and a comprehensive assessment of the health of the oceans. The International SeaKeepers Society has signed a formal Memorandum of Understanding with the National Oceanic and Atmospheric Administration (NOAA). Pursuant to this agreement, ocean data gathered by SeaKeepers member yachts will be transmitted to NOAA, and through NOAA to weather forecasters, government agencies, and research institutes around the world (such as the International Ocean Commission [IOC] and World Meteorological Organization [WMO]).

By the same token, participating yacht owners enjoy such benefits as: exclusive access to the SeaKeepers website with updated ocean conditions (e.g., wave heights and currents, weather forecasts, and recent marine life observations) to plan safe routes and enjoyable recreational activities; feedback on data collection activities; invitations to SeaKeepers social gatherings and scientific conferences; priority in volunteering for research voyages to areas where critical ocean data is needed; and assistance in gaining entry to marine reserves and sanctuaries.

In the never-ending quest to add even "just one more ship," and increase the effectiveness of the U.S. Coast Guard's Automated Mutual-assistance VEssel Rescue (AMVER) System, Maritime Relations Officer Rick Kenney, on a recent trip to Miami, met with the Chief Scientist on the Seakeepers Project, Professor Rod G. Zika, Ph.D., Chairman of the Marine and Atmospheric Chemistry Department at RSMAS.

Dr. Zika provided a brief on the SeaKeepers Program. He pointed out how the United Nations' designation of 1998 as the International Year of the Ocean sent a clear signal to people everywhere that government agencies and the professional scientific community alone can not reverse the deterioration of the seas. The SeaKeepers Society was established to harness the extraordinary power and vast

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An Exchange in the Weather?
Continued from Page 33

resources of the world's yachtsmen to provide a virtual armada of support to agencies and scientists in every corner of the world. The yachts provide a highly accurate, relatively low cost source of data, downloaded and transmitted via satellite, to verify the existing stream of information now being obtained by a multi-billion-dollar network of research and monitoring satellites.

Mr. Kenney could not help but to comment on the parallel situation in the realm of search and rescue (SAR), where the magnitude of the millions of square miles of ocean, assigned to the responsibility of individual nations for maritime and aviation SAR, taxes the finite resources of ships, helicopters and fixed-wing aircraft of any government. AMVER-participating ships fill in those sea areas not routinely patrolled by national SAR agencies. SeaKeeper Society yachts provide a particular bonus in that they often travel in areas even further away from the normal shipping lanes, especially during research operations, thus enhancing their value in the case of a ship or aircraft in distress.

Participation by the world's major yachts, Mr. Kenney continued, would provide rescue coordinators around the world with that many more "eyes and ears on scene," to verify the authenticity of electronic distress alerts (in view of an almost 97% accidental activation rate), thus allowing rescue coordinators to hold precious search and rescue assets in reserve for "the real thing!" The yachts themselves become ideal rescue assets in an emergency, due to their size, professional crews, excellent communications, and comprehensive medical supplies and equipment routinely carried on board.

Dr. Zika explained the SeaKeepers shipboard module, a high-tech, state-of-the-art device for accurately measuring and transmitting data on ocean conditions. It is capable of carrying a variety of sensors, including those deployed in a detached MET station to gather weather conditions (air temperature, wind speed and direction, barometric pressure, and humidity) and those encased in a "wet box" to gather data on ocean temperature, salinity, pH, oxygen, water clarity, water color, pollution levels, etc. The actual sensors deployed in any given module depend upon such factors as the size of the vessel, its cruising areas, its preexisting MET sensors, the shape and design of its hull and decks, and the scientific need for data in certain regions of the world.

The three components (sensor box, electronics box, and MET station), operating autonomously, are rack-mounted in modular design (for future upgrades), usually in the engine room. Aesthetics, of necessity, play an important role in the design and location of the equipment on the yacht. The system uses low power and voltage and a saltwater through-hull fitting. Collected data is displayed on the ship's computer and the information is sent in data bursts via Inmarsat-C satellite transmissions through COMSAT Mobile Communications earth stations. NOAA pays the cost of the satellite transmissions. Readings are used by scientists to verify groundtruth and calibrate satellite data. Ultimately, the collated data from SeaKeepers, in addition to many other sources, is used to prepare the annual, worldwide "State of the Oceans" report.

Dr. Zika noted that Tom Houston, President of the SeaKeepers Society, likes to describe the program as "one of the most dynamic public/private partnerships in the world to protect our imperiled oceans." Mr. Kenney opined that the role of the worldwide AMVER program in protecting lives and property at sea is a similarly successful public/private partnership that dates back over 40 years!

Mr. Kenney made an impassioned plea to Dr. Zika to bring AMVER's proposal for participation by the SeaKeeeper Society Yachts to its Board of Directors for consideration. Position report information needed by AMVER is already contained in the data bursts provided by the member yachts, and could be extracted and routed electronically by NOAA to AMVER in a similar fashion to the AMVER/SEAS program used by merchant vessels. The lyrics of an old song say: "There'll be a change in the weather, and a change in the sea…" An exchange of SeaKeepers data with AMVER would be a positive change for everyone out on the seas. Stay tuned for developments!⚓

A Guide to Surface-Analysis Charts

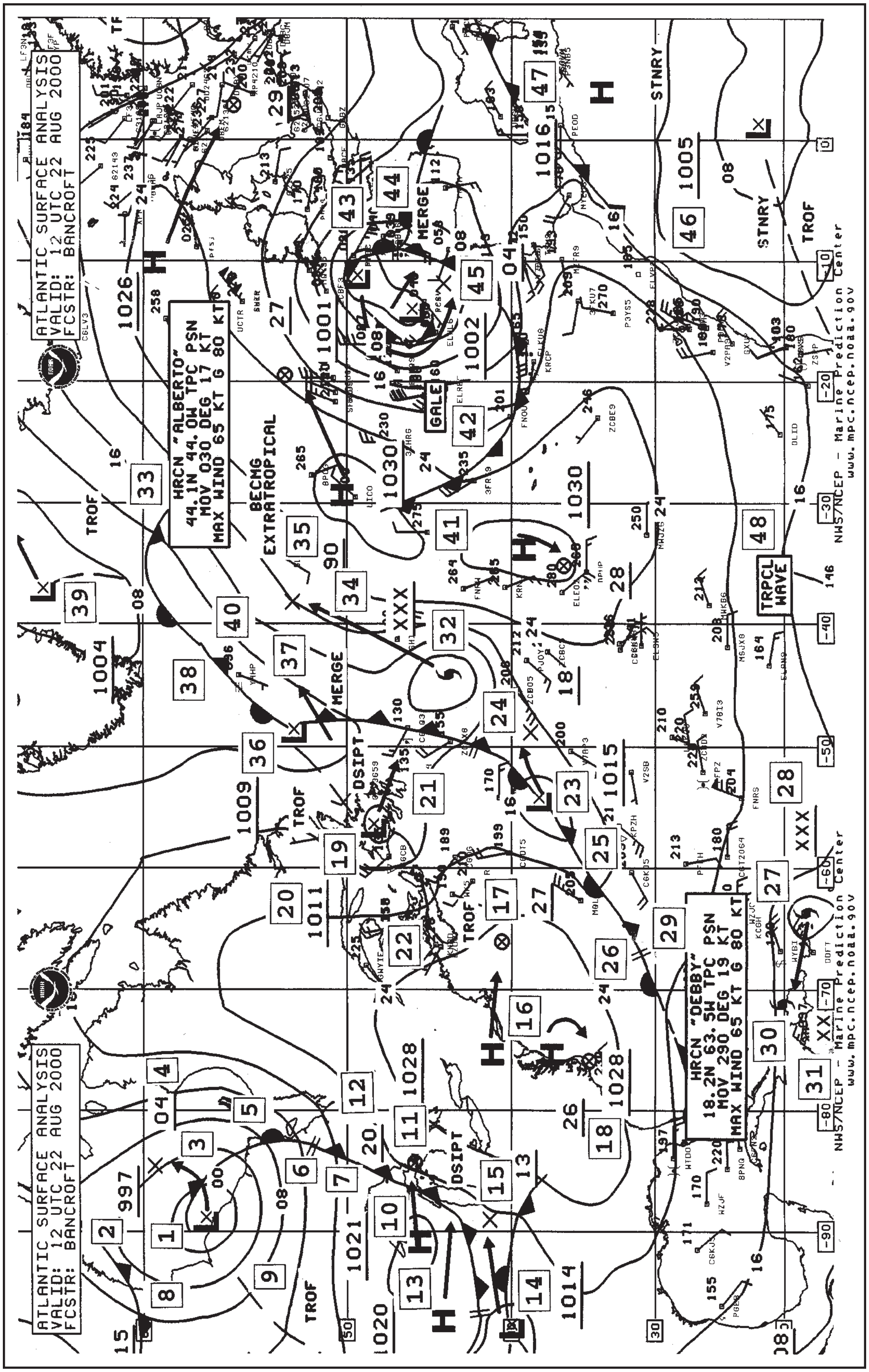
George P. Bancroft
Marine Prediction Center

The surface analysis is perhaps the most widely used chart in the marine community. Since these analyses show both the current weather situation and also serve as a forecast tool for the user, it is vitally important that the mariner understand the symbols and terminology that MPC uses on the charts.

In the example pictured here, the North Atlantic analysis is prepared for the area from 15N to 65N latitude and between 10E and 100W longitude, but is broadcast over HF radiofacsimile and posted to the Internet in two parts with 10 degrees of longitude overlap between the eastern and western parts (Parts 1 and 2). The two parts were meshed together for display. Note that MPC also issues an oceanic surface analysis for the North Pacific in two parts. The boxes in the upper left and upper right show the chart's valid time and date: 1200 UTC (noon, Greenwich time) 22 August 2000. The forecaster's name is on the line below: George Bancroft. The chart below was chosen for its variety of symbols and combination of tropical and extratropical cyclone activity.

Analyses of surface isobars (lines of equal atmospheric pressure at sea level) are shown in 4-millibar increments, with the isobars labeled every 8 mb (last two whole digits of pressure in millibars). Low and high pressure systems are depicted as "L" and "H" with an underlined pressure label nearby given in whole millibar units of 3 or 4 digits. The Marine Prediction Center also includes forecast tracks for pressure systems (denoted by arrows) and forecast positions valid 24 hours after the chart's valid time ("X" for lows and circled X's for highs, and tropical cyclone symbols). The 24-hour forecast pressures are shown near the forecast positions as the last two whole digits of pressure, underlined, or undetermined pressure "XX" for tropical cyclones. The first two digits, the 9 or 10, of the forecast pressure are left out to distinguish forecast positions from actual (synoptic) positions. If there is a 24-hour forecast of a pressure system that

Continued on Page 37


ATLANTIC SURFACE ANALYSIS
VALID: 12 UTC 22 AUG 2000
FCSTR: BANCROFT
HRCN "ALBERTO"
44.1N 44.0W TPC PSN
MOV 030 DEG 17 KT
MAX WIND 65 KT G 80 KT
BECMG EXTRATROPICAL
HRCN "DEBBY"
18.2N 63.5W TPC PSN
MOV 290 DEG 19 KT
MAX WIND 65 KT G 80 KT
TRPCL WAVE
GALE
MERGE
DSIPT
TROF
STNRY
NWS7/NCEP – Marine Prediction Center
www.mpc.ncep.noaa.gov

Surface-Analysis Charts

Continued from Page 35

was not present at analysis time, it would be labeled as "NEW".

Fronts (warm, cold, occluded, stationary) and low-pressure troughs are also shown. If a front is dissipating, it is broken into alternating pips (filled triangles or half-circles) and line segments. Fronts that are forming are depicted as broken lines of pips, without the alternating line segments. A pair of parallel line segments ("=") appears at a junction between one type of front and another. Troughs are shown as dashed lines labeled as "TROF".

As an example, the North Atlantic surface analysis is shown here. Boxed numbers have been placed adjacent to various features, and are organized as increasing from west to east. The same numbers appear below with accompanying explanations. This example follows a format similar to that found in the article *An Introduction to Surface-Analysis Charts* found in Cruising World magazine (November 2000), by Michael Carr and Lee Chesneau.

1. Inland low ("L") is over Hudson Bay near 57N 89.5W.
2. The central pressure is 997 mb.
3. The low has a forecast track (arrow) that takes it NE to a position near 59.5N 85W 24 hours later, marked by an "X".
4. The 24-hour forecast pressure is "04" (1004 mb).
5. An occluded front extends SE from the low center.
6. The "=" marks the transition from an occluded front to a cold front.
7. The cold front extends SW to near 42N 97W.
8. Another cold front is shown entering the NW corner of the chart.
9. A low-pressure trough (labeled as "TROF") extends SW from the Hudson Bay low. This is an elongated area of relatively low pressure often accompanied by clouds, precipitation, and shifting winds.
10. A high-pressure center appears farther to the south ("H") near 46N 91W and has a central pressure of 1021 mb.
11. The high is forecast to be near 46N 84W 24 hours later, marked by a "circled X".
12. The 24-hour forecast of central pressure of the high is "20" (1020 mb).
13. Another high to the west with central pressure 1020 mb is forecast to move east and dissipate ("DSIPT") within 24 hours.
14. Another inland low is on the west edge of the chart near 40N 98W with a central pressure of 1014 mb and a stationary front extending E from the center to 39N 85W.
15. The low is forecast to be near 41N 89W ("X") 24 hours later, with a forecast pressure of "13" (1013 mb).
16. Near the coast, a complex area of high pressure has centers near 41N 75W and 38N 76W, both with pressures of 1028 mb.
17. The northern high-pressure center is forecast to be near 40.5N 67W ("circled X") 24 hours later, with a forecast pressure of "27" (1027 mb).
18. The southern high-pressure center is forecast to move SE initially, then curve SW, to a 24-hour forecast position near Cape Hatteras with a pressure of "26" (1026 mb).
19. A low-pressure center is shown over the island of Newfoundland.
20. Its central pressure is 1011 mb.
21. The low is forecast to move ESE and dissipate ("DSIPT") within 24 hours.
22. A low-pressure trough ("TROF") extends SW from the low.
23. Another low to the south is near 38N 54W, with a central pressure of 1015 mb.
24. The low is forecast to move ENE to near 39N 49W 24 hours later, with a forecast central pressure of "18" (1018 mb).
25. A stationary front extends southwest from the low to 30.5N 67W and northeast from the low center to 42N 50W.
26. The symbol ("=") marks the transition from a stationary front to a dissipating stationary front, which extends southwest to near Florida.
27. Hurricane Debby is centered near 18.2N 63.5W.
28. The central pressure of Debby is shown as "XXX", which stands for the central pressure of any named tropical cyclone. These pressures are so low that drawing all the isobars

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Surface-Analysis Charts

Continued from Page 37

would make the chart illegible. Beginning in the 2001 Atlantic hurricane season, MPC will begin showing estimated central pressures of tropical cyclones instead of "XXX".

29. Information about Debby's synoptic position, motion and maximum winds is contained in the rectangle above Debby's hurricane symbol.
30. Debby is forecast to move WNW to a 24-hour forecast position near 20N 71W, and remain a hurricane.
31. The "XX" represents an undetermined 24-hour forecast of central pressure located near the forecast hurricane symbol.
32. Hurricane Alberto is centered near 44.1N 44.0W with central pressure "XXX".
33. Information about Alberto's synoptic position, motion and winds is in the rectangle above and to the right of Alberto's hurricane symbol.
34. Alberto is forecast to move NE and lose tropical characteristics, becoming an extratropical low-pressure system (typically associated with fronts) near 53N 38W, marked by an "X", 24 hours later.
35. Since Alberto will be extratropical in 24 hours, its forecast central pressure is shown ("90") or 990 mb.
36. The low-pressure center north of Alberto near 53N 49W has a central pressure of 1009 mb. A low-pressure trough ("TROF") extends SW from the center to the island of Newfoundland.
37. The low is forecast to merge with Alberto within 24 hours.
38. A stationary front extends NE from the low center to 59N 30W. A cold front trails SW from the low to 42N 50W, where the "=' symbol marks the change to a stationary front.
39. A weak low centered near Greenland, with central pressure 1004 mb, is forecast to move NE, to a 24-hour forecast position north of the chart area. A trough ("TROF") extends south from the center.
40. A ship, call sign "Y4HP", near 55N 44W, reports a pressure of 1009.6 mb ("096") and a SSW wind of 5 kt (one-half of a wind barb). Each full wind barb is 10 kt, and a pennant is 50 kt. A weather symbol appears to the left of the ship's location (dense fog).
41. An elongated area of high pressure dominates this portion of the Atlantic and contains 3 centers. The northern center, near 59.5N 10W with a 1026 mb center, is forecast to move SE, to be near 56N 3E with a pressure of "29" (1029 mb) 24 hours later. The central high-pressure center at 50N 30W with pressure label 1030 mb is forecast to move NE to a 24-hour position near 53N 19.5W with pressure "27" (1027 mb). The southern center near 39.5N 34W with pressure 1030 mb is forecast to be near 36N 35W with a pressure of "28" (1028 mb) 24 hours later.
42. The area near the European coast is dominated by a primary gale-force low near 46N 14W with pressure 1002 mb and a secondary center at 49N 11W with a central pressure of 1001 mb. A dying occluded front surrounds the primary low center.
42. A short occluded front extends SE from the secondary low center.
43. From the frontal change symbol ("=") near 47N 9W, a warm front extends E and a cold front curves SW and then NW.
44. The secondary low center is forecast to move SW and then SE to 44N 12W by 24 hours with the 24-hour forecast pressure label "04" (1004 mb). The primary low is forecast to merge with it ("MERGE" label).
45. This part of North Africa is dominated by a 1005 mb low centered at 21N 1E and a 1016 mb high near 34N 4E. Both are stationary ("STNRY"). A low-pressure trough extends SW from the low.
46. A cold front extends SW across the western Mediterranean Sea.
47. A tropical wave, or trough embedded in the trade-wind easterlies, is depicted with a trough symbol and the label "TRPCL WAVE". A tropical wave is often accompanied by showers and a small wind shift.⚓

Some Technical Terms Used in This Month's Marine Weather Reviews

Isobars: Lines drawn on a surface weather map which connect points of equal atmospheric pressure.

Trough: An area of low pressure in which the isobars are elongated instead of circular. Inclement weather often occurs in a trough.

Short Wave Trough: Specifies a moving low or front as seen in upper air (constant pressure) weather charts. They are recog-nized by characteristic short wavelength (hence short wave) and wavelike bends or kinks in the constant pressure lines of the upper air chart.

Digging Short Wave: Upper air short waves and waves of longer wavelength (long waves) interact with one another and have a major impact on weather systems. Short waves tend to move more rapidly than longer waves. A digging short wave is one that is moving into a slower moving long wave. This often results in a develop-ing or strengthening low pressure or storm system.

Closed Low: A low which has developed a closed circulation with one or more isobars encircling the low. This is a sign that the low is strengthening.

Cutoff Low: A closed low or trough which has become detached from the prevailing flow it had previously been connected to (becoming cutoff from it).

Blocking High Pressure: A usually well developed, stationary or slow moving area of high pressure which can act to deflect or obstruct other weather systems. The motion of other weather systems can be impeded, stopped completely, or forced to split around the blocking High Pressure Area.

Frontal Low Pressure Wave: refers to an area of low pressure which has formed along a front.

Tropical Wave or Depression: An area of low pressure that originates over the tropical ocean and may be the early stage of a hurricane. Often marked by thunderstorm or convective cloud activity. Winds up to 33 knots.

Wind Shear: Refers to sharp changes in wind speed and/or direction over short distances, either vertically or horizontally. It is a major hazard to aviation. Wind shear above Tropical depressions or storms will impede their development into hurricanes.

Closed off Surface Circulation: Similar to a closed low. Refers to a surface low with one or more closed isobars. When there are falling pressures, the low is considered to be strengthening.

Marine Weather Review
North Atlantic Area—May through August 2000

George P. Bancroft
Meteorologist
Marine Prediction Center

The most active portion of the four-month period was during the first six weeks when the area appeared to be in a transition from a winter to a more summerlike pattern. The main track of low-pressure systems was from the Canadian Maritimes northeastward toward Greenland and Iceland, with a few going north into the Davis Strait. Later in May and in early June some of the action shifted to the U.S. East Coast as a mean upper level trough formed there. Most of the events described here came from this active period and are considered significant because they produced gale to storm force winds and occurred in areas of considerable ship traffic.

Figure 1 shows two significant weather events in the same figure. A front extended from southwest to northeast across the Atlantic. Low pressure formed on the front south of Newfoundland on 29 May, with much of the development occurring during the first 12 hours. The third part, or surface analysis, in Figure 1 shows the storm in mid-ocean at maximum development with a 983 mb central pressure. From 0000 UTC 31 May to 1200 UTC 31 May, the ship **WQVY** was just north of the center**,** reporting north to northeast winds of 55 kts. The ship **SFRZ** encountered southwest winds of 50 kts near 46N 32W at 0600 UTC 31 May. This system subsequently moved east and weakened before reaching the European coast. Figure 2 is the MPC North Atlantic sea state analysis valid 1200 UTC 31 May, or 12 hours after the valid time of the third analysis in Figure 1, showing a maximum of 9 m (30 ft) with this storm. The other storm in Figure 1 formed near Cape Hatteras on the same front. Cut off from the

Continued on Page 44

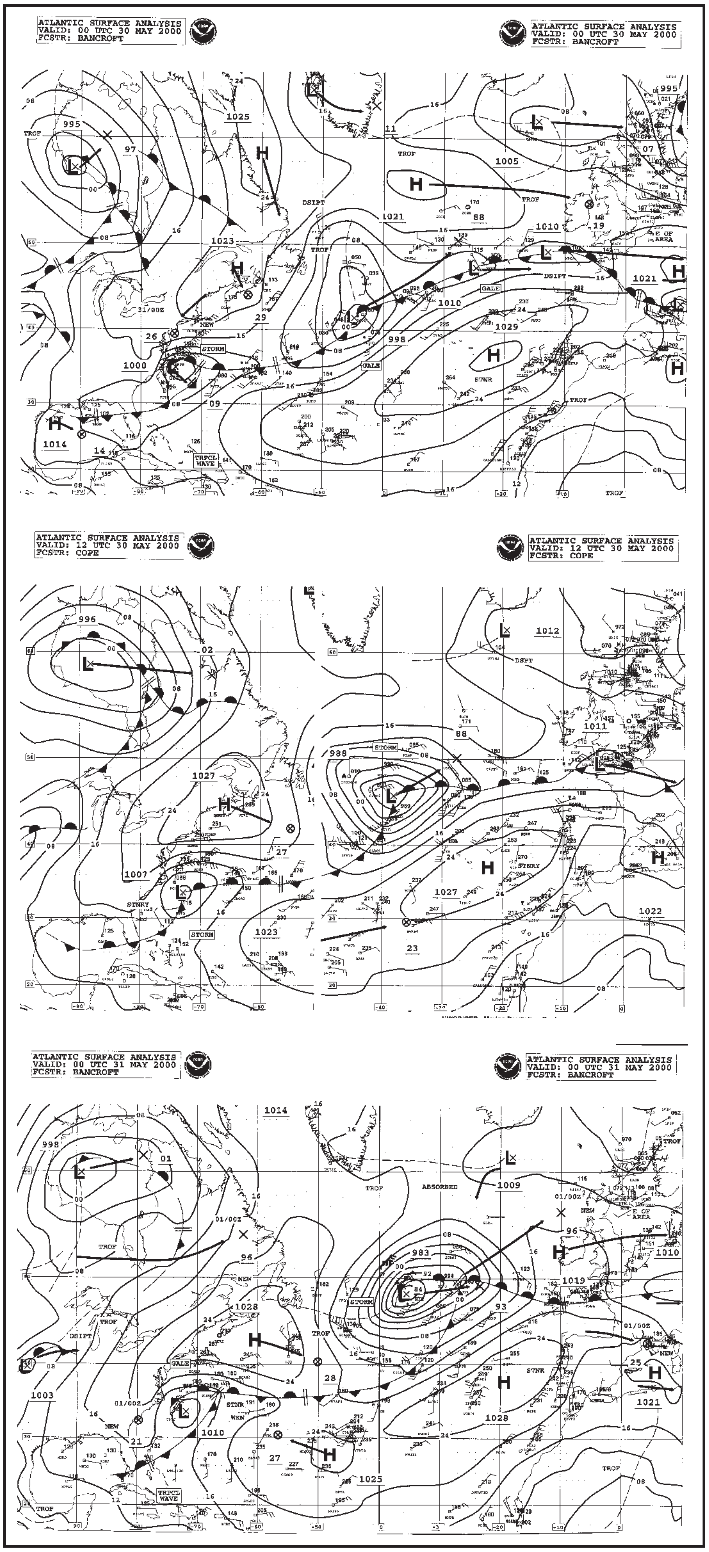

Figure 1. MPC North Atlantic surface analyses valid at 0000 UTC and 1200 UTC 30 May and 0000 UTC 31 May 2000.

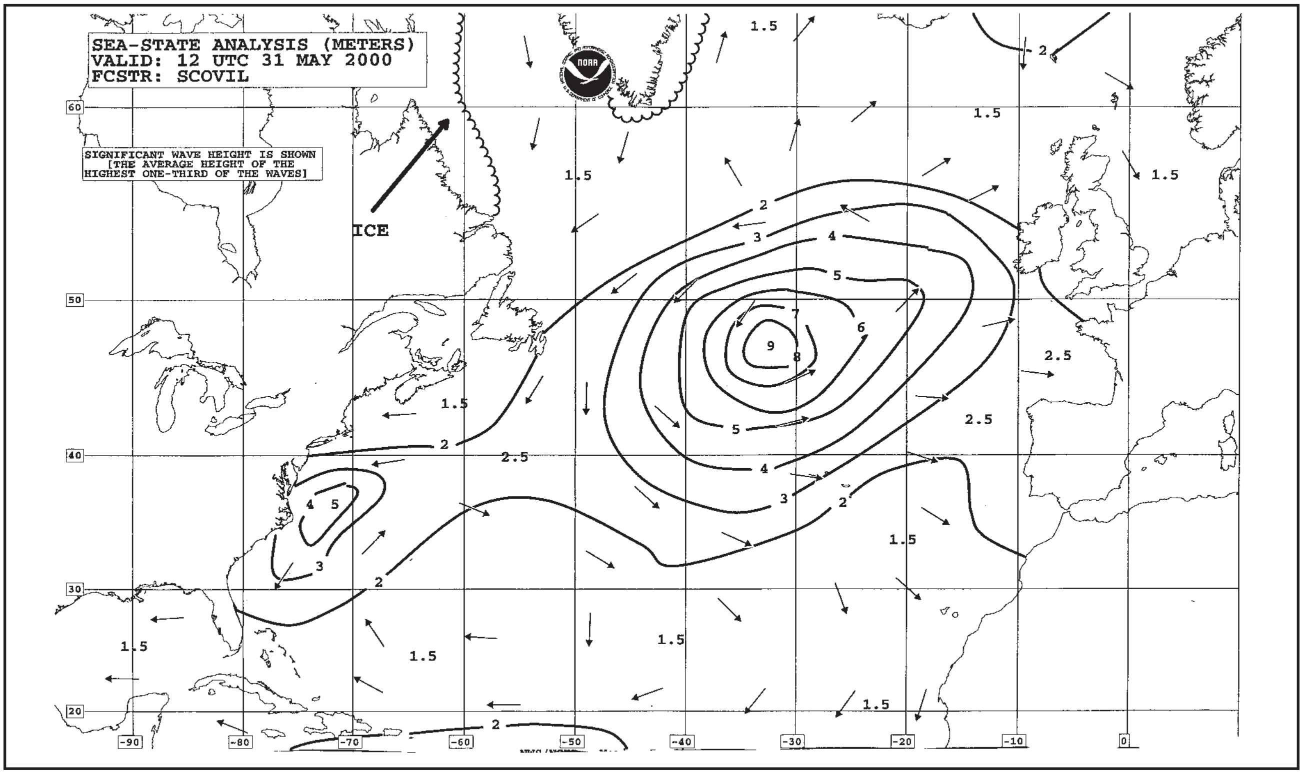

Figure 2. MPC North Atlantic sea state analysis valid at 1200 UTC 31 May 2000. Significant wave height is depicted, or the average height of the highest one-third of the waves.

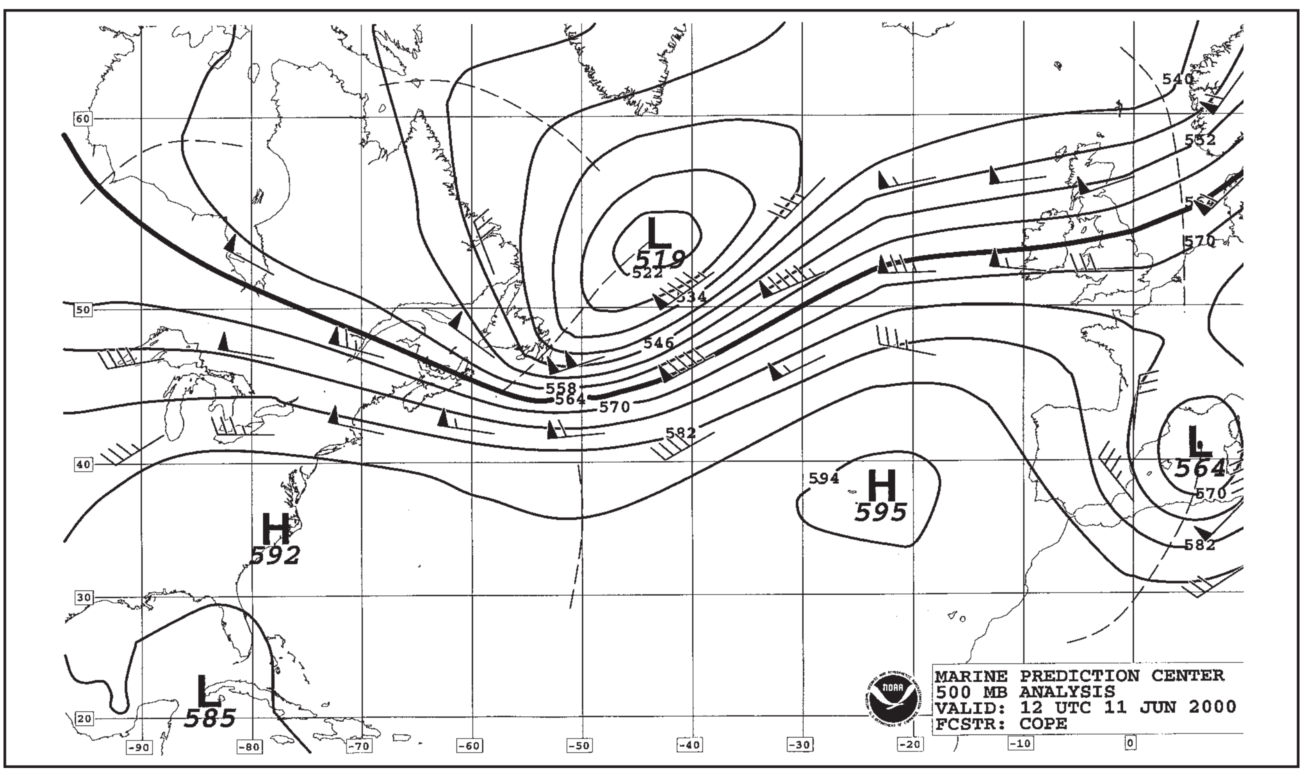

Figure 3. 500-Mb analysis valid at 1200 UTC 11 June.

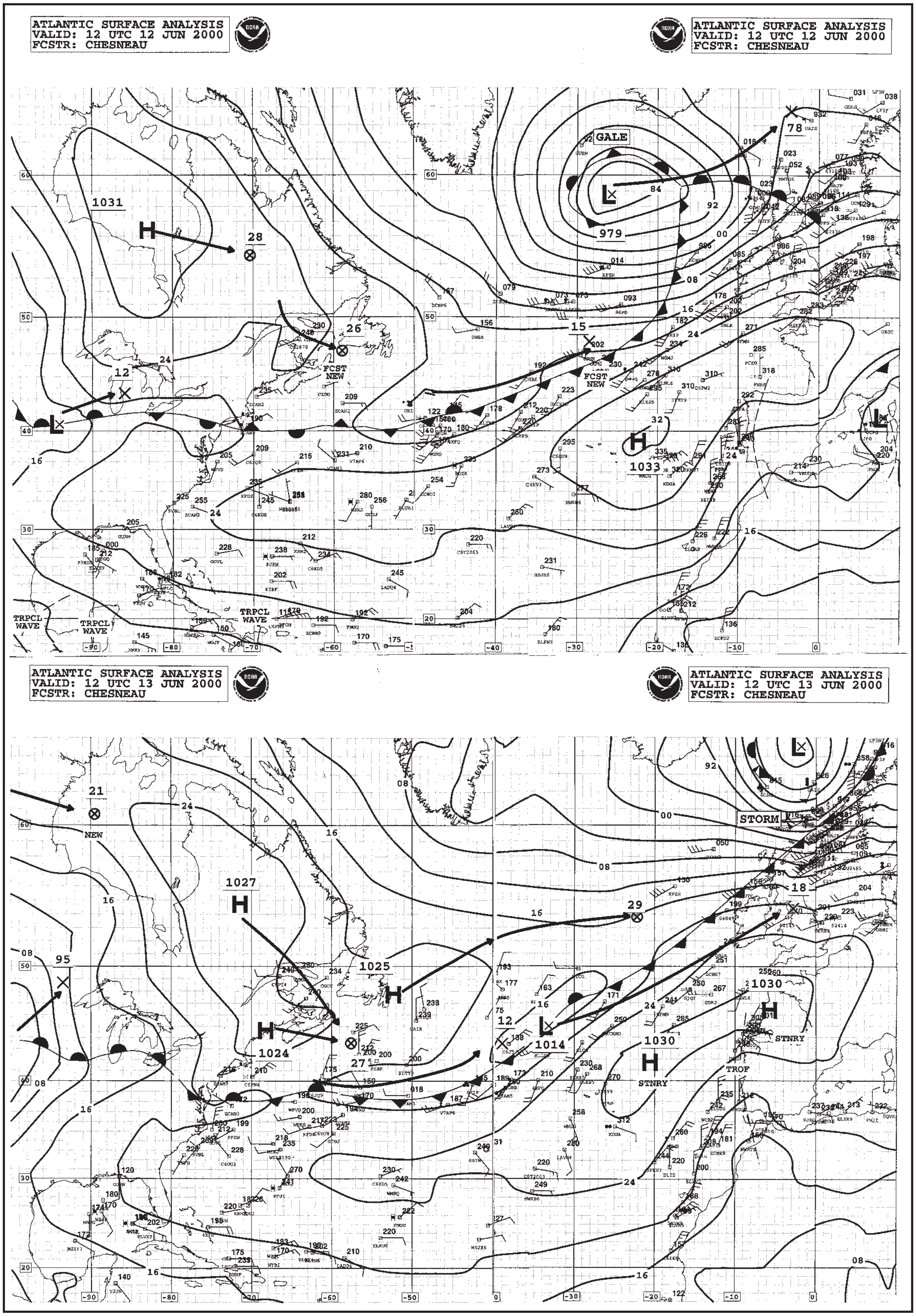

Figure 4. MPC North Atlantic surface analysis charts valid 1200 UTC 12 and 13 June 2000.

North Atlantic Area

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westerlies, this small compact system drifted slowly southeast. The first part of Figure 1 shows this system at its strongest, with a 1000 mb central pressure. While this pressure is high for a storm, high pressure to the north helped produce a tight pressure gradient on the north side. The highest winds reported were at coastal locations, such as **Chesapeake Light** (**CHLV2**) at 37N 76W, which reported a northeast wind of 50 kts with gusts to 56 kts at 1500 UTC May 29, and **Duck Pier** (**DUCN7**) on the North Carolina coast, which reported a north wind of 50 kt at 1800 UTC 29 May. The highest winds reported by a ship were northeast 45 kts from **UCJM** near 37N 74W at 0600 UTC 30 May. The **Sea-Land Performance** (**KRPD**) encountered northeast winds of 40 kts and 8 m (26 ft) seas near 38N 73W at 0000 UTC 30 May. The buoy **44014** (36.6N 75W) reported northeast winds as high as 37 kts with gusts to 47 kts and 5.5 m (18 ft) seas at 1900 UTC 29 May.

The westerlies shifted north in early June, especially after the 7th, when a strong jet stream developed, unusual for June. Figure 3 is a 500 mb analysis valid at 1200 UTC 11 June, showing a trough and 100 kt jet stream leaving the coast. This supported development of a surface low, which crossed the Atlantic and developed storm force winds as it passed north of the British Isles late on 12 June. See Figure 4. The central pressure bottomed out at 968 mb near 62N 8W at 0600 UTC 13 June, making this the deepest low of the May to August period in both oceans. The second part of Figure 4 shows the storm with several ship reports in the 50 to 60 kt range south of the center. Among then, the vessel **GNLB** encountered southwest winds of 60 kts near 61N 1W at 1200 UTC 13 June. Figure 5 is a North Atlantic sea state analysis valid at that time, with a maximum of 8.5 m (28 ft) analyzed south of the storm center.

From the last half of June into August, the low-pressure systems were of gale strength or less, as is typical of summer. There was frequent activity off the U.S. East Coast, as lows moved off the coast along trailing cold fronts, but these were weak.

Hurricane Alberto

The first named tropical cyclone of the 2000 Atlantic hurricane season, Alberto was remarkable for its persistence and the unusual clockwise loop it made over the southern part of MPC's high seas waters. Figure 6 shows the looping track of Alberto in MPC's high seas area, with labels for valid times and tropical cyclone symbols. Alberto formed west of the Cape Verde Islands on August 5, and moved north of 30N into MPC's waters late on August 10. Alberto reached maximum intensity at 1800 UTC 12 August, becoming a major hurricane with maximum sustained winds of 110 kts with gusts to 135 kts (Category 3 on the Saffir-Simpson scale of 1-5 of hurricane intensity). Figure 7 consists of two surface analyses showing Alberto at maximum strength, and curving around a subtropical ridge. Alberto did not merge with the stationary front to the north and become extratropical; instead, Alberto became trapped under a building upper ridge as seen in the two 500 mb analyses of Figure 8. During this period from 0000 UTC 14 August to 0000 UTC 15 August, Alberto weakened to a tropical storm and began its clockwise loop to the south. The storm began a turn to the north again early on the 18th and re-intensified into a hurricane. The storm crossed its previous track at 1200 UTC 21 August and began accelerating north, in response to an approaching short wave trough and cold front. Figure 9 is a surface analysis and accompanying 500 mb analysis valid at 1200 UC 22 August, which shows Alberto being "picked up" by the approaching upper trough and cold front. Figure 10 is a GOES8 infrared satellite image with the same valid time as Figure 8, showing Hurricane Alberto still well defined with a large "eye," and a frontal cloud band approaching from the west. Alberto remained tropical until after crossing 53N, and finally became an extratropical gale near 57N 34W at 1800 UTC 23 August.

Reference

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

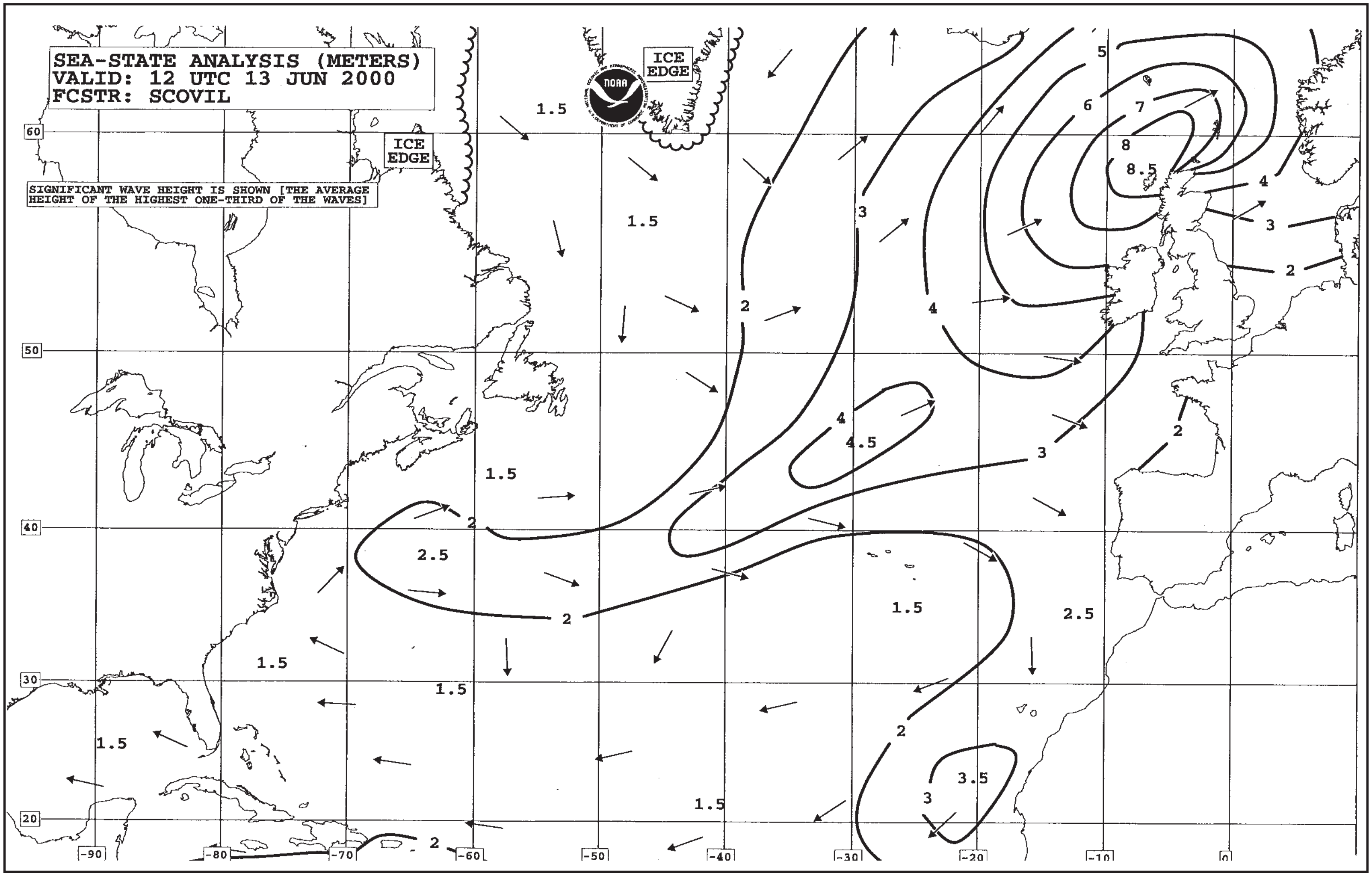

Figure 5. MPC North Atlantic sea state analysis valid at 1200 UTC June 13, 2000.

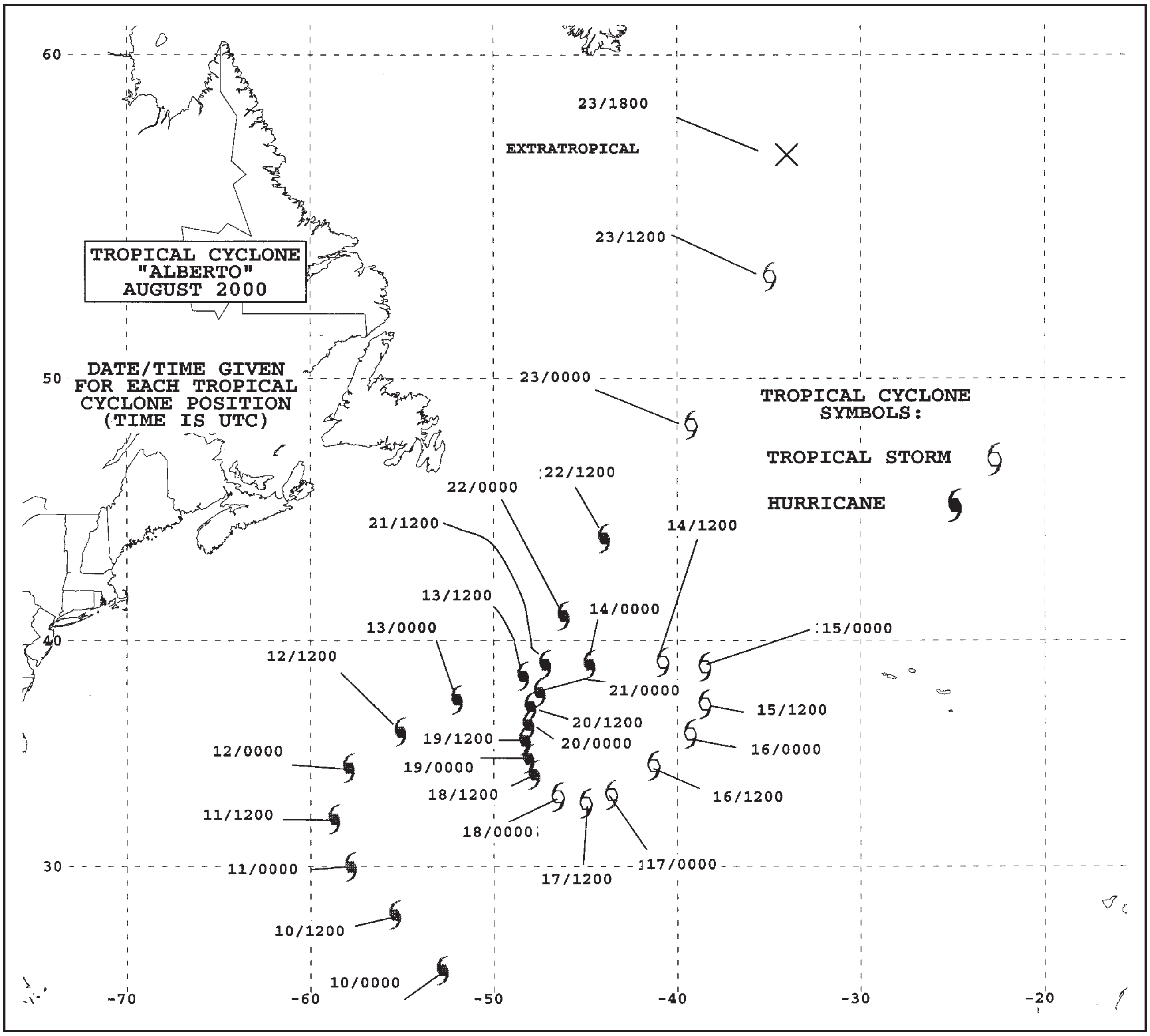

Figure 6. The track of Tropical Cyclone Alberto in MPC's marine area, consisting of tropical symbols (tropical storm or hurricane) and date/time (UTC) labels every 12 hours.

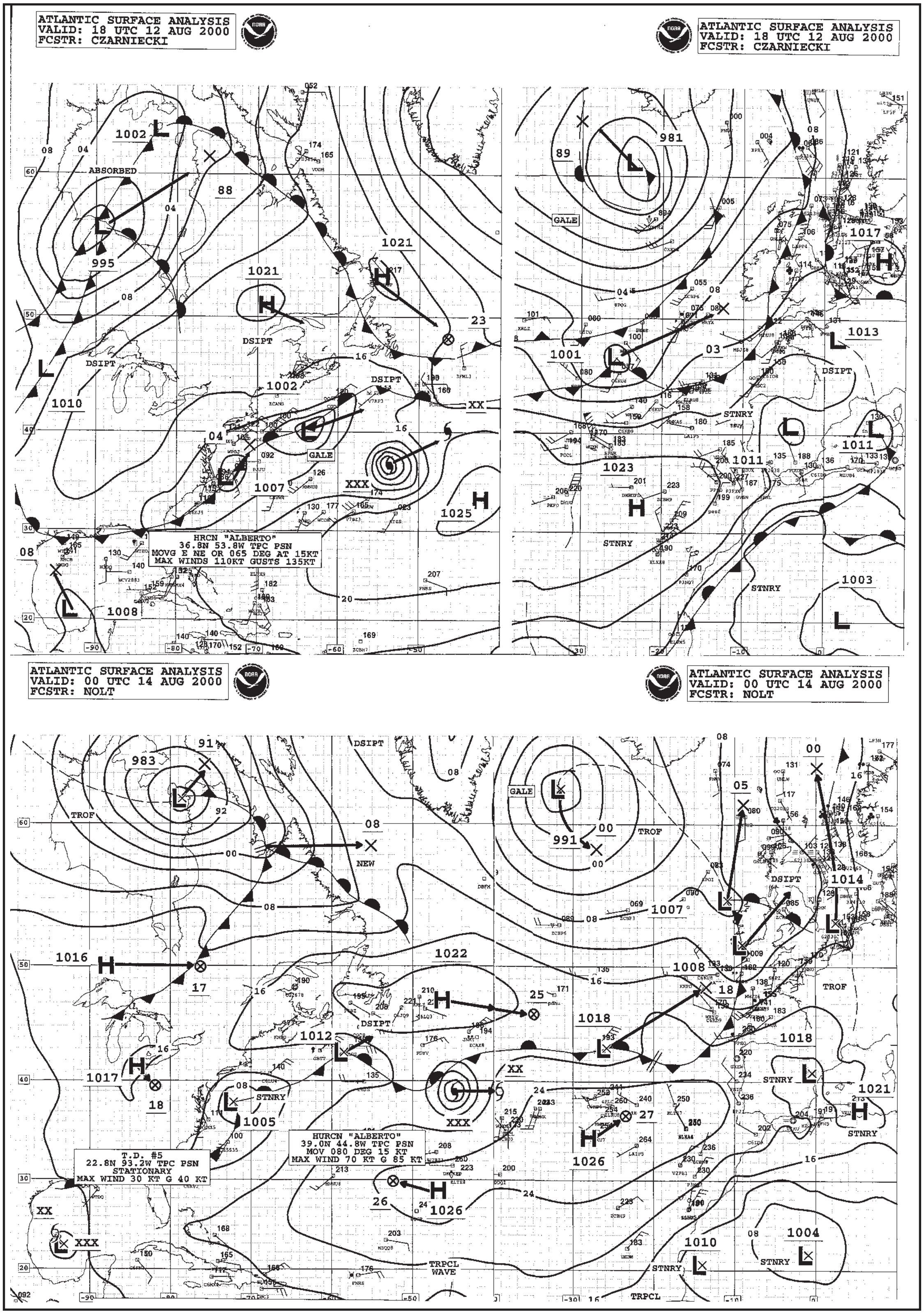

Figure 7. MPC North Atlantic surface analysis charts valid 1800 UTC 12 August and 0000 UTC 14 August 2000.

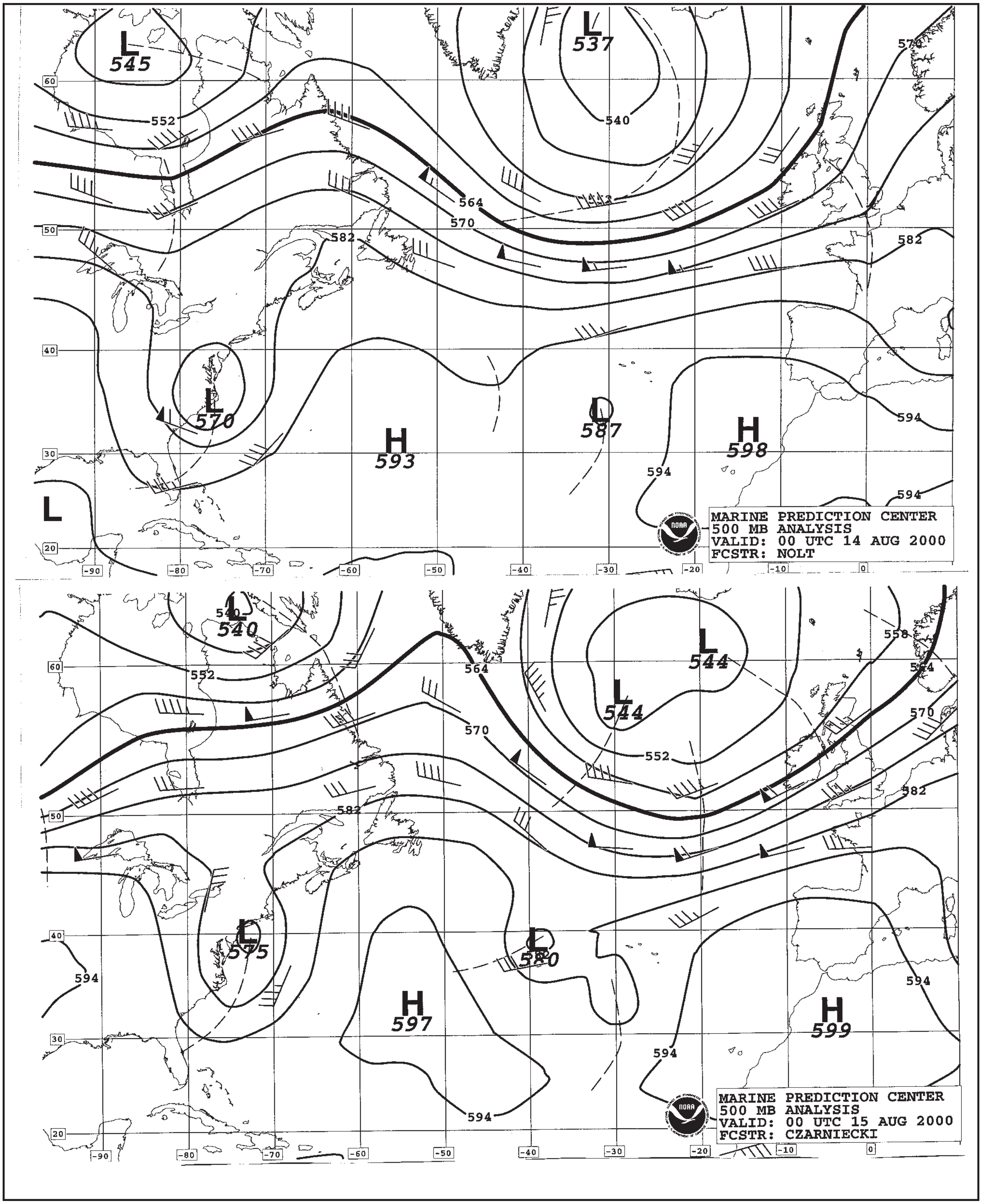

Figure 8. 500-Mb analysis charts valid 0000 UTC 14 and 15 August 2000.

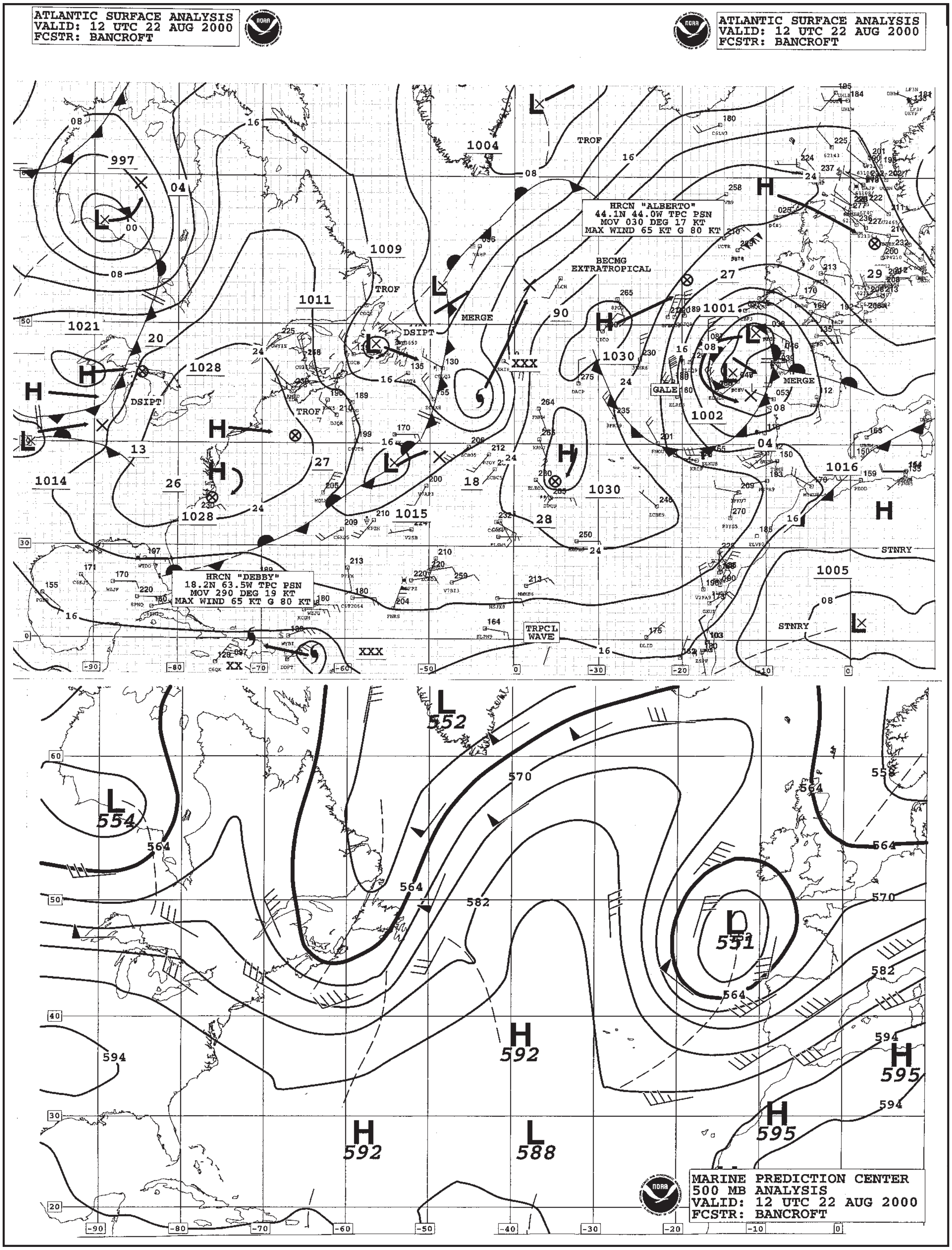

Figure 9. MPC North Atlantic surface analysis and corresponding 500-Mb analysis valid at 1200 UTC 22 August 2000.

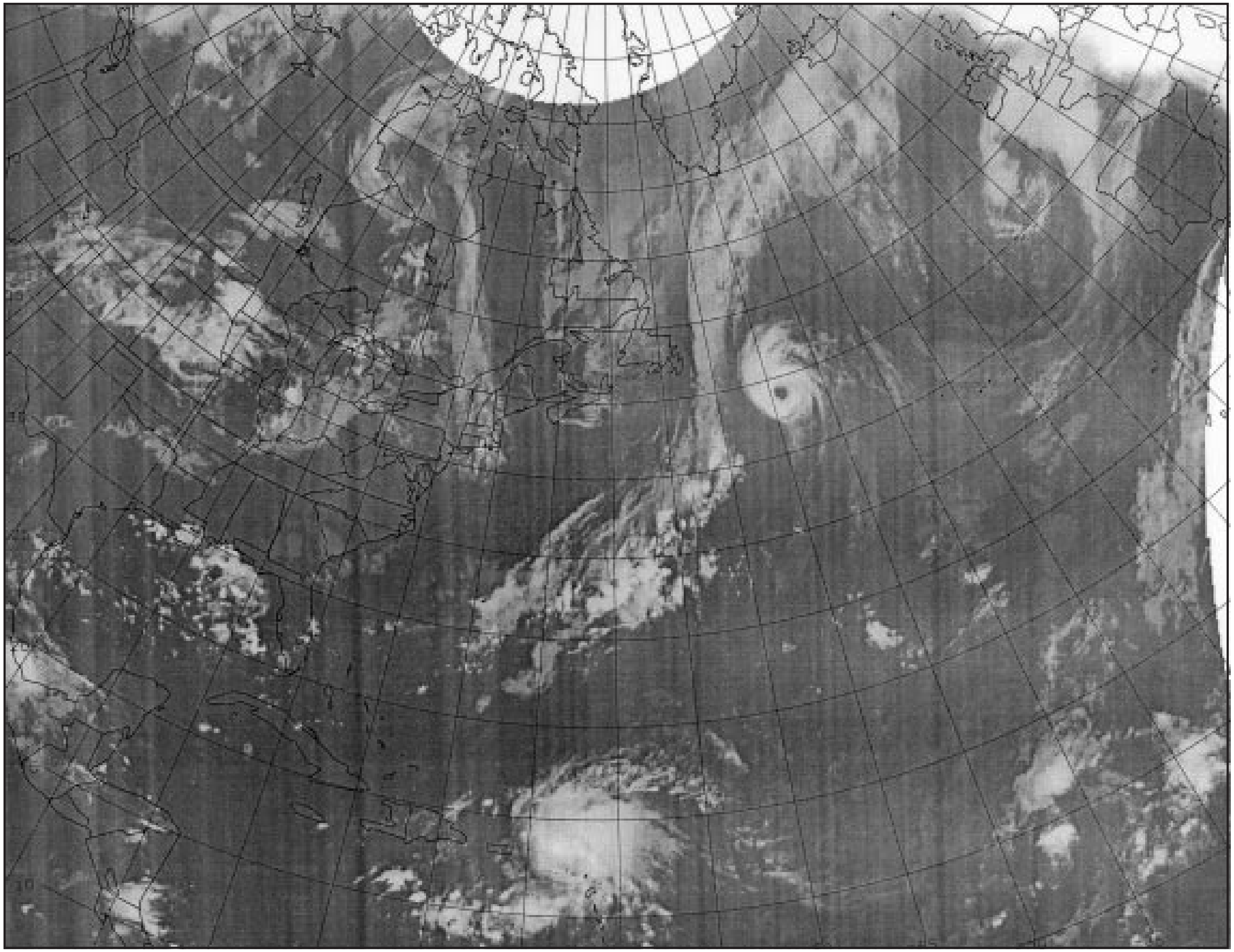

Figure 10. GOES8 infrared satellite image valid 1145 UTC 22 August 2000, or approximately the valid time in Figure 9. Satellite senses temperature and displays it in shades of gray, ranging from white (cold, high cloud tops) to black (hot surface). This allows clouds to be viewed at night.

Marine Weather Review
North Pacific Area—May through August 2000

George P. Bancroft
Meteorologist
Marine Prediction Center

The pattern in May began with low-pressure centers moving from off Japan east-northeast toward the southern Gulf of Alaska. One of these became a strong gale in the southeast Gulf of Alaska at 0000 UTC on 3 May, before becoming stationary and weakening. The flow pattern became more amplified by 12 May, when a high pressure ridge at the surface and aloft developed near 160W and resulted in the most significant events of the four-month period.

One low, after initially weakening while passing through the ridge, rapidly intensified as it encountered a strengthening upper-level low. Figure 1 shows this system during rapid development to maximum intensity as a 986-mb storm off the U.S. West Coast, a drop in central pressure of 25 mb in the 24-hour period ending at 0600 UTC 13 May. The strongest winds were likely in the strong pressure gradient or packed isobars around the west side of the center at 0600 UTC 13 May, but there were no ships or buoys reporting in this area. The ship **WRYE** reported at 46N 136W with an east wind 40 kts and 8 m seas (26 ft) at 0600 UTC 13 May. Six hours later the ship **S6TA** encountered a northwest wind of 40 kts and 10.5 m seas (35 ft) near 35N 141W. Figure 2 is an infrared satellite image showing the storm at maximum intensity, with a well-defined center and frontal cloud band wrapping around to the south of the center. To the west, during the same period, another low pressure system developed near the dateline and moved to near the eastern Aleutians as a 980 mb storm (Figure 1), forced north by the ridge to the east. The most rapid drop in central pressure (14 mb) occurred in the 6-hour period ending at 0600 UTC 13 May. The center bottomed out at 977 mb in central pressure in the southern Bering Sea at 0000 UTC 14 May before drifting southeast and beginning a weakening trend. The strongest winds with this system were reported by the ship **9HJY5** near 48N 179W south of the center, a west wind of 60 kts at 1200 UTC 13 May. Sea state observations were lacking in this area of strongest winds. Figure 3 is a 500-mb analysis valid at 0000 UTC 13 May during the period of rapid development of this and the other storm to the east. These developments are supported by 500 mb jet streams and associated short wave troughs. (See

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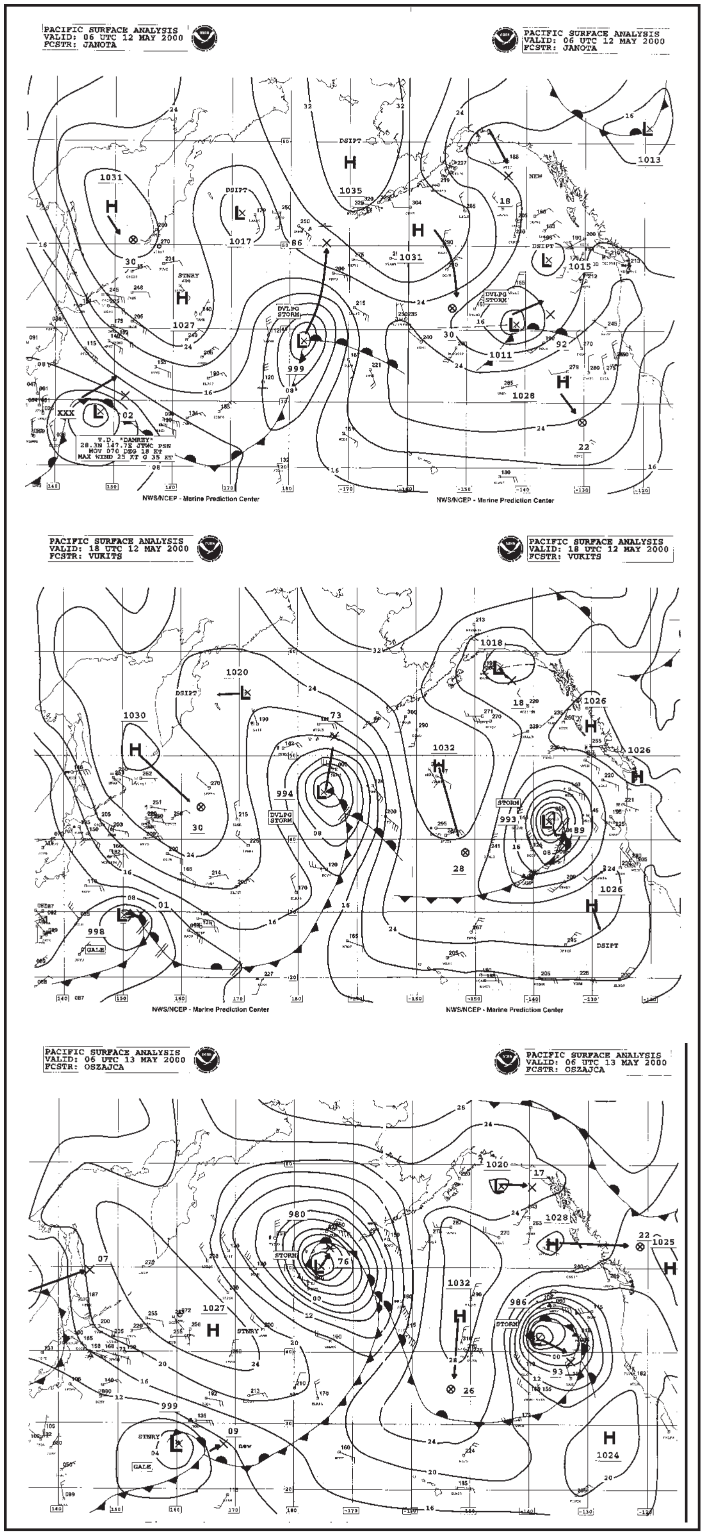

Figure 1. MPC North Pacific surface analyses valid 12 May 0600 and 1800 UTC; and 13 May 0600 UTC.

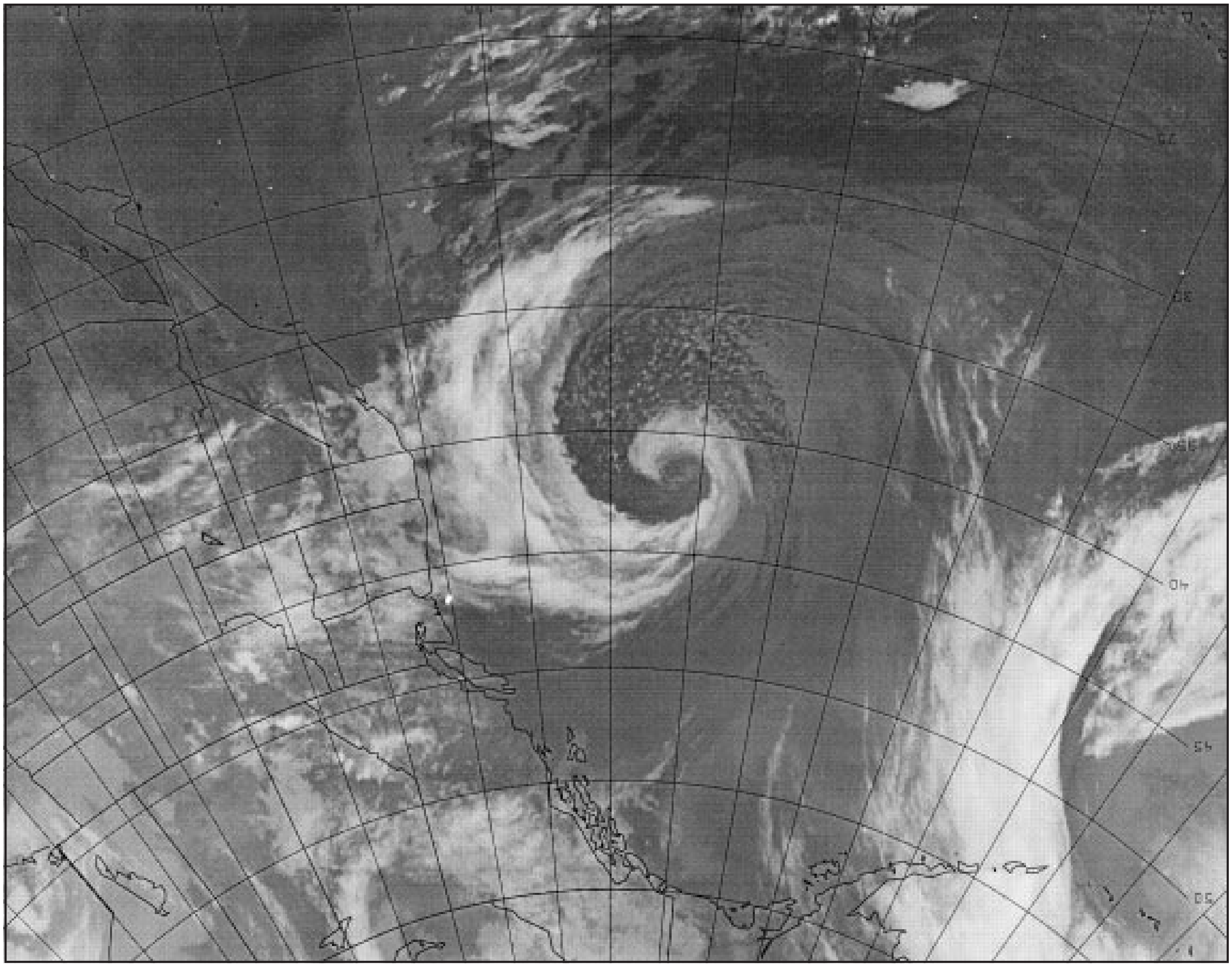

Figure 2. GOES10 infrared satellite image valid 0600 UTC 13 May 2000. Temperature is indicated as various shades of gray, ranging from cold (white) to warm (black). High clouds (cold tops) are indicated as whiter shades. Valid time is same as that of third analysis in Figure 1.

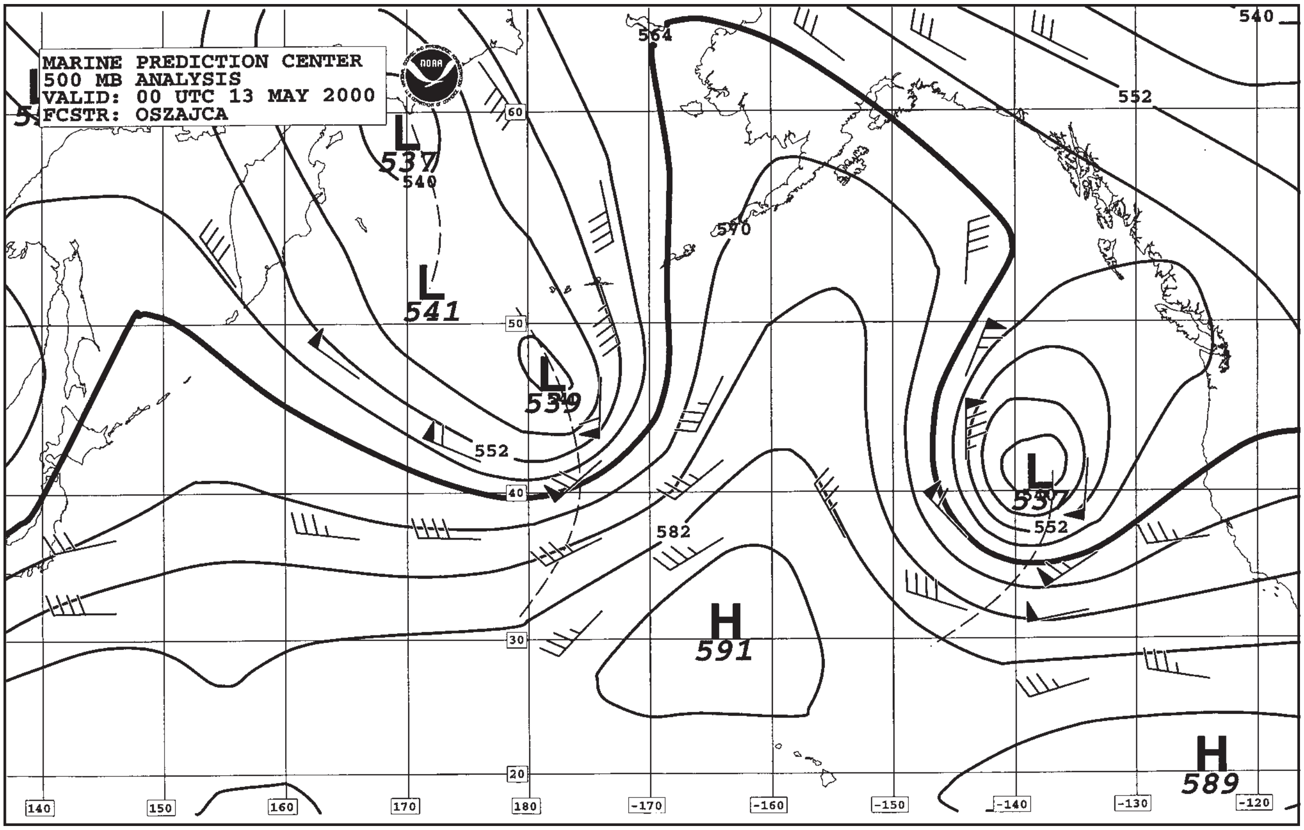

Figure 3. 500-MB analysis valid at 0000 UTC 13 May 2000.

North Pacific Area

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Mariner's Guide to the 500-Millibar Chart in References section.)

Later in May high pressure shifted to the eastern waters, with low-pressure centers tracking east off Japan, then northward toward the Gulf of Alaska, with others moving east at higher latitudes into the Bering Sea. With the approach of summer the trend was toward weaker systems and fewer storms. A late season storm did develop early in June off Japan and moved northeast into the Bering Sea, as shown in Figure 4. This storm attained a lowest pressure of 976 mb near 45N 167E at 1200 UTC 5 June before moving into the Bering Sea and beginning to weaken on the 6th. The ship **4XGT** at 36N 159E reported a south wind of 45 kts and 7.5 m (24 ft) seas at 1200 UTC 4 June.

The pattern settled into a more summerlike pattern late in June with high pressure becoming increasingly dominant, especially in the eastern North Pacific. Except for tropical cyclones, there were no more low-pressure systems producing storm force winds until August, when activity began to pick up again.

The first strong non-tropical low of the approaching fall season came early, at the beginning of August and is shown in Figure 5. A complex "developing gale" is shown passing along or south of the western Aleutians at 0000 UTC 1 August, then turning north into the Bering Sea during the following 48 hours and becoming a single 975 mb gale center by 0000 UTC 3 August. Figure 6, a GOES10 infrared satellite image valid at 0600 UTC 2 August (or 6 hours later than the second part of Figure 5), in fact reveals two centers of this system along 56N—one north of Adak Island and the other near the eastern

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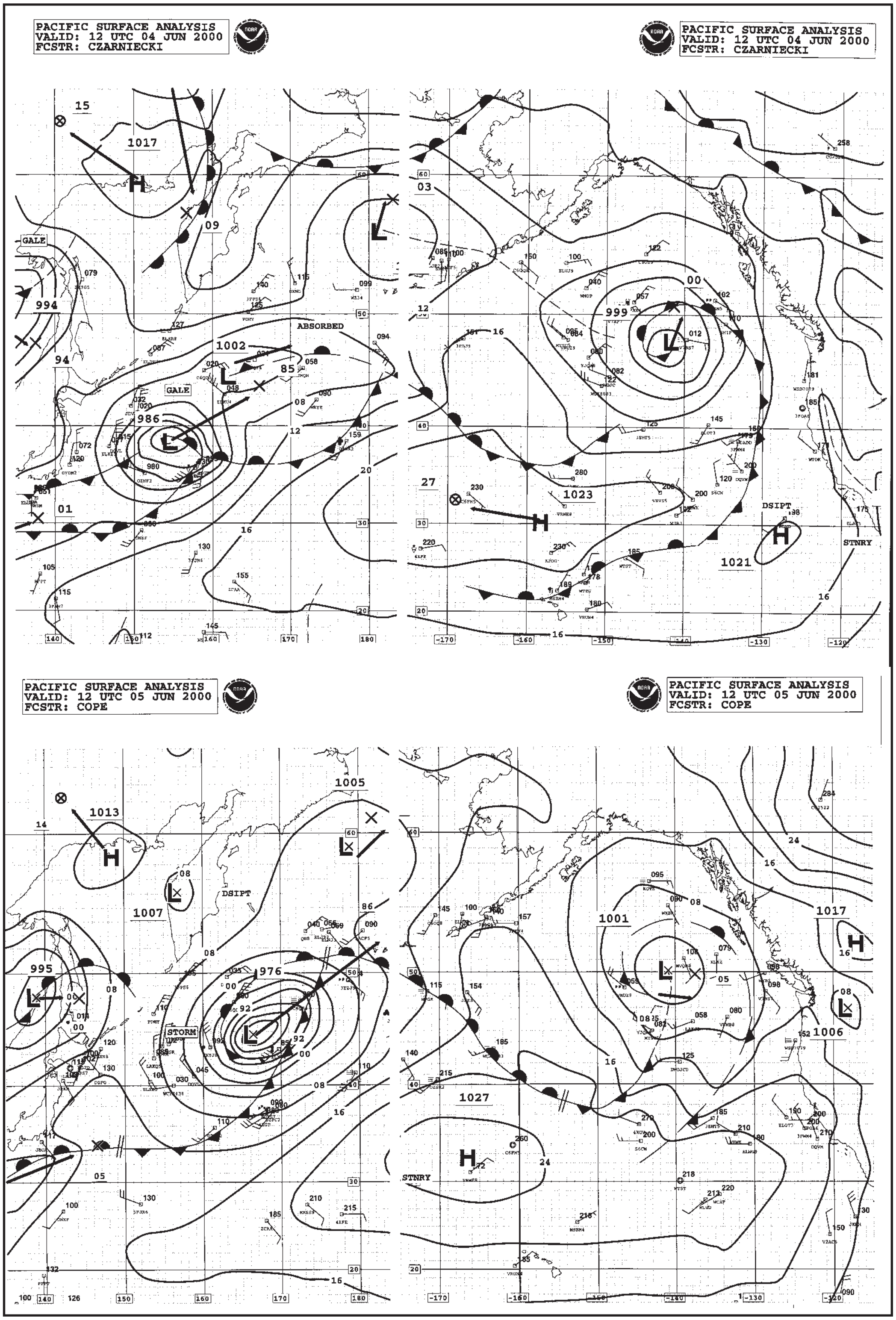

Figure 4. MPC North Pacific surface analysis valid 1200 UTC 4 and 5 June 2000.

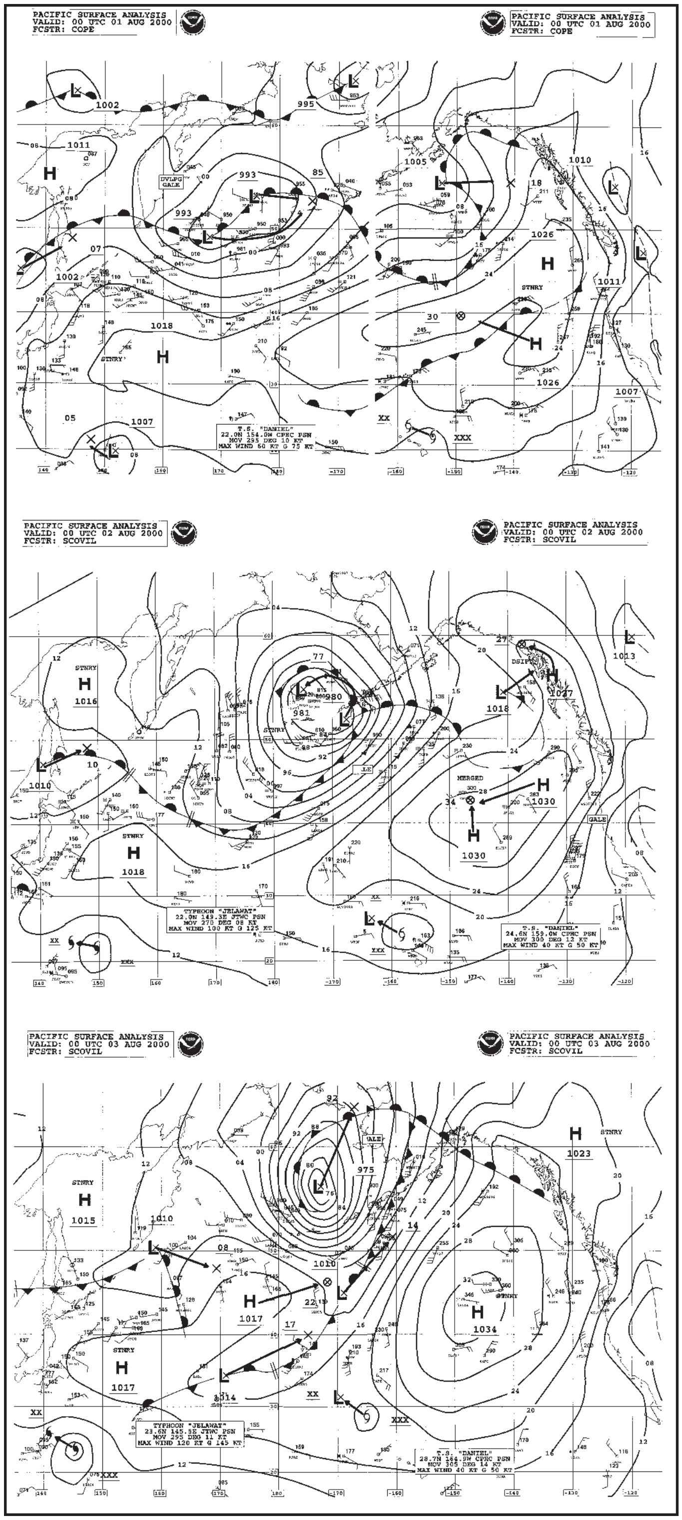

Figure 5. MPC North Pacific surface analysis valid 0000 UTC 1, 2, and 3 August 2000.

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Aleutians. Mostly gales were reported with this system, first south of the Aleutians and then in the Bering Sea as the center lifted north after 0000 UTC 3 August. There was one report of 50 kts (from the south) along with 4 m (13 ft) seas from the ship **3FIQ7** near 50N 163W at 0000 UTC 2 August, ahead of the cold front. The 60 kt report to the east in Figure 5 appears to be too high compared to its neighbors and is likely unreliable. The ship **WRYW** encountered a northwest wind of 40 kts and 10.5 m (34 ft) seas near 53N 178E at 0600 UTC 2 August, and the **Westwood Marianne** (**C6QD3)** reported a west wind of 35 kts and 10.5 m (34 ft) seas at 0000 UTC 3 August. Toward the end of August, another system of similar central pressure moved along a similar track and was classified as a storm by MPC (not shown).

Tropical Activity

Several tropical cyclones moved near or into MPC's high seas area

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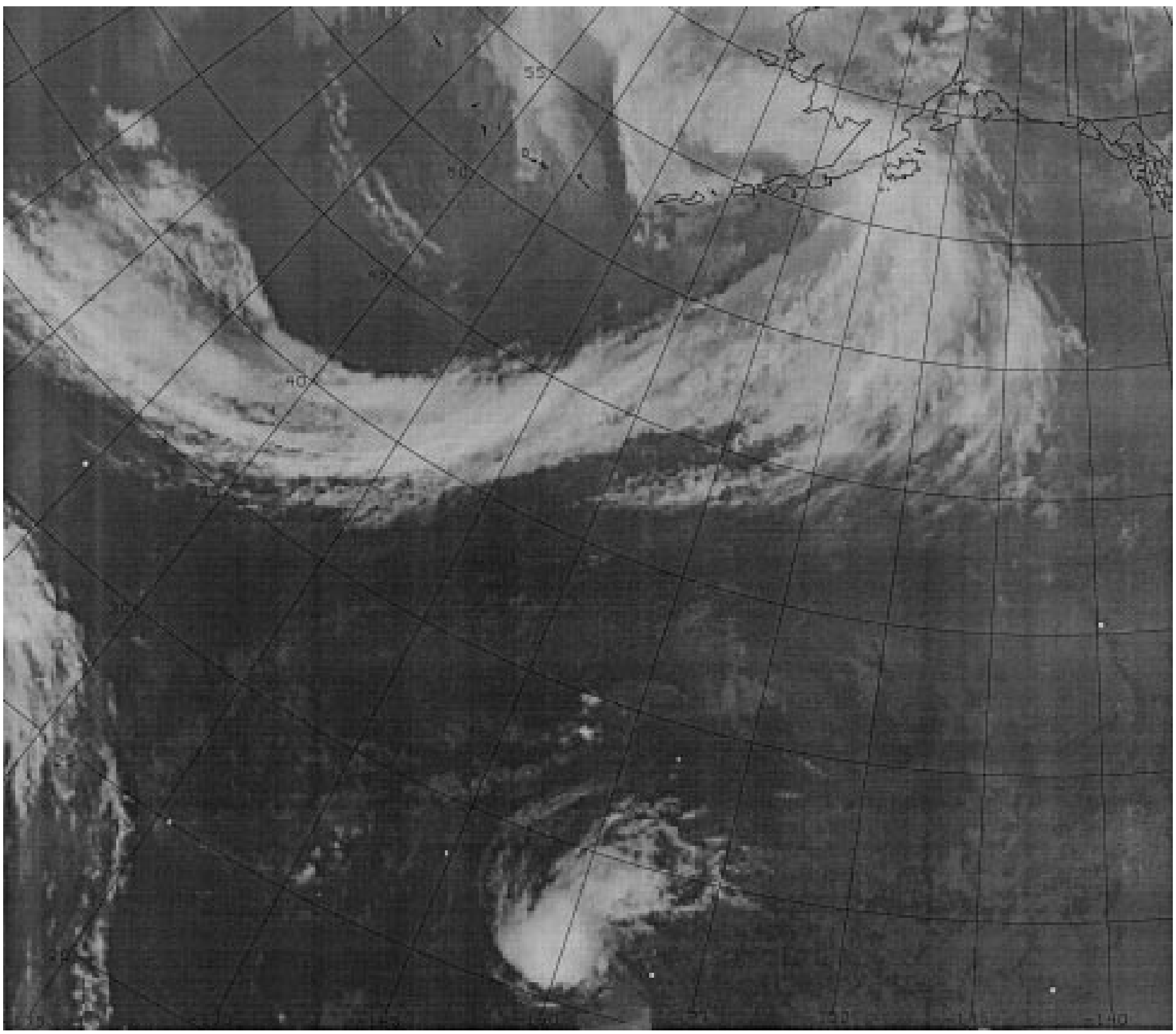

Figure 6. GOES10 infrared satellite image valid 0600 UTC 2 August 2000, or 6 hours later than valid time of second analysis in Figure 5.

North Pacific Area

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of responsibility (north of 30N east of 160E and east of a line from 50N 160E to the Bering Strait) during this period, most during August. Others remained south of 30N or recurved off Japan and became extratropical (associated with fronts, like lows found outside the tropics) as they approached 160W.

Typhoon Damrey appeared on the southwest corner of MPC ocean analyses by 9 May and moved east, but weakened and became an extratropical gale as it drifted into the far southwest high seas waters by the 14th, before dissipating 16 May. This was followed by Tropical Depression Longwang which appeared south of Japan on 20 May, but soon became extratropical and moved east of 160E as a gale on 22 May, then weakened near Vancouver Island on 27 May. Kirogi, a typhoon, approached Japan from the south on 6 July, but weakened to an extratropical gale near the Kurile Islands on 9 July, and later redeveloped as a 980 mb gale near 53N 169E at 1800 UTC 11 July. This system then weakened and moved into Alaska on 17 July. In August, Tropical Storm Daniel moved northwest from near Hawaii (appears as circular cloud cluster near bottom of Figure 6), and became a tropical depression (maximum sustained winds below 34 kts) upon entering MPC's high seas area near 30N 167W at 1800 UTC 3 August, before dissipating near 39N 172W at 1200 UTC 5 August. Figure 7 is a surface analysis from mid-August, which was the most active period for tropical cyclones. Four appear on the chart. Typhoon Ewiniar, nearly stationary, remained west of the high seas area and became extratropical at 1200 UTC 19 August. Tropical Storm Wene, just upgraded to a tropical storm by CPHC (Honolulu) after crossing the dateline, moved northeast and became an extratropical gale near 42N 176W 36 hours later. This was absorbed by another gale center approaching from the southwest on 19 August.⚓

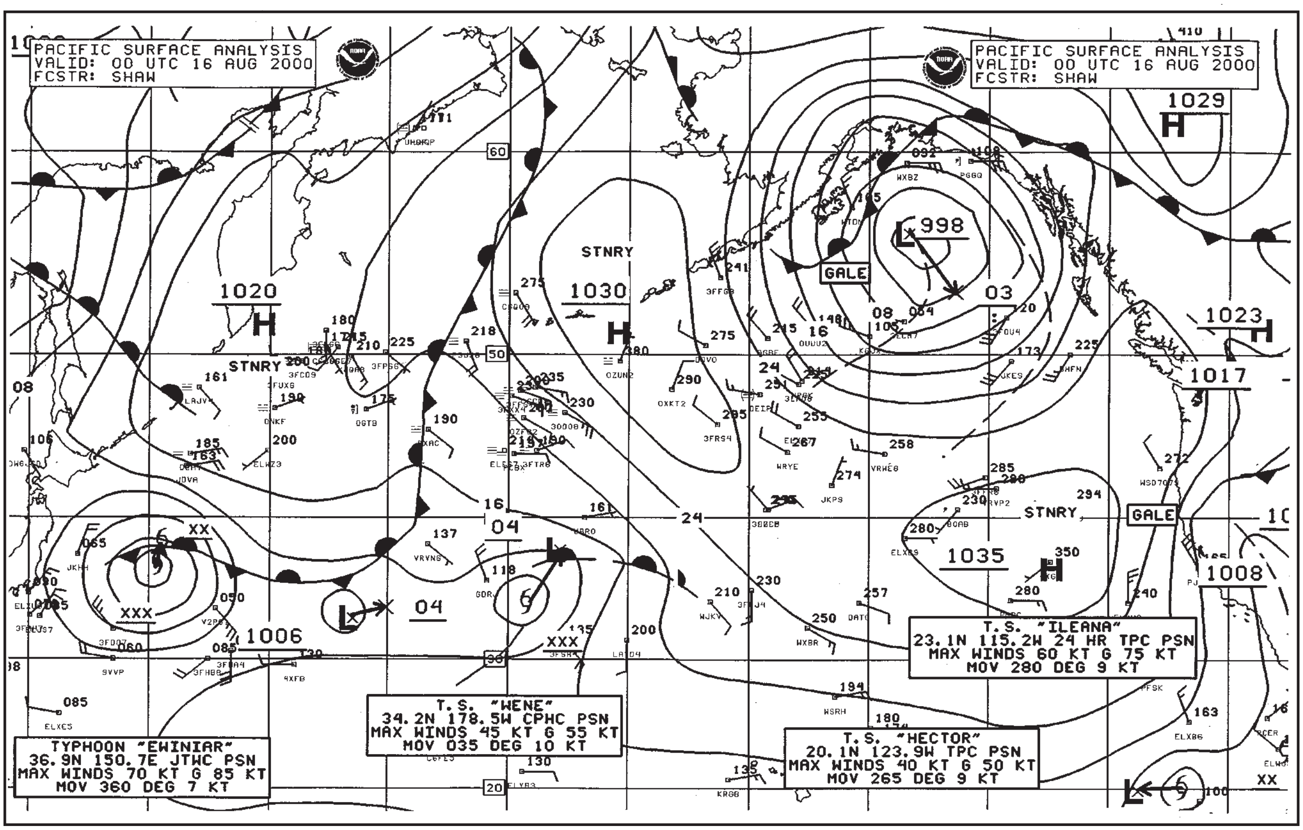

Figure 7. MPC North Pacific surface analysis valid 0000 UTC 16 August 2000.

Marine Weather Review
Tropical Atlantic and Tropical East Pacific Areas—May through August 2000

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I. Introduction

These four months were very busy at the Tropical Prediction Center (TPC). Above normal tropical cyclone activity occurred in both the Atlantic and Eastern Pacific basin with a total of 20 cyclones during the period. There were no significant non-tropical cyclone events during the period.

II. New Mariner's Guide For Hurricane Awareness

The TPC has produced a public service manual entitled "Mariner's Guide for Hurricane Awareness in the North Atlantic Basin." This document was written specifically for mariners to help increase their understanding of the structure, behavior, and characteristics of Atlantic Basin hurricanes while providing guidance and suggestions on avoiding these systems in the maritime environment.

Topics covered in the manual include basic hurricane structure, evolution, and motion, along with a detailed discussion of available hurricane-related products issued by the TPC/National Hurricane Center. An in-depth review of the available methods, including radio frequencies and schedules, for acquiring these products both at sea and in port is also included. The final section of the guide discusses many of the fundamental considerations mariners must account for in order to safely evade North Atlantic tropical cyclones, both in port or at sea.

The document, 2.2 MB in size and in PDF format, is free for review, printing, or download from the TPC web site at **www.nhc.noaa.gov**. The link to the document can be found under the "Additional Resources" section in the main

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page of the Hurricane Center web site. A limited printing of the manual will become available over the next few months with distribution through National Weather Service Port Meteorological Officers on the Atlantic and Gulf coasts of the United States. The author welcomes any comments and feedback regarding this manual at eholweg@nhc.noaa.gov.

III. Significant Weather of the Period

A. Tropical Cyclones: After a slightly slow start, seven tropical cyclones developed over the Atlantic during the period. These included one major hurricane (winds greater than 96 kts), one other hurricane, two tropical storms, and three tropical depressions. Thirteen cyclones formed over the eastern Pacific. These included two major hurricanes, three other hurricanes, six tropical storms, and two tropical depressions. Note: Tropical cyclone data should be considered preliminary. Only the tracks of the depressions will be included here. Maps showing the tracks of all the named storms of 2000 will be available in the next Mariners Weather Log.

1. Atlantic

Tropical Depression One: This poorly-defined system formed from a tropical wave over the Bay of Campeche on 7 June and moved little before dissipating the next day (Figure 1). The maximum winds were 25 kts, and there are no reports of damage or casualties.

Tropical Depression Two: This system formed from a tropical wave about 300 NM southeast of the Cape Verde Islands (Figure 2) on 23 June. It moved steadily westward and dissipated over the central tropical Atlantic on 25 June. The maximum winds were 30 kts, and the cyclone may have been close to tropical storm strength for a short time on the 23rd. There are no reports of damage or casualties.

Hurricane Alberto: Alberto was a long-lived Cape Verde hurricane that remained at sea through its lifetime. It is the longest-lived Atlantic tropical cyclone to form in August, and the third-longest-lived of record in the Atlantic. Alberto's track included intensifying into a hurricane three times, a large anticyclonic loop that took five days, and extratropical transition near 53°N.

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Ship (Name or ID)	Date/Time (UTC)	Lat. (°N)	Lon. (°W)	Wind dir/speed (deg/kt)	Pressure (mb)
MZYF3	04/0600	12.1	22.1	150/44	1007.8
V2PA9	04/1800	13.3	24.8	090/37	1005.0
Iver Pride	12/0600	34.7	54.3	160/39	1012.0
Stonewall Jackson	12/0900	34.2	55.4	200/43	1010.8
Kent Voyageur	15/0300	36.7	40.7	300/43	1014.8
Liberty Sun	16/0000	34.5	39.3	250/34	1010.6

Table 1. Selected ship observations of tropical storm force or greater winds associated with Hurricane Alberto, 3 - 23 August 2000.

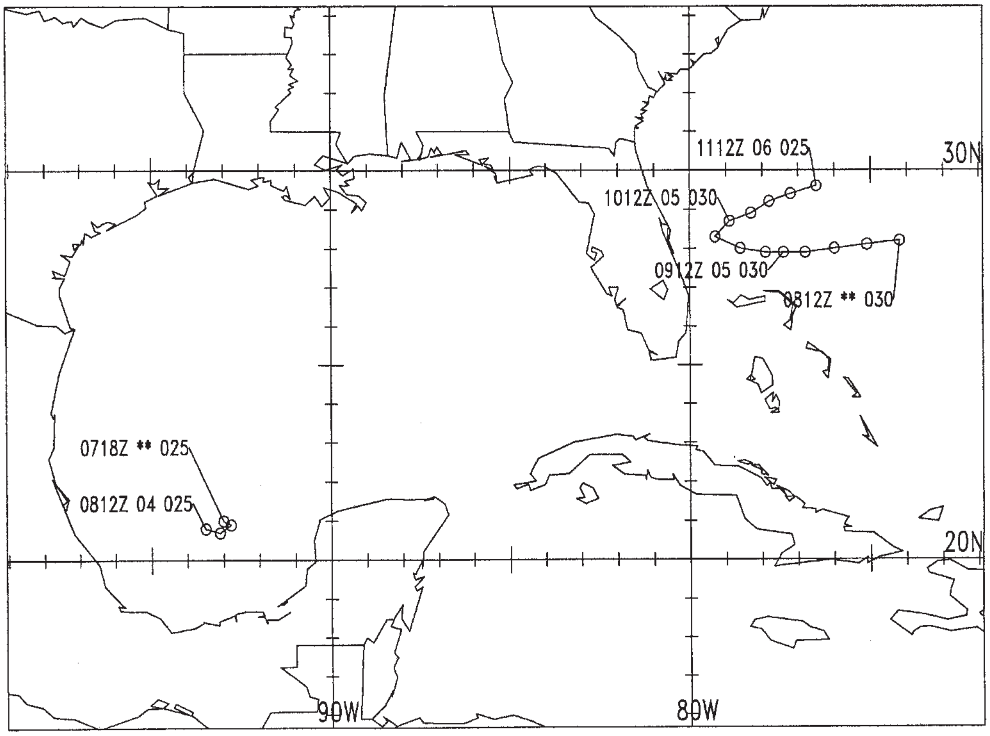

Figure 1. Best tracks for Tropical Depression One (left) and Tropical Depression Four (right). Circles are at 6 hr intervals.

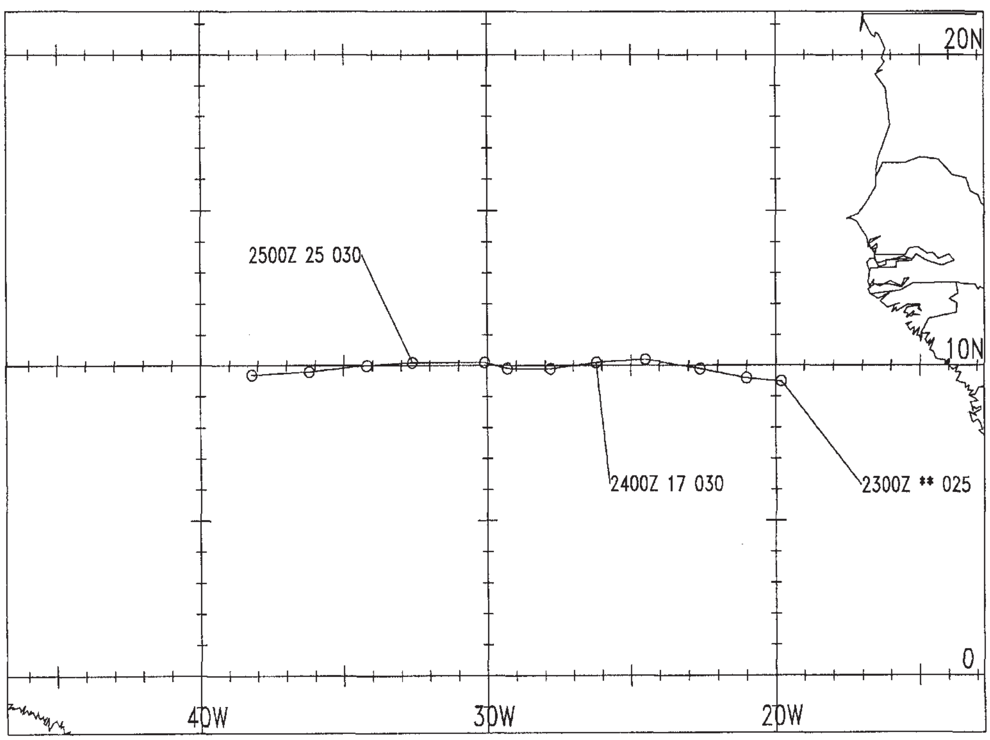

Figure 2. Best track for Tropical Depression Two. Circles are at 6 hr intervals.

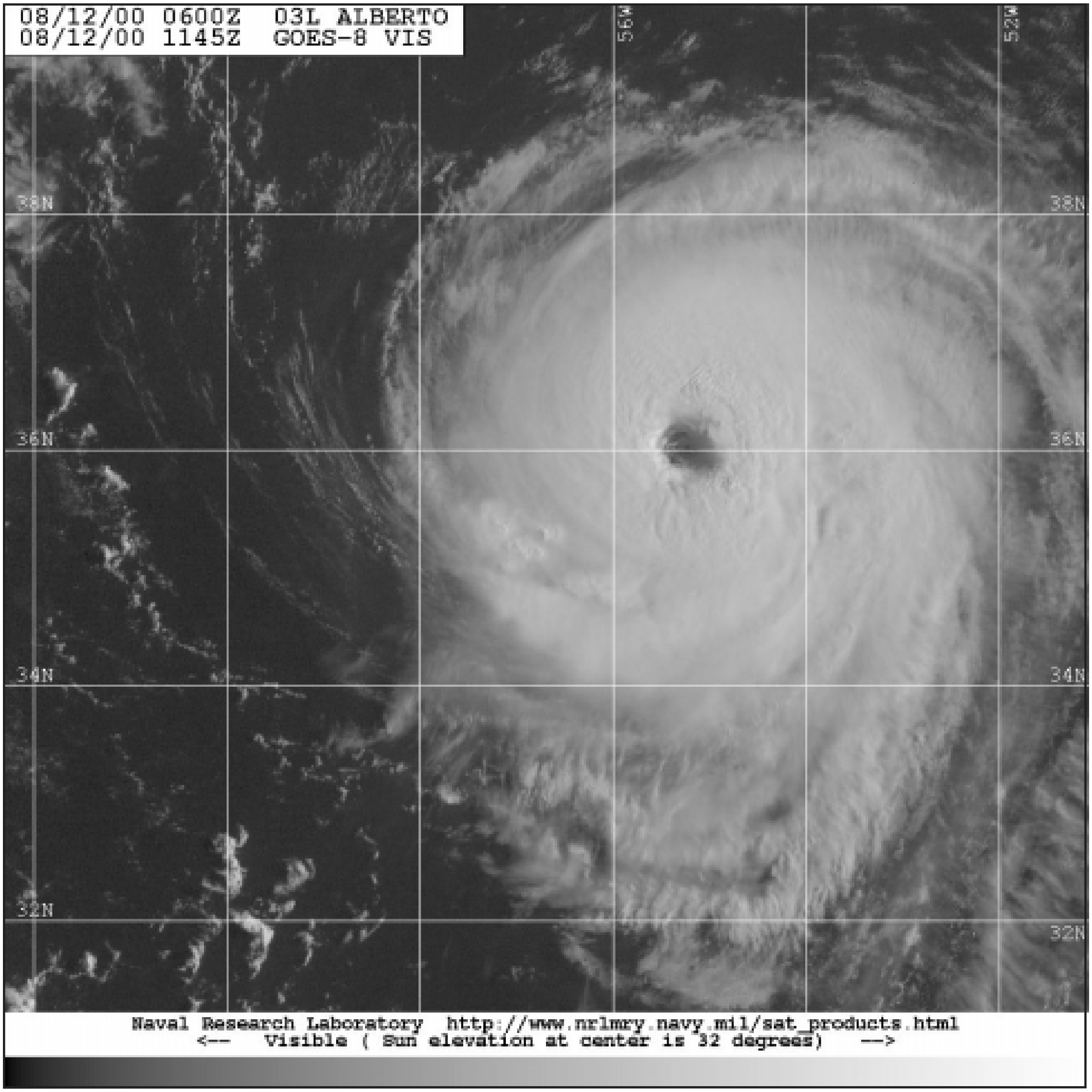

Figure 3. GOES-8 visible image of Hurricane Alberto near peak intensity at 1145 UTC 12 August 2000. Image courtesy of the Naval Research Laboratory, Monterey, California.

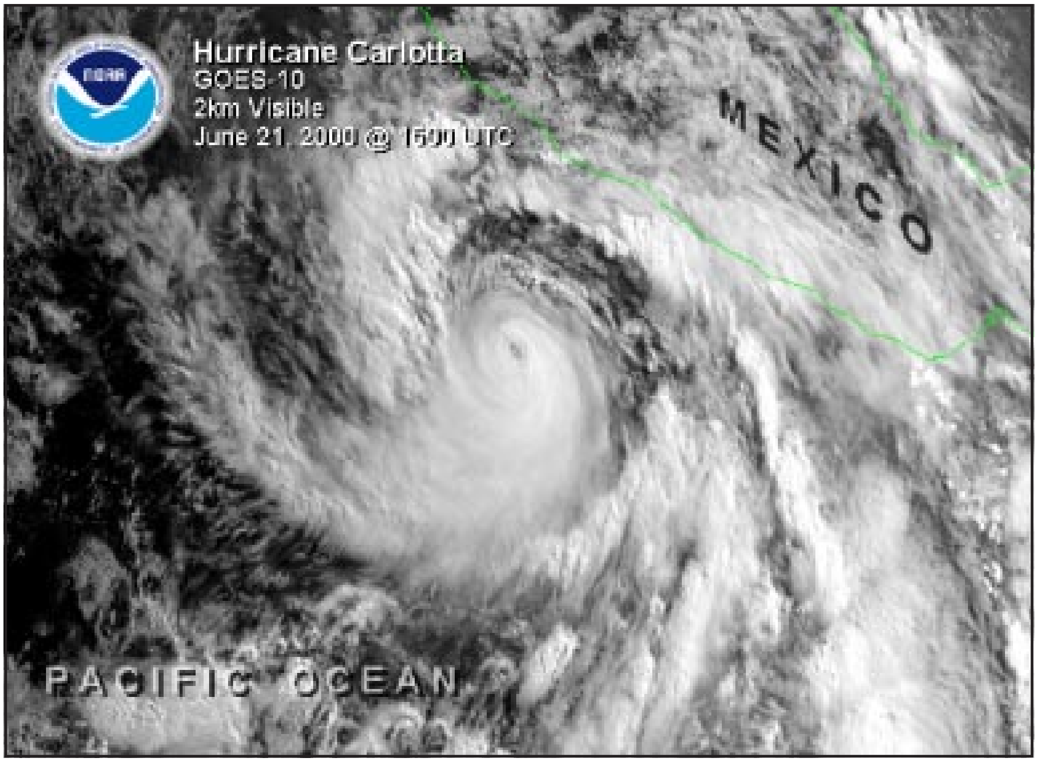

Figure 4. GOES-10 visible image of Hurricane Carlotta just after peak intensity at 1500 UTC 21 June 2000. Image courtesy of the National Climatic Data Center.

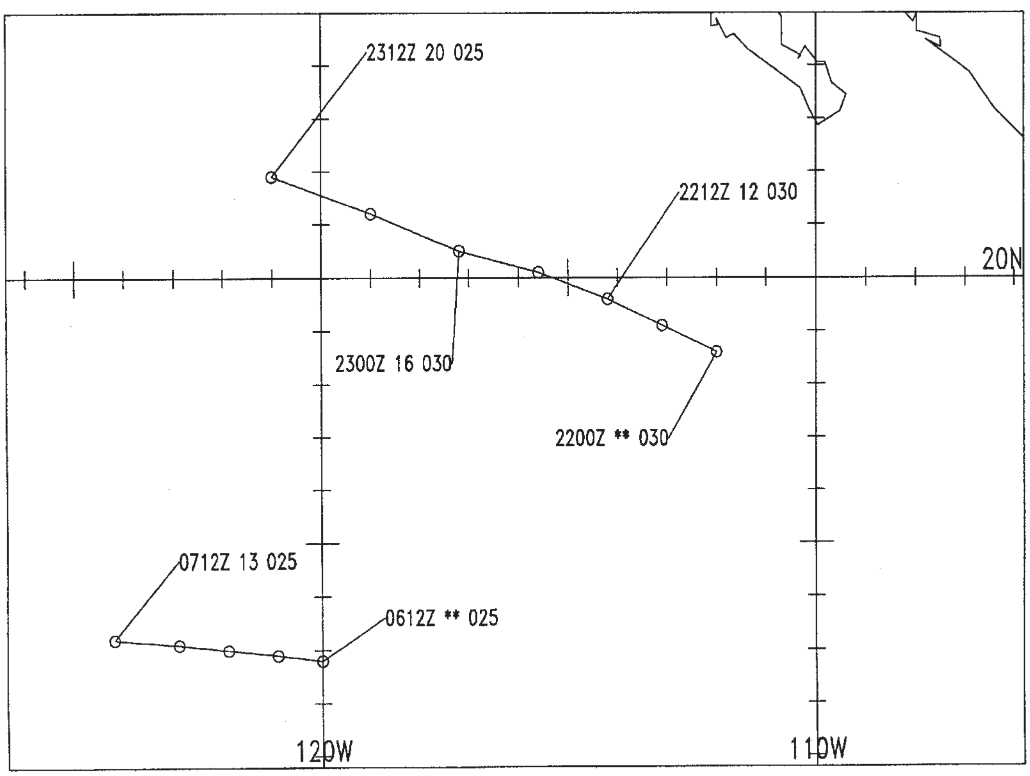

Figure 5. Best tracks for Tropical Depression Four-E (bottom) and Tropical Depression Five-E (top). Circles are at 6 hr intervals.

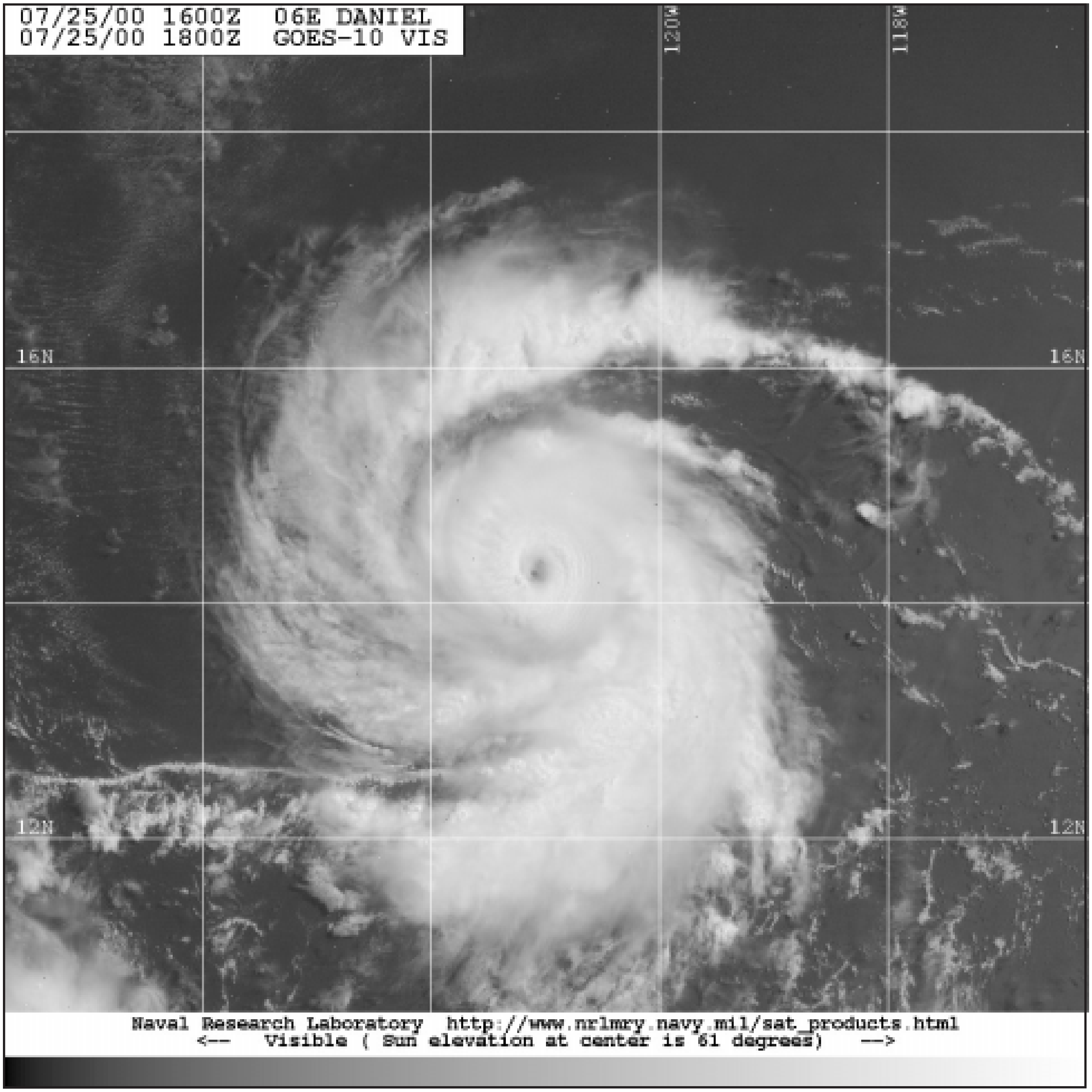

Figure 6. GOES-10 visible image of Hurricane Daniel near peak intensity at 1800 UTC 25 July 2000. Image courtesy of the Naval Research Laboratory, Monterey, California.

Tropical Prediction Center

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A well-organized tropical wave that moved off the African coast on 3 August developed into a tropical depression later that day. The cyclone moved quickly west-northwestward and became Tropical Storm Alberto early the next day. Alberto continued to strengthen, reaching hurricane status early on the 6th. This was coincident with a brief westward turn. The hurricane resumed a west-northwestward motion later that day. It reached a first peak intensity of 80 kts on the 7th.

Alberto turned northwestward on 8 August, and due to increased vertical shear weakened to a tropical storm the next day. It continued quickly northwest on the 10th while regaining hurricane strength. Alberto gradually recurved northeastward about 300 NM east of Bermuda on 11-12 August and reached its peak intensity of 110 kts on the 12th (Figure 3). Weakening occurred on the 13th and 14th as Alberto moved east-northeastward, with the cyclone becoming a tropical storm on the 14th.

Alberto started its loop by turning southward on 15 August, south-westward on 16 August, and westward on 17 August. The storm started to re-intensify on the 17th, and it regained hurricane status for the third time the next day. A third peak intensity of 90 kts occurred on the 20th. The hurricane completed its loop during this time, turning north-westward on the 18th, northward on the 19th, and north-northeast-ward on the 20th and 21st. Weakening and acceleration occurred on 22 August, and Alberto again weakened to a tropical storm before becoming extratropical the next day about 800 NM south-southwest of Iceland.

Shipping mostly avoided Alberto. At 0600 UTC 4 August, the **MZYF3** (name unknown) reported 44 kt winds and a 1007.8 mb pressure. This was the basis for upgrading the cyclone to a tropical storm. Table 1 contains other selected ship reports from Alberto.

There are no reports of damage or casualties from Alberto.

Tropical Depression Four: This small cyclone formed from a non-tropical weather system on 8 August about 350 NM off the east central coast of Florida (Figure 1). It moved slowly westward to about 70 NM from the coast on the 10th and then recurved north-eastward. The cyclone dissipated about 250 NM east of the north-east coast of Florida the next day. The maximum winds were 30 kts, and there are no reports of damage or casualties.

Tropical Storm Beryl: A broad area of low pressure over the western Gulf of Mexico organized into a tropical depression on 13 August. An Air Force Reserve Hurricane Hunter aircraft indicated the west-northwestward-moving system became Tropical Storm Beryl the next day. Maximum winds reached 45 kts with an aircraft-measured minimum central pressure of 1007 mb before landfall in northeastern Mexico on 15 August. Beryl dissipated over land later that day.

The only ship report of tropical storm-force winds was from the **Koeln Express**, which reported 35 kts at 0500 UTC 15 August and a 1008.0 mb pressure 3 hr earlier. Beryl is blamed for one death in Mexico.

Tropical Storm Chris: A tropical wave which moved off the African coast on 12 August organized into a tropical depression about 600 NM east of the Lesser Antilles on 17 August. The cyclone briefly became a tropical storm the next day before being torn apart by strong upper level winds. Chris dissipated about 150 NM east of the Leeward Islands on the 19th.

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

Hurricane Debby: A tropical wave that moved off the African coast on 16 August gradually organized into a tropical depression about 900 NM east of the Windward Islands on 19 August. Moving generally west-northwest-ward, the cyclone reached tropical storm strength the next day and hurricane strength on 21 August.

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Debby reached a peak intensity of 75 kt later on the 21st, then weakened to minimal hurricane strength while passing through the northern Leeward Islands on the 22nd. The hurricane passed just north of Puerto Rico later that day. Strong upper level winds caused Debby to weaken to a tropical storm as it turned westward along the northern coast of Hispaniola. Debby continued generally westward on 24 August while weakening to a depression, and it dissipated along the south coast of eastern Cuba later that day.

Shipping generally avoided Debby, and there are no marine reports of tropical storm-force or greater winds. St. Barthelemy reported a gust to 66 kts, while St. Maarten reported a gust to 52 kts. Other gusts to tropical storm-force occurred in Puerto Rico. The aircraft-measured minimum central pressure was 991 mb.

No deaths are directly attributed to Debby. While there was minor damage to property, no monetary estimates are available.

2. Eastern Pacific

Hurricane Aletta: A tropical wave that crossed Central America on 18-19 May gradually organized into a tropical depression about 210 NM south of Acapulco, Mexico on 22 May. Initially moving west-northwestward, the cyclone turned westward the next day as it became a tropical storm. Aletta reached hurricane strength on 24 May with a peak intensity of 90 kts later that day. Aletta stalled near 15°N 107.5°W on the 25th, and a slow and erratic motion continued into the 27th. Aletta weakened to a tropical storm and then a depression on the 27th, and the cyclone dissipated the next day about 400 NM south-southeast of Cabo San Lucas, Mexico.

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

Tropical Storm Bud: A tropical wave which moved into the eastern Pacific on 6 June started to slowly organize on 11 June. The system formed into a tropical depression about 370 NM south-southwest of Manzanillo, Mexico on 13 June and reached tropical storm status later that day. Initially moving northwestward, the storm

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Ship (Name or ID)	Date/Time (UTC)	Lat. (°N)	Lon. (°W)	Wind dir/speed (deg/kt)	Pressure (mb)
Zim Italia	18/1800	13.2	93.8	070/35	1008.8
Roger Revelle	19/2100	15.0	98.0	090/40	1008.0
Maren Maersk	20/0000	16.8	100.8	100/35	1010.0
Zim Atlantic	21/1500	18.1	103.5	090/40	1011.0
Hong Kong Express	22/0000	17.9	103.4	090/34	1011.0
Alligator Liberty	23/0000	19.8	106.0	120/39	1009.9
ELWZ5	23/0600	20.7	106.8	140/35	1012.0

Table 2. Selected ship observations of tropical storm force or greater winds associated with Hurricane Carlotta, 18 - 25 June 2000.

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turned north-northwestward on the 14th while reaching a peak intensity of 45 kts. Bud weakened to a depression on the 16th while slowing to an erratic drift, and it dissipated the next day about 90 NM north-northeast of Socorro Island.

Bud passed near Socorro Island, which reported a pressure of 997.3 mb at 1500 UTC 15 June. The **Roger Revelle** reported 40 kt winds and a 1001.0 mb pressure at 0000 UTC 14 June. There are no reports of damage or casualties.

Hurricane Carlotta: A tropical wave moved into the eastern Pacific on 15 June and gradually became better organized. The system developed into a tropical depression on 18 June about 235 NM southeast of Puerto Angel, Mexico. The cyclone moved west-northwestward as it became a tropical storm on the 19th and a hurricane on the 20th. Rapid strengthening occurred on 20-21 June as Carlotta turned westward, and the hurricane reached a peak intensity of 135 kts early on the 21st (Figure 4). Carlotta turned west-northwestward on 22-23 June again while slowly weakening. This was followed by a northwestward motion and weakening to a tropical storm on the 24th. The cyclone weakened to a depression on 25 June and dissipated later that day about 415 NM west of Cabo San Lucas. Several ships encountered Carlotta, with the observations listed in Table 2. Bahias de Huatulco, Mexico reported a gust to 38 kt.

While Carlotta did not seriously affect land, it did cause a marine tragedy. Press reports indicate the Lithuanian freighter **MV Linkuva** suffered an engine failure and was caught near the center of Carlotta at or near peak intensity on 20 or 21 June. The ship and its crew of 18 were lost.

Tropical Depression Four-E: The tropical wave that spawned Atlantic Tropical Depression Two crossed Central America around 30 June. The system organized into a tropical depression about 1200 NM southwest of Cabo San Lucas on 6 July (Figure 5) and moved westward before dissipating the next day. The maximum winds were 25 kts and there are no reports of damage or casualties.

Tropical Depression Five-E: A tropical wave that crossed Central America on 16 July spawned a tropical depression just west of Socorro Island on 22 July. The system moved steadily west-northwestward and dissipated the next day about 620 NM west of Cabo San Lucas. The maximum winds were 30 kts, and there are no reports of damage or casualties.

Hurricane Daniel: A tropical wave organized into a tropical depression on 23 July about 560 NM south-southeast of Manzanillo. Moving steadily west-northwestward, the system became Tropical Storm Daniel later that day. Rapid intensification followed, and Daniel became a major hurricane with 110 kt winds 48 hr after it was a minimal tropical storm (Figure 6). Daniel continued west-northwestward until it crossed 140°W into the central Pacific on 28 July. During this time, maximum winds fluctuated between 90-105 kts. Daniel weakened to a tropical storm before passing north of the Hawaiian Islands on 1-2 August. It turned northwestward and further weakened to a depression on 3 August. The cyclone dissipated on the 5th about 1000 NM northwest of the Hawaiian Islands.

There are no ship reports of tropical storm-force winds from Daniel, or reports of damage or casualties. Air Force Reserve Hurricane Hunter Aircraft did observe tropical storm-force winds while Daniel was north and northeast of Hawaii.

Tropical Storm Emilia: A tropical wave that crossed Central America on 21-22 July developed into a tropical depression about 290 NM south-southwest of Manzanillo on 26 July. Moving west-northwestward, the cyclone reached tropical storm strength later that day. This was followed by a peak intensity of 55 kts on the 27th. Emilia turned westward and weakened on 28 August. Further weakening made Emilia a depression on the 29th, and it dissipated on the 30th about 630 NM west-southwest of Cabo San Lucas.

Continued on Page 68

Tropical Prediction Center

Continued from Page 67

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

Tropical Storm Fabio: A tropical wave which moved across Central America on 27 July organized into a tropical depression about 445 NM south-southwest of Cabo San Lucas on 3 August. Initially moving west-northwestward, the cyclone turned westward on the 4th as it became 45 kt Tropical Storm Fabio. Fabio turned west-southwestward on 5 August, and this motion would continue for the rest of the cyclone's life. It weakened to a depression on the 6th and dissipated about 1165 NM west-southwest of Cabo San Lucas on the 8th.

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

Hurricane Gilma: A tropical wave that moved into the Pacific on 2 August gradually organized into a tropical depression about 250 NM south of Manzanillo on 5 August. The cyclone became a tropical storm later that day as it moved generally west-northwestward, a motion it would follow for all its life. Gilma reached hurricane strength on the 8th, with a peak intensity of 70 kts later that day. It weakened to a tropical storm on the 9th and to a depression on the 10th. The cyclone dissipated about 750 NM west of Cabo San Lucas on the 11th.

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

Hurricane Hector:A tropical wave that crossed Mexico into the Pacific on 9 August organized into a tropical depression about 160 NM southwest of Manzanillo on 10 August. Moving generally westward, the system became a tropical storm on the 12th and a hurricane on the 14th. A northwestward turn occurred later that day as Hector reached a peak intensity of 70 kts. Hector turned westward on 15 August and continued this motion until dissipation. It weakened to a tropical storm later on the 15th and to a depression on the 16th. Hector dissipated as a tropical cyclone about 1030 NM west-southwest of Cabo San Lucas. However, the remains of the system continued westward and produced heavy rains in the Hawaiian Islands on 20 August.

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

Tropical Storm Ileana: A tropical wave that crossed Mexico into the Pacific on 12 August developed into a tropical depression about 100 NM south of Manzanillo the next day. It intensified into Tropical Storm Ileana on the 14th. Ileana moved northwestward parallel to the Mexican coast on the 15th while reaching a peak intensity of 60 kts. It then turned west-northwestward, passing about 60 NM south of Cabo San Lucas. This motion continued on the 16th as Ileana weakened to a depression, and the cyclone dissipated the next day about 250 NM west of Cabo San Lucas.

The **Golden Bear** reported 35 kt winds and a 1008.4 mb pressure at 0000 UTC 15 August. Although Ileana affected portions of mainland Mexico and Baja, California, there are no reports of damage or casualties.

Tropical Storm John: A disturbance in the Intertropical Convergence Zone developed into a tropical depression about 1700 NM west-southwest of Cabo San Lucas on 28 August. The system moved slowly northwestward and reached tropical storm strength later that day. John continued northwest into the central Pacific on 30 August where it reached a peak intensity of 60 kts. The motion became erratic as John weakened on the 31st, and John dissipated the next day about 750 NM east-southeast of the Hawaiian Islands.

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

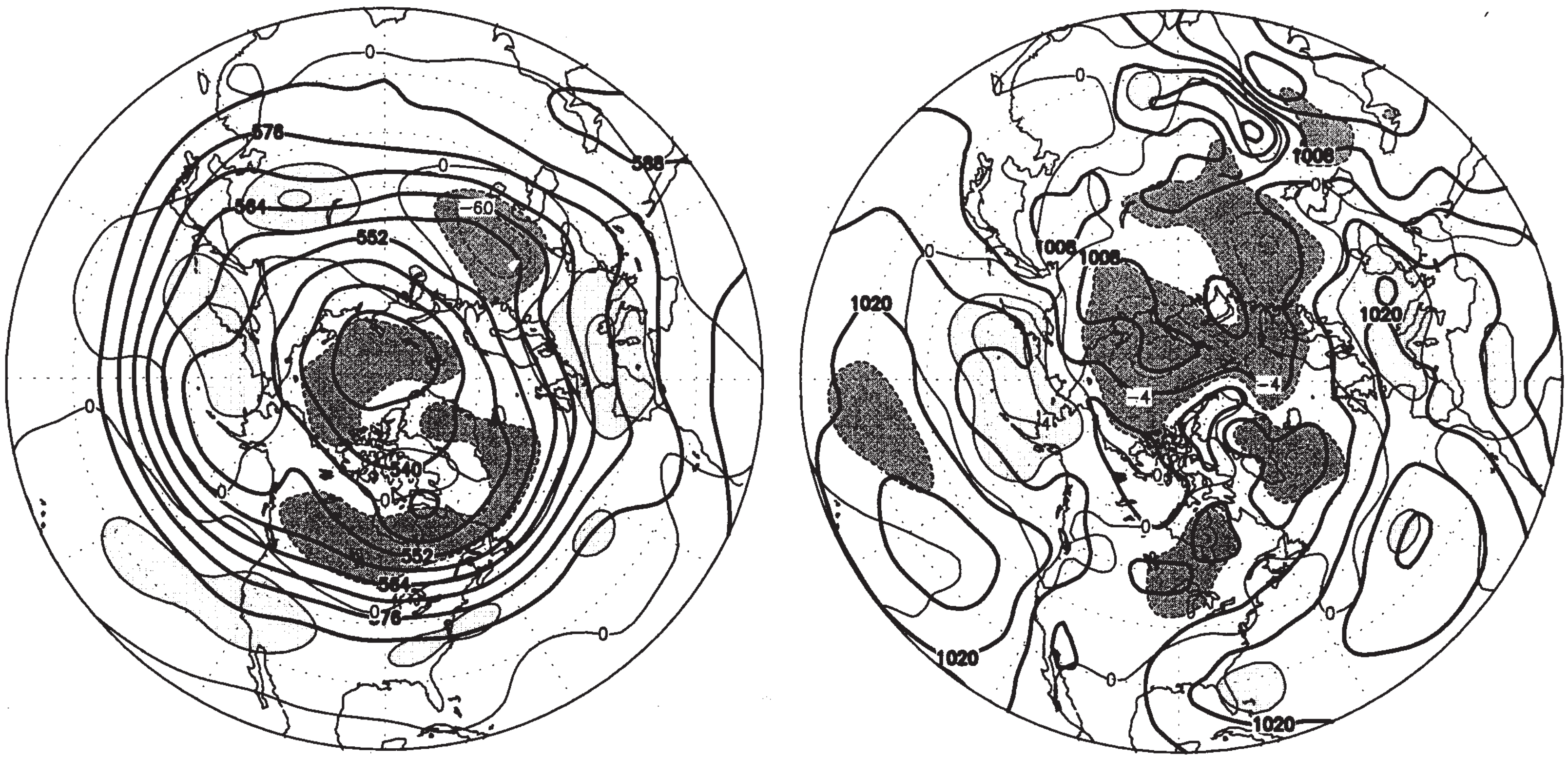
Tropical Storm Kristy: While this system developed on 31 August, most of its life was in September. More information will found in the next Mariners Weather Log.

B. Other Significant Events

None.⚓

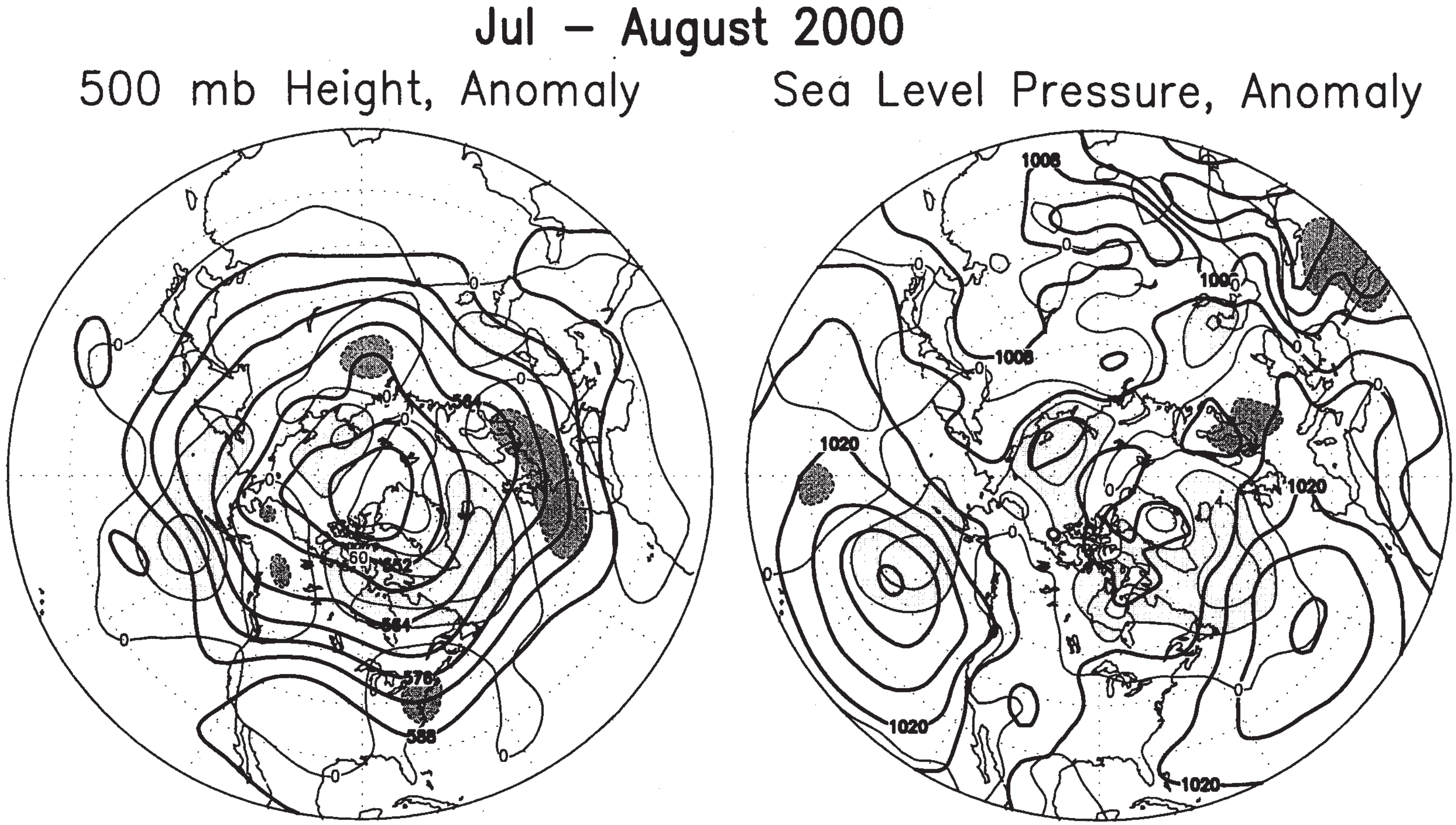
May – June 2000

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.

Coastal Forecast Office News

Small Craft Should Exercise Caution

Mike Colby
Newport/Morehead City, North Carolina

Very soon the title you see above will appear as a headline in marine forecasts when winds are expected to range from 20 to 24 knots, or for seas of 5 feet. Winds 25 knots and greater or seas 6 feet and higher will have the familiar "Small Craft Advisory" headline. The addition of this new headline reflects concern among the local boating community in a recent survey conducted by the NWS. Mariners voiced the need for a cautionary heads-up when conditions pose a potential threat but remain just below small craft advisory criteria. This change will become effective sometime before November in the coastal waters from Currituck Beach Light to Cape Hatteras to Surf City including the Pamlico and Albemarle Sounds. Those plying the waters also expressed a need for more frequent updates of thunderstorm location and movement via NOAA weather radio. The NWS has listened and has responded. We now issue marine weather statements that describe short-term trends for thunderstorms at sea. The statements detail location and movement of storms, while highlighting factors such as lightning activity, restrictions to visibility, and local sea heights.

The survey made it clear that mariners rely significantly on timely and accurate forecasts. The primary mission of the NWS is providing protection to life and property against the damaging effects of adverse weather. If you have any suggestions on how we may improve our marine services, please write to: NWS attn: M.Colby 533 Roberts Road, Newport, NC 28570.

WFO Eureka Looks Ahead To New Marine Forecasting Possibilities

Jeff Osiensky and John Lovegrove
WFO Eureka, California

Marine forecasting has advanced over the past decade thanks to new technology, namely faster computers and an increase in data. Over the past two years, yet another advancement has taken place with the NWS adopting the WaveWatch III as its ocean model. The WaveWatch, with its improved physics package, is a superior wave model to those previously

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Coastal Forecast Office News

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available. The marine program at WFO Eureka is one of the most important programs in the office and great efforts are put forth to support it.

Customer feedback from marine outreach sessions in 1998 revealed the need for having an extended seas forecast. Mariners stated that although the extended period wind forecast was helpful, the additional seas information would be extremely useful in planning. The staff at the Eureka office set out to determine how to provide this information to its customers. After coordination with Regional Headquarters, the office became a test site for this forecast. Several months of testing and evaluation (including verification) ensued. WFO Eureka now routinely issues the extended seas forecast as part of the coastal waters forecast.

Due to the many changes and enhancements to marine forecasts a Marine Weather Advisory Group was formed. This group is comprised of NWS meteorologists, U.S. Coast Guard, harbor masters, tug operators, local yacht club representatives, fisherman, academia, and harbor commissioners. The group meets formally once a year and corresponds via e-mail and phone at other times. The group serves to represent the user community and provides input on issues which impact our customers. The marine customers truly have a voice in the decision making process.

A project was started in December 1999 which looked at the standard 10-foot criteria used to issue Small Craft Advisory for Hazardous Seas on the west coast. Numerous customers said that the hazard is not sea height dependant, but rather wave steepness and boat size dependant. The office began a study where the marine forecasters would forecast a predominate wave period and sea height for a zone. Nearby buoys were used to verify the forecasts. The goal was to develop an index which represents a steepness which would be the new criteria used to issue Small Craft Advisory for Hazardous Seas. In the midst of this project it became evident that the forecasters showed skill in forecasting wave period. This lead to the Small Craft Advisory project being temporarily set aside in favor of a larger project.

Forecasting period had always been a long range goal of the office due to customer requests. After the local study revealed skill in forecasting period, a proposal was written with Regional Headquarters to test the period forecast. The test confirmed the period forecast skill. Beginning in late November 2000, the swell period will be included in Northern California coastal waters forecasts.

The Humboldt Bay entrance has the reputation as one of the most dangerous harbor entrances on the West Coast. Humboldt Bay is also one of the few major ports between San Francisco and Portland. The bar crossing can be dangerous at times and several people have been killed attempting to traverse it. There are more optimum times to cross the bar which correlate to seas, current, and tides. The NWS in Eureka is working to develop a bar model with the idea of producing a bar forecast. The NWS in Portland currently writes a bar forecast for the Columbia River and Seattle for Grays Harbor. The Eureka project will create a nested model using the WaveWatch III for deep water, a shallow water model to propagate the waves to shore, then finally a bar model.

NWS Eureka hired a summer student from the local university who will work on the development of a bar model for the Humboldt Bay entrance. Cooperators on the project include Humboldt State University and the U.S. Coast Guard.

The many simultaneous marine projects necessitated the formation of a marine team. This group consists of five meteorologists in the office including the Warning Coordination Meteorologist (WCM) and the Service Hydrologist (SH). The SH provides insight since he is a mariner and vessel owner. The idea of the team was to have project leaders to keep some organization within all the activities.

The NWS Eureka office has a firm commitment to marine forecasting on the north coast of California. This progressive, forward thinking philosophy will continue to allow for new marine forecasting possibilities in the future.⚓

Voluntary Observing Ship Program

Martin S. Baron
National Weather Service
Silver Spring, Maryland

VOS Program Management Now Under the National Data Buoy Center

As part of the National Weather Service (NWS) Headquarters reorganization implemented October 2000, management of the Voluntary Observing Ship (VOS) program has come under the NWS Office of Operational Systems, National Data Buoy Center (NDBC) in Bay St. Louis, Mississippi. The program will reside in NDBC's Data Systems Division. Publication of the Mariners Weather Log will also be transferred to the NDBC. There should be no interruption in the printing schedule.

This consolidates the entire NWS Marine Observations Program (including the VOS, Data Buoy, and Coastal Marine Automated Network [C-MAN] stations), under central management. It is expected that this will lead to more efficient operations and facilitate the making of plans and improvements in these important programs.

Vince Zegowitz Retires

Vincent Zegowitz, NWS Marine Observations Program Leader for the past 14 years, retired effective December 1, 2000, after completing 34 years of federal service. Vince is well known in the marine community, both nationally and internationally, and will be missed both for his enthusiasm and storehouse of knowledge about the VOS and marine observations programs.

For the immediate future, Vince plans to remain in the Silver Spring area and can be contacted at his home address: 9923 Grayson Ave, Silver Spring, Maryland. His home telephone number is 301-593-8657, e-mail vzegowitz@hotmail.com. In the future, he may relocate to the family seaside home on the North Carolina Outer Banks.

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Vince and Mary Ann Zegowitz

VOS Program

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Your Cooperation is Appreciated

The National Weather Service thanks ships' officers for participating in the VOS Program and for taking the time to observe, format, and transmit weather observations as real-time messages.

All vessels should follow the weather reporting schedule as closely as possible—**Report weather at 0000, 0600, 1200, and 1800 UTC when underway.** This is a worldwide schedule for all marine areas. Also remember the 3-hourly reporting schedule for vessels operating within 300 miles of named tropical storms or hurricanes (also in effect worldwide). Additionally, the United States and Canada request 3-hourly reports from within 200 miles of their coastlines and from anywhere on the Great Lakes.

Report Accurate Data

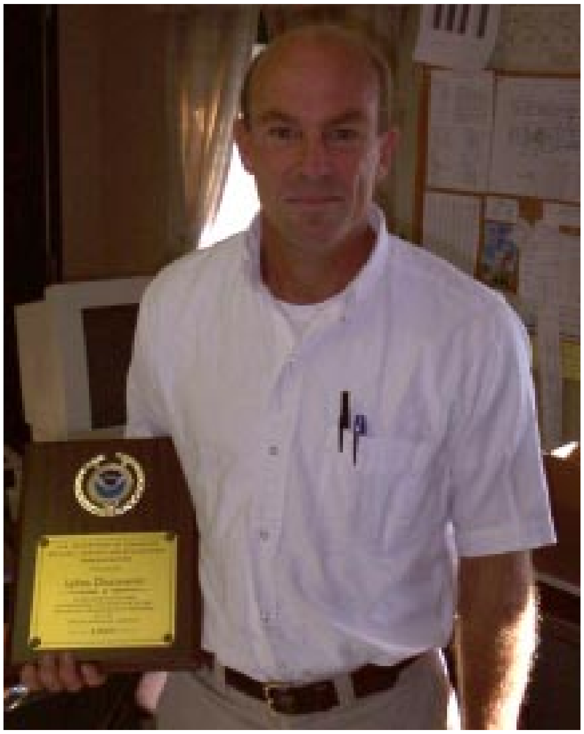
Take care at all times to ensure the accuracy of your data. Make sure your equipment is properly calibrated. Sea water thermometers should be checked and calibrated annually. If your vessel has an anemometer, the recommended interval for calibration is once every six months. Make sure the anemometer is located where the ships' superstructure will not interfere with air motion (preferably near the bow or as far forward as possible on the vessel). A PMO should calibrate your barometer and barograph once every three months and check your psychrometer during every ship visit. When recording dry and wet bulb temperatures, take your psychrometer to the windward side of the ship (to ensure that your measurements are for air fresh from the sea).⚓

National Weather Service Voluntary Observing Ship Program

New Recruits from May 1 through August 31, 2000

NAME OF SHIP	CALL	AGENT NAME	RECRUITING PMO
ARIES HARMONY	3FEY7	LIBERA SHIP MANAGEMENT CO.	SEATTLE, WA
ARISO	3FHJ6	SENSO CO. LTD (K-LINE SHIP MANG.)	SEATTLE, WA
AROSIA	V2SB	GENSHIPPING CORPORATION	NEW ORLEANS, LA
ASPHALT COMMANDER	WFJN	RICE UNRUH REYNOLDS	NEW ORLEANS, LA
BUNGA ORKID TIGA	9MBS3	MALAYSIAN INTERNATIONAL SHIPPING CO.	SEATTLE, WA
CAPRICORN	PDAY	B.V. KUSTVAARTBEDRIJF MOERMAN	BALTIMORE, MD
CGM RENOIR	ELVZ8	INCHAPE SHIPPING SERVICES	NORFOLK, VA
CHANG-LIN TIEN	C6FE6	CHEVRON SHIPPING CO	SAN FRANCISCO, CA
COLUMBIA BRIDGE	ELXS4	K-LINE AMERICA, INC	SEATTLE, WA
COURIER	KCBK	RICE, UNRUH, REYNOLDS CO	HOUSTON, TX
DRESDEN	ELXZ4	INCHCAPE SHIPPING SERVICES	SAN FRANCISCO, CA
ENCHANTED ISLE	3FMG2	CSA	NEW ORLEANS, LA
EVER APEX	3FCX7	EVERGREEN AMERICA CORP.	BALTIMORE, MD
EVER GENERAL	BKHY	EVERGREEN AMERICA CORP.	BALTIMORE, MD
EVER GOLDEN	BKHL	EVERGREEN AMERICA CORPORATION	BALTIMORE, MD
EVER GUEST	3ETV4	EVERGREEN MARINE CORP, EVERGREEN BLDG 166, SEC 2	NEWARK, NJ
EVER UNITY	3FCO9	EVERGREEN AMERICA CORP.	SEATTLE, WA
FRONTIER ACE	H3CH	M. O. SHIP MGMT CO., LTD.	JACKSONVILLE, FL
GREEN COVE	WCZ9380	INTEROCEAN	SAN FRANCISCO, CA
GREEN DALE	WCZ5238	WATERMAN STEAMSHIP CORP.	JACKSONVILLE, FL
GUDRUN MAERSK	OZFQ2	MAERSK-SEALAND INC	NEW YORK CITY, NY
HYUNDAI FRONTIER	C6RF6	HYUNDAI AMERICA SHIPPING AGENCY, INC	SEATTLE, WA
LADY MARYLAND	WTV4008	LIVING CLASSROOM FOUNDATION	BALTIMORE, MD
NAGOYA EXPRESS	P3LE4	INTERNATIONAL SHIPPING CO., INC	SEATTLE, WA
NORWEGIAN MAJESTY	C6OY4	ROYAL MAJESTY	MIAMI, FL
PATRIOT	KGBQ	PORT METEOROLOGICAL OFFICER	HOUSTON, TX
PERSEUS LEADER	3FBO9	NYK LINES	JACKSONVILLE, FL
POLYNESIA	DNMR	INTEROCEAN STEAMSHIP CORP	SAN FRANCISCO, CA
SEA-LAND URUGUAY	DGVZ	STRACHAN SHIPPING CO.	NORFOLK, VA
STAR HIDRA	LAVN4	A/S BILLAGONG	BALTIMORE, MD
STAR HOSANGER	LAXF4	WESTFAL-LARSEN MANAGEMENT AS.	JACKSONVILLE, FL
STAR IKEBANA	S6BK	STRACHAN SHIPPING CO.	NORFOLK, VA
STRONG PATRIOT	WCZ8589	ANDERS WILLIAMS SHIP AGENCY	NORFOLK, VA
TALISMAN	LAOW5	BARBER SHIP MGMT AS	JACKSONVILLE, FL
UNITED SPIRIT	ELYB2	CHIBA SHIPPING CO., LTD, KANPAI BLDG	SEATTLE, WA
USCGC GENTIAN	NBHF	COMMANDING OFFICER	NORFOLK, VA
WEST DIANA	3FCZ4	MALAYA SHIP MANAGEMENT CO., INC - LEONIS BLDG	BALTIMORE, MD

VOS Program Awards and Presentations Gallery



Captain William L. Miles of the ***Lykes Navigator*** *received a 1999 observing award from Jim Nelson PMO Houston.*

Houston PMO Jim Nelson (right) presenting a 1999 VOS award to Captain Bob Groh of the ***Sealand Florida*** *(formerly Nedlloyd Holland).*

The tug ***Seneca*** *took 98 observations during the month of August 2000, which was the most reported to weather offices in Alaska. Most of the observations were transmitted via e-mail and then encoded into BBXX format at WSO Kodiak. Pictured from left to right are 2nd Mate Roger Pederson and Chief Mate Charles T. Tessaro.*

The ***Sealand Performance (KRPD)*** *received a 1999 VOS award from Houston PMO Jim Nelson. Accepting the award was Captain Russell Woodill (center) with C/M Dana Ramsdell to his right and 2/M Douglas Vines to his right.*

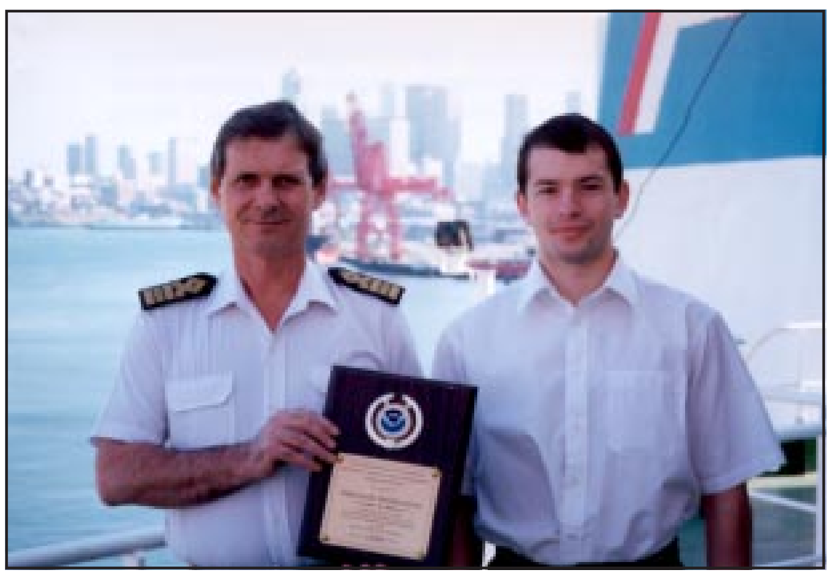
This picture was taken from the bridge of the ***Cherry Valley (WIBK)*** *40 miles from the center of Tropical Storm Helene.*

The **Northern Light** from Tacoma received a VOS award plaque for 1999. Pictured left to right are Second Mate Dan Lunny, Captain Jack Hearn, and Third Mate Jed Comerford.

A 1999 VOS plaque was awarded to the **Ocean Palm** for the high quality of surface observations. Pictured left to right are Second Mate Thomas Nieves, Captain Kewn Yung Hwan, PMO Pat Brandow, Chief Mate Mario Monte, and Third Mate Joel Cabanas.

A 1999 VOS plaque was awarded to the **Kapitan Konev** for the high quality of weather observations. Pictured from the left are Captain A. Maurer and Third Mate B. Konev. The picture was taken by PMO Pat Brandow in Seattle. The vessel was named after the Third Mate's grandfather who was a Captain for Fesco Lines in the 1920s and 1930s.

Captain Indar Mohan Singh (left) of the M/V ***Federal MacKenzie*** *is presented a certificate of achievement in the Canadian VOS program by Roland Kleer, PMO, Ontario Region.*



The ***Mekhanik Moldovanov*** *comes through with one of the honors for 1998 in the VOS awards program. The plaque was presented by Pat Brandow, PMO of Seattle. Pictured are Captain Valeriy Goryutskiyi (left) and Third Mate Dmitriy Bondarenko (right).*

*Brisk north winds and an icy harbor greet the crew of the **USCGC Storis** on their visit to Cold Bay, Alaska, which is at the tip of the Alaska peninsula at 55 degrees north and 162 degrees west. December of 1999 was one of Cold Bay's coldest months of all times.*

*National Weather Service employee Kimberly Vaughan is pictured here on the Cold Bay dock in front of the **USCGC Storis** in this January 2000 photo. "Four wheelers" are the preferred method of transportation by many local residents.*

The **Westwood Cleo** was presented a VOS award for 1998. Pictured right to left are Captain Per Lien Steinar, PMO Pat Brandow, Third Officer Pedro Cariguitan, Chief Mate Frank Larsen, and Second Officer Joe Arboleda.

A 1998 VOS plaque was presented to the **NOAA Ship McArthur** for the high quality of surface weather observations. Pictured with PMO Pat Brandow of Seattle from the left are Commanding Officer Bill Sites and Third Mate Greg Hubner.

Our thanks go out to the **USCGC Mellon (WHEC 717)** for participation in the VOS program in 1998. Pictured right to left are Commanding Officer Robert Parker, PMO Pat Brandow of Seattle, and QM3 Osburn.

VOS Coop Ship Reports — May through August 2000

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, Climate DataDivision, 151 Patton Avenue, Asheville, NC 28801, Attention: Dimitri Chappas (828-271-4060 or dchappas@ncdc.noaa.gov).

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
1ST LT BALDOMERO LOPEZ	WJKV	Jacksonville	0	0	0	47	47
1ST LT JACK LUMMUS	WJLV	New York City	0	0	7	27	34
A. V. KASTNER	ZCAM9	Jacksonville	56	76	84	78	294
AALSMEERGRACHT	PCAM	Long Beach	0	13	13	4	30
ADVANTAGE	WPPO	Norfolk	32	11	7	8	58
AGDLEK	OUGV	Miami	0	7	6	1	14
AGNES FOSS	WYZ3112	Seattle	13	14	13	6	46
AGULHAS	3ELE9	Baltimore	38	42	42	0	122
AL FUNTAS	9KKX	Miami	6	18	5	0	29
AL SAMIDOON	9KKF	Houston	46	67	45	91	249
ALBEMARLE ISLAND	C6LU3	Newark	22	15	26	24	87
ALBERNI DAWN	ELAC5	Houston	14	55	0	25	94
ALBLASGRACHT	PCIG	Houston	4	24	23	47	98
ALEXANDER VON HUMBOLD	Y3CW	Miami	720	708	685	675	2788
ALFAMAR	TCYB	Norfolk	9	10	0	10	29
ALKMAN	C6OG4	Houston	11	9	10	2	32
ALLEGIANCE	WSKD	Norfolk	5	6	6	12	29
ALLIANCA AMERICA	DHGE	Baltimore	4	3	3	3	13
ALLIGATOR BRAVERY	3FXX4	Oakland	52	53	41	45	191
ALLIGATOR COLUMBUS	3ETV8	Seattle	20	18	62	50	150
ALLIGATOR FORTUNE	ELFK7	Seattle	7	7	5	5	24
ALLIGATOR GLORY	ELJP2	Seattle	31	45	21	31	128
ALLIGATOR HOPE	ELFN8	Seattle	2	2	1	1	6
ALLIGATOR LIBERTY	JFUG	Seattle	72	69	72	25	238
ALTAIR	DBBI	Miami	687	545	584	533	2349
AMBASSADOR BRIDGE	3ETH9	Oakland	54	43	65	45	207
AMERICA	WCY2883	New York City	0	28	34	43	105
AMERICA STAR	GZKA	Houston	89	84	80	76	329
AMERICAN MARINER	WQZ7791	Cleveland	0	13	9	16	38
ANASTASIS	9HOZ	Miami	0	0	0	1	1
ANATOLIY KOLESNICHENKO	UINM	Seattle	10	0	11	0	21
ANKERGRACHT	PCQL	Baltimore	10	21	24	12	67
APL CHINA	S6TA	Seattle	53	68	33	38	192
APL GARNET	9VVN	Oakland	5	1	2	12	20
APL JAPAN	S6TS	Seattle	28	36	28	68	160
APL KOREA	WCX8883	Seattle	7	34	44	21	106
APL PHILIPPINES	WCX8884	Seattle	25	26	26	39	116
APL SINGAPORE	WCX8812	Seattle	31	12	41	43	127
APL THAILAND	WCX8882	Seattle	37	40	52	19	148
APL TOURMALINE	9VVP	Oakland	67	46	62	47	222
APOLLOGRACHT	PCSV	Baltimore	0	28	4	21	53
AQUARIUS ACE	3FHB8	New York City	43	80	66	71	260
ARCO ALASKA	KSBK	Long Beach	14	9	3	7	33
ARCO CALIFORNIA	WMCV	Long Beach	2	0	4	1	7
ARCO FAIRBANKS	WGWB	Long Beach	0	52	5	12	69
ARCO INDEPENDENCE	KLHV	Long Beach	15	15	10	15	55
ARCO JUNEAU	KSBG	Seattle	15	0	0	0	15
ARCO SAG RIVER	WLDF	Long Beach	1	0	0	0	1
ARCO SPIRIT	KHLD	Long Beach	1	0	0	0	1
ARCO TEXAS	KNFD	Long Beach	5	8	9	7	29
ARCTIC OCEAN	C6T2062	Newark	2	0	8	20	30
ARIES HARMONY	3FEY7	Seattle	0	0	1	15	16
ARINA ARCTICA	OVYA2	Miami	36	60	68	62	226
ARISO	3FHJ6	Seattle	0	0	6	86	92
AROSIA	V2SB	New Orleans	0	0	0	62	62
ARTHUR M. ANDERSON	WE4805	Chicago	101	83	48	41	273

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SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
ASTORIA BRIDGE	ELJJ5	Long Beach	54	38	29	30	151
ATLANTIC	3FYT	Miami	197	186	209	221	813
ATLANTIC CARTIER	C6MS4	Norfolk	25	14	22	11	72
ATLANTIC COMPANION	SKPE	Newark	33	16	35	15	99
ATLANTIC COMPASS	SKUN	Norfolk	21	35	30	17	103
ATLANTIC CONCERT	SKOZ	Norfolk	0	3	0	0	3
ATLANTIC CONVEYOR	C6NI3	Norfolk	34	33	17	23	107
ATLANTIC ERIE	VCQM	Baltimore	5	12	15	0	32
ATLANTIC OCEAN	C6T2064	Newark	0	16	23	29	68
ATLANTIS	KAQP	New Orleans	22	11	9	0	42
AUCKLAND STAR	C6KV2	Baltimore	61	72	83	85	301
B. T. ALASKA	WFQE	Long Beach	14	2	0	0	16
BARBARA ANDRIE	WTC9407	Chicago	26	35	27	47	135
BARRINGTON ISLAND	C6QK	Miami	30	21	17	69	137
BAY BRIDGE	ELES7	Long Beach	27	25	23	21	96
BELLONA	3FEA4	Jacksonville	36	31	0	31	98
BERING SEA	C6YY	Miami	14	0	1	0	15
BERNARDO QUINTANA A	C6KJ5	New Orleans	30	32	36	47	145
BLACKHAWK	WBN2081	Seattle	12	8	1	5	26
BLUE GEMINI	3FPA6	Seattle	20	22	0	0	42
BLUE NOVA	3FDV6	Seattle	27	47	28	16	118
BOHEME	SIVY	New York City	17	0	0	24	41
BONN EXPRESS	DGNB	Houston	705	689	337	685	2416
BP ADMIRAL	ZCAK2	Houston	0	14	17	46	77
BRIGHT PHOENIX	DXNG	Seattle	44	38	45	23	150
BRIGHT STATE	DXAC	Seattle	33	44	0	33	110
BRITISH ADVENTURE	ZCAK3	Seattle	33	36	48	0	117
BROOKLYN BRIDGE	3EZJ9	Oakland	26	27	45	51	149
BURNS HARBOR	WQZ7049	Chicago	123	84	121	84	412
CALCITE II	WB4520	Chicago	14	9	17	24	64
CALIFORNIA HIGHWAY	3FHQ4	Seattle	5	2	0	3	10
CALIFORNIA JUPITER	ELKU8	Long Beach	52	38	42	49	181
CALIFORNIA MERCURY	JGPN	Seattle	21	24	12	17	74
CAPE MAY	JBCN	Norfolk	0	8	0	0	8
CAPRICORN	PDAY	Baltimore	22	4	0	0	26
CAPT STEVEN L BENNETT	KAXO	New Orleans	3	30	6	6	45
CARIBBEAN MERCY	3FFU4	Miami	0	35	0	6	41
CARNIVAL PARADISE	3FOB5	Miami	58	20	24	11	113
CAROLINA	WYBI	Jacksonville	34	34	33	35	136
CASON J. CALLAWAY	WE4879	Chicago	44	45	26	13	128
CELEBRATION	H3GQ	New Orleans	0	3	0	7	10
CELTIC SEA	C6RT	Miami	0	0	0	1	1
CENTURY	ELQX6	Miami	0	0	1	0	1
CENTURY HIGHWAY #2	3EJB9	Long Beach	18	20	17	19	74
CENTURY HIGHWAY NO. 1	3FFJ4	Houston	33	33	38	34	138
CENTURY HIGHWAY_NO. 3	8JNP	Houston	25	13	0	0	38
CENTURY LEADER NO. 1	3FBI6	Houston	29	42	46	25	142
CGM RENOIR	ELVZ8	Norfolk	0	50	12	4	66
CHANG-LIN TIEN	C6FE6	Oakland	0	0	9	3	12
CHARLES E. WILSON	WZE4539	Cleveland	37	20	26	7	90
CHARLES ISLAND	C6JT	Miami	60	61	57	55	233
CHARLES M. BEEGHLEY	WL3108	Cleveland	11	5	2	10	28
CHC NO.1	3FSL2	Seattle	0	5	0	0	5
CHELSEA	KNCX	Miami	2	0	0	0	2
CHEMICAL PIONEER	KAFO	Houston	34	18	28	53	133
CHEMICAL TRADER	KRGJ	Jacksonville	13	0	0	0	13
CHERRY VALLEY	WIBK	Houston	0	0	23	39	62
CHESAPEAKE BAY	WMLH	Houston	29	38	36	5	108
CHESAPEAKE TRADER	WGZK	Houston	75	38	83	15	211
CHEVRON ARIZONA	KGBE	Miami	7	12	5	8	32
CHEVRON ATLANTIC	C6KY3	New Orleans	6	31	0	4	41
CHEVRON COLORADO	KLHZ	Oakland	12	0	0	0	12
CHEVRON EMPLOYEE PRIDE	C6MC5	Baltimore	11	1	0	26	38
CHEVRON FELUY	C6FH5	Houston	91	63	46	0	200
CHEVRON MISSISSIPPI	WXBR	Oakland	75	58	58	31	222
CHEVRON PERTH	C6KQ8	Oakland	15	26	39	16	96
CHEVRON SOUTH AMERICA	ZCAA2	New Orleans	36	18	14	23	91
CHEVRON WASHINGTON	KFDB	Oakland	12	32	9	19	72
CHIEF GADAO	WEZD	Oakland	4	0	23	24	51
CHIQUITA BARU	ZCAY7	Jacksonville	3	0	1	0	4
CHIQUITA BELGIE	C6KD7	Baltimore	55	54	34	39	182
CHIQUITA BREMEN	ZCBC5	Miami	55	27	45	48	175

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SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
CHIQUITA BRENDA	ZCBE9	Miami	69	49	37	58	213
CHIQUITA DEUTSCHLAND	C6KD8	Baltimore	59	68	76	61	264
CHIQUITA ELKESCHLAND	ZCBB9	Miami	60	61	47	27	195
CHIQUITA FRANCES	ZCBD9	Miami	39	58	68	53	218
CHIQUITA ITALIA	C6KD5	Baltimore	26	23	44	48	141
CHIQUITA JEAN	ZCBB7	Jacksonville	0	17	34	55	106
CHIQUITA JOY	ZCBC2	Miami	39	13	34	37	123
CHIQUITA NEDERLAND	C6KD6	Baltimore	42	60	66	50	218
CHIQUITA ROSTOCK	ZCBD2	Miami	48	37	46	56	187
CHIQUITA SCANDINAVIA	C6KD4	Baltimore	52	51	51	57	211
CHIQUITA SCHWEIZ	C6KD9	Baltimore	28	36	52	56	172
CHO YANG ATLAS	DQVH	Seattle	64	37	27	41	169
CHOYANG PHOENIX	P3ZY6	Norfolk	1	36	15	58	110
CITY OF DURBAN	GXIC	Long Beach	65	74	70	54	263
CLEVELAND	KGXA	Houston	23	7	28	11	69
CMA CGM MONET	ELRR6	New Orleans	46	58	63	50	217
COASTAL MERCHANT	WCV8696	Seattle	31	36	6	36	109
COASTAL SEA	WCA7944	Seattle	1	1	2	0	4
COLORADO	KWFE	Miami	16	0	0	0	16
COLUMBIA BRIDGE	ELXS4	Seattle	0	0	35	63	98
COLUMBIA STAR	WSB2018	Cleveland	0	0	13	4	17
COLUMBINE	3ELQ9	Baltimore	8	10	35	0	53
COLUMBUS CALIFORNIA	ELUB7	Houston	33	44	58	0	135
COLUMBUS CANADA	P3RD8	Norfolk	55	64	29	80	228
COLUMBUS CANTERBURY	ELUB8	Norfolk	60	54	60	36	210
COLUMBUS VICTORIA	ELUB6	Long Beach	0	0	0	1	1
CONDOLEEZZA RICE	C6OK	Baltimore	1	0	0	0	1
CONTSHIP AMERICA	V7BZ3	Houston	19	50	45	40	154
CONTSHIP ENDEAVOUR	ZCBE7	Houston	32	38	25	22	117
CONTSHIP SUCCESS	ZCBE3	Houston	50	97	80	39	266
CORAL SEA	C6YW	Miami	21	19	6	0	46
CORMORANT ARROW	C6IO9	Seattle	6	7	22	9	44
CORNELIA MAERSK	OXIF2	Norfolk	0	0	3	5	8
CORWITH CRAMER	WTF3319	Norfolk	18	0	9	9	36
COSMOWAY	3EVO3	Seattle	6	1	10	16	33
COURIER	KCBK	Houston	0	0	0	26	26
COURTNEY BURTON	WE6970	Cleveland	17	26	18	0	61
COURTNEY L	ZCAQ8	Baltimore	12	10	13	22	57
CROWLEY UNIVERSE	ELRU3	Miami	19	11	6	0	36
CROWN OF SCANDINAVIA	OXRA6	Miami	33	36	34	46	149
CSAV BRASILIA	DGVS	New York City	0	0	9	76	85
CSL CABO	D5XH	Seattle	58	64	57	56	235
CSS HUDSON	CGDG	Norfolk	1	56	20	41	118
DAGMAR MAERSK	DHAF	New York City	66	19	25	52	162
DAISHIN MARU	3FPS6	Seattle	82	84	86	92	344
DANIA PORTLAND	OXEH2	Miami	87	111	80	78	356
DELAWARE BAY	WMLG	Houston	27	30	18	6	81
DENALI	WSVR	Long Beach	23	23	58	58	162
DIRECT CONDOR	ELWP7	Long Beach	22	0	0	0	22
DIRECT EAGLE	ELWY5	Long Beach	43	0	0	0	43
DIRECT FALCON	ELWQ5	Long Beach	62	75	81	69	287
DOCK EXPRESS 20	PJRF	Baltimore	32	0	0	0	32
DON QUIJOTE	SFQP	New York City	18	35	55	13	121
DORTHE OLDENDORFF	ELXC4	Seattle	34	23	29	21	107
DRAGOER MAERSK	OXPW2	Long Beach	34	6	38	15	93
DUHALLOW	ZCBH9	Baltimore	38	67	78	52	235
DUNCAN ISLAND	C6JS	Miami	11	31	31	37	110
E.P. LE QUEBECOIS	CG3130	Norfolk	0	10	219	224	453
EASTERN BRIDGE	C6JY9	Baltimore	56	13	18	46	133
ECSTASY	ELNC5	Miami	20	21	0	0	41
ECSTASY	H3GR	Miami	0	0	14	8	22
EDGAR B. SPEER	WQZ9670	Chicago	114	84	85	82	365
EDWIN H. GOTT	WXQ4511	Chicago	42	38	35	33	148
EDYTH L	C6YC	Baltimore	26	54	55	28	163
EL MORRO	KCGH	Miami	22	15	18	23	78
EL YUNQUE	WGJT	Jacksonville	70	48	52	71	241
ELATION	3FOC5	Miami	8	5	4	5	22
EMPIRE STATE	KKFW	New York City	15	36	13	0	64
ENCHANTED ISLE	3FMG2	New Orleans	0	0	44	21	65
ENCHANTMENT OF THE SEAS	LAXA4	Miami	4	7	21	30	62
ENDEAVOR	WAUW	New York City	35	36	17	25	113
ENDURANCE	WAUU	New York City	23	25	28	30	106

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SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
ENERGY ENTERPRISE	WBJF	Baltimore	0	24	0	0	24
ENGLISH STAR	C6KU7	Long Beach	63	69	82	81	295
ENIF	9VVI	Houston	31	18	0	16	65
ENTERPRISE	WAUY	New York City	36	21	7	37	101
EVER DECENT	3FUO7	New York City	0	0	0	7	7
EVER DELIGHT	3FCB8	New York City	8	2	9	0	19
EVER DELUXE	3FBE8	Norfolk	6	6	8	0	20
EVER DEVOTE	3FIF8	New York City	14	5	0	4	23
EVER DYNAMIC	3FUB8	New York City	0	0	0	5	5
EVER GENERAL	BKHY	Baltimore	0	7	0	4	11
EVER GUIDE	3EVJ2	Seattle	12	6	5	0	23
EVER LEVEL	BKHJ	Miami	3	4	3	0	10
EVER RACER	3FJL4	Norfolk	0	0	1	0	1
EVER REFINE	3FSB4	New York City	2	3	0	13	18
EVER RESULT	3FSA4	Norfolk	5	0	9	0	14
EVER RIGHT	3FML3	Long Beach	17	3	11	3	34
EVER ROUND	3FQN3	Long Beach	0	4	3	0	7
EVER ULTRA	3FEJ6	Seattle	5	6	0	0	11
EVER UNION	3FFG7	Seattle	0	6	0	12	18
EVER UNISON	3FTL6	Long Beach	11	11	11	6	39
FAIRLIFT	PEBM	Norfolk	0	4	0	28	32
FANTAL MERCHANT	ELXB6	Seattle	0	36	53	58	147
FAUST	WRYX	Jacksonville	39	32	37	46	154
FEYZA	TCFJ	Newark	0	0	0	26	26
FIDELIO	WQVY	Jacksonville	45	44	47	54	190
FIGARO	S6PI	Newark	47	29	26	25	127
FRANCES HAMMER	KRGC	Jacksonville	8	15	0	0	23
FRANCES L	C6YE	Baltimore	26	35	29	15	105
FRANK A. SHRONTZ	C6PZ3	Oakland	5	31	3	57	96
FRANKFURT EXPRESS	9VPP	New York City	16	10	25	14	65
FRED R. WHITE JR	WAR7324	Cleveland	0	7	0	0	7
GALVESTON BAY	WPKD	Houston	28	41	47	55	171
GANNET ARROW	C6QF5	Seattle	1	0	0	0	1
GEETA	VRUL7	New Orleans	0	17	5	10	32
GEMINI	KHCF	New York City	0	0	0	2	2
GEORGE A. SLOAN	WA5307	Chicago	19	15	20	11	65
GEORGE SCHULTZ	C6FD4	Baltimore	8	10	7	6	31
GEORGE WASHINGTON BRIDGE	JKCF	Seattle	54	39	39	56	188
GEORGIA RAINBOW II	VRVS5	Jacksonville	24	49	0	75	148
GERD MAERSK	OZNC2	New York City	0	32	2	0	34
GINGA MARU	JFKC	Long Beach	0	0	56	84	140
GLOBAL LINK	WWDY	Baltimore	0	0	12	5	17
GLOBAL MARINER	WWXA	Baltimore	0	0	0	33	33
GLOBAL SENTINEL	WRZU	Baltimore	2	6	13	22	43
GLORIOUS SUCCESS	DUHN	Seattle	31	0	0	0	31
GOLDEN BEAR	NMRY	Oakland	65	45	64	55	229
GOLDEN GATE	KIOH	Long Beach	10	14	19	5	48
GOLDEN GATE BRIDGE	3FWM4	Long Beach	71	72	78	88	309
GRANDEUR OF THE SEAS	ELTQ9	Miami	16	11	4	0	31
GREAT LAND	WFDP	Seattle	27	21	1	21	70
GREEN BAY	KGTH	Long Beach	33	33	0	0	66
GREEN DALE	WCZ5238	Jacksonville	0	5	0	18	23
GREEN ISLAND	KIBK	New Orleans	0	14	0	0	14
GREEN LAKE	KGTI	Baltimore	40	62	73	62	237
GREEN POINT	WCY4148	New York City	1	0	0	0	1
GREEN RAINIER	3ENI3	Seattle	28	50	52	24	154
GREEN RIDGE	WRYL	Seattle	0	16	19	16	51
GRETE MAERSK	OZNF2	New York City	15	59	10	4	88
GROTON	KMJL	Newark	8	17	2	0	27
GUAYAMA	WZJG	Jacksonville	24	27	36	45	132
GUDRUN MAERSK	OZFQ2	New York City	0	0	2	53	55
GYPSUM BARON	ZCAN3	Norfolk	76	74	60	54	264
HADERA	ELBX4	Baltimore	40	46	32	91	209
HANJIN KEELUNG	P3VH7	Houston	11	5	11	3	30
HANJIN OSAKA	3EQD9	New York City	0	0	3	3	6
HEIDELBERG EXPRESS	DEDI	Houston	299	621	316	69	1305
HENRY HUDSON BRIDGE	JKLS	Seattle	66	60	61	42	229
HERBERT C. JACKSON	WL3972	Cleveland	5	4	0	0	9
HOEGH DENE	ELWO7	Norfolk	0	1	0	1	2
HOEGH DUKE	ELWP2	Norfolk	19	0	5	2	26
HONG KONG SENATOR	DEIP	Seattle	31	33	29	22	115
HONSHU SILVIA	3EST7	Seattle	5	11	11	0	27

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SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
HOOD ISLAND	C6LU4	Miami	44	52	48	52	196
HUAL ASIA	C6QX7	New York City	1	4	0	1	6
HUMACAO	WZJB	Norfolk	35	40	36	36	147
HUMBERGRACHT	PEUQ	Houston	15	13	10	0	38
HUME HIGHWAY	3EJO6	Jacksonville	15	27	25	0	67
HYUNDAI DISCOVERY	3FFR6	Seattle	39	53	50	47	189
HYUNDAI FORTUNE	3FLG6	Seattle	18	44	35	30	127
HYUNDAI FREEDOM	3FFS6	Seattle	6	7	0	2	15
HYUNDAI FRONTIER	C6RF6	Seattle	0	0	0	34	34
HYUNDAI INDEPENDENCE	3FDY6	Seattle	13	14	4	13	44
HYUNDAI LIBERTY	3FFT6	Seattle	18	5	1	0	24
INDAMEX NEW YORK	C6W2034	New Orleans	11	1	0	0	12
INDIAN OCEAN	C6T2063	New York City	25	29	10	40	104
INDIANA HARBOR	WXN3191	Cleveland	113	98	55	67	333
INLAND SEAS	WCJ6214	Chicago	7	7	3	2	19
IRENA ARCTICA	OXTS2	Miami	75	62	47	67	251
ISLA DE CEDROS	3FOA6	Seattle	37	34	20	33	124
ITB BALTIMORE	WXKM	Baltimore	19	41	4	12	76
ITB MOBILE	KXDB	New York City	1	0	0	0	1
ITB NEW YORK	WVDG	Newark	5	7	0	1	13
IVARAN HUNTER	DNKL	Norfolk	0	0	10	38	48
IWANUMA MARU	3ESU8	Seattle	87	91	99	82	359
J. BENNETT JOHNSTON	C6QE3	Oakland	0	0	9	18	27
J.A.W. IGLEHART	WTP4966	Cleveland	0	0	7	0	7
JACKLYN M.	WCV7620	Chicago	17	19	9	12	57
JACKSONVILLE	WNDG	Baltimore	45	27	17	22	111
JADE PACIFIC	ELRY5	Seattle	0	4	3	0	7
JAMES R. BARKER	WYP8657	Cleveland	0	0	0	11	11
JEB STUART	WRGQ	Oakland	3	8	3	3	17
JO CLIPPER	PFEZ	Baltimore	10	9	7	4	30
JOHN G. MUNSON	WE3806	Chicago	45	36	29	14	124
JOHN J. BOLAND	WF2560	Cleveland	0	0	1	0	1
JOIDES RESOLUTION	D5BC	Norfolk	29	46	23	0	98
JOSEPH	ELRZ8	Houston	29	33	17	12	91
JOSEPH L. BLOCK	WXY6216	Chicago	1	0	0	0	1
KANIN	ELEO2	New Orleans	35	49	4	47	135
KAPITAN BOCHEK	P3NC5	Houston	1	0	0	0	1
KAPITAN BYANKIN	UAGK	Seattle	19	14	13	2	48
KAPITAN KONEV	UAHV	Seattle	58	84	55	71	268
KAPITAN MASLOV	UBRO	Seattle	0	10	41	35	86
KAREN ANDRIE	WBS5272	Chicago	2	12	9	8	31
KAREN MAERSK	OZKN2	Seattle	32	0	0	30	62
KATRINE MAERSK	OZLL2	New York City	4	10	0	0	14
KAUAI	WSRH	Long Beach	17	51	39	12	119
KAYE E. BARKER	WCF3012	Cleveland	15	5	2	0	22
KAZIMAH	9KKL	Houston	62	55	17	0	134
KEE LUNG	BHFN	Seattle	1	14	6	28	49
KEN KOKU	3FMN6	Seattle	0	0	9	0	9
KEN SHIN	YJQS2	Seattle	7	8	7	9	31
KENAI	WSNB	Houston	0	0	10	5	15
KENNETH E. HILL	C6FA6	Newark	10	4	9	3	26
KENNETH T. DERR	C6FA3	Newark	19	30	15	0	64
KENNICOTT	WCY2920	Seattle	0	0	0	2	2
KINSMAN INDEPENDENT	WUZ7811	Cleveland	48	49	0	0	97
KIRSTEN MAERSK	OYDM2	Seattle	38	11	0	0	49
KIWI ARROW	C6HU6	Houston	24	0	0	22	46
KNOCK ALLAN	ELOI6	Houston	83	65	78	72	298
KOELN EXPRESS	9VBL	New York City	733	713	725	732	2903
KURE	3FGN3	Seattle	23	22	15	21	81
LAKE GUARDIAN	WAO9082	Chicago	2	0	0	0	2
LEE A. TREGURTHA	WUR8857	Cleveland	0	7	9	3	19
LEONARD J. COWLEY	CG2959	Norfolk	34	46	2	0	82
LIBERTY SEA	KPZH	New Orleans	24	42	35	36	137
LIBERTY SPIRIT	WCPU	New Orleans	38	28	17	0	83
LIBERTY STAR	WCBP	New Orleans	27	28	52	11	118
LIBERTY SUN	WCOB	Houston	0	15	42	31	88
LICORNE PACIFIQUE	J8CV5	Houston	0	0	0	97	97
LIHUE	WTST	Oakland	73	57	35	44	209
LINDA OLDENDORF	ELRR2	Baltimore	0	53	0	0	53
LNG AQUARIUS	WSKJ	Oakland	16	25	19	0	60
LNG ARIES	KGBD	New York City	21	0	0	0	21
LNG CAPRICORN	KHLN	New York City	16	18	19	22	75

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SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
LNG LEO	WDZB	New York City	36	35	37	6	114
LNG LIBRA	WDZG	New York City	0	2	0	8	10
LNG TAURUS	WDZW	New York City	53	50	37	7	147
LNG VIRGO	WDZX	New York City	31	22	31	1	85
LOK PRAGATI	ATZS	Seattle	0	7	14	22	43
LOOTSGRACHT	PFPT	Houston	52	60	40	48	200
LUISE OLDENDORFF	3FOW4	Seattle	10	42	0	26	78
LURLINE	WLVD	Oakland	19	29	34	45	127
LYKES CHALLANGER	FNHV	Houston	85	61	40	28	214
LYKES COMMANDER	3ELF9	Baltimore	53	26	69	0	148
LYKES CONDOR	DGGD	Houston	64	50	40	42	196
LYKES DISCOVERER	WGXO	Houston	67	34	54	70	225
LYKES EAGLE	DNEN	Houston	67	51	42	0	160
LYKES EXPLORER	WGLA	Houston	30	52	25	29	136
LYKES HAWK	ELVB6	Houston	1	0	0	0	1
LYKES LIBERATOR	WGXN	Houston	44	42	45	35	166
LYKES NAVIGATOR	WGMJ	Houston	48	49	45	35	177
LYKES RAVEN	DIGF	Houston	0	0	6	0	6
M/V SP5. ERIC G. GIBSON	KAKF	Baltimore	30	46	16	16	108
MAASDAM	PFRO	Miami	2	3	0	1	6
MACKINAC BRIDGE	JKES	Seattle	58	76	82	78	294
MADISON MAERSK	OVJB2	Oakland	18	23	17	15	73
MAERSK ARIZONA	KAKG	Baltimore	0	0	0	6	6
MAERSK CALIFORNIA	WCX5083	Miami	4	25	19	0	48
MAERSK CHARLESTON	ELRO2	New York City	0	0	0	17	17
MAERSK GIANT	OU2465	Miami	245	238	243	245	971
MAERSK SANTO TOMAS	OXOL2	Long Beach	9	6	0	0	15
MAERSK SCOTLAND	MXAR9	Houston	88	32	44	25	189
MAERSK SEA	S6CW	Seattle	41	23	15	21	100
MAERSK SHETLAND	MSQK3	Miami	79	42	29	0	150
MAERSK SOMERSET	MQVF8	New Orleans	35	30	43	4	112
MAERSK STAFFORD	MRSS9	New Orleans	37	50	88	44	219
MAERSK SUFFOLK	MRSS8	Houston	0	0	0	9	9
MAERSK SURREY	MRSG8	Houston	8	4	0	0	12
MAERSK TENNESSEE	WCX3486	Miami	18	21	44	33	116
MAERSK TEXAS	WCX3249	Miami	29	18	11	23	81
MAERSK VALENCIA	ELXK7	Norfolk	53	27	17	22	119
MAGLEBY MAERSK	OUSH2	Newark	11	29	12	13	65
MAHARASHTRA	VTSQ	Seattle	2	0	0	0	2
MAHIMAHI	WHRN	Oakland	30	46	51	54	181
MAIRANGI BAY	GXEW	Long Beach	66	81	57	66	270
MAJESTIC MAERSK	OUJH2	Newark	0	0	32	4	36
MANHATTAN BRIDGE	3FWL4	Seattle	40	49	48	32	169
MANOA	KDBG	Oakland	51	20	18	17	106
MARCHEN MAERSK	OWDQ2	Long Beach	33	24	20	15	92
MAREN MAERSK	OWZU2	Long Beach	18	26	20	16	80
MARGRETHE MAERSK	OYSN2	Long Beach	24	20	55	20	119
MARIA LAURA	C6MZ8	Newark	0	1	0	0	1
MARIE MAERSK	OULL2	Newark	4	0	0	11	15
MARINE CHEMIST	KMCB	Houston	34	25	42	27	128
MARINE COLUMBIA	KLKZ	Oakland	28	24	16	23	91
MARIT MAERSK	OZFC2	Miami	19	23	21	35	98
MARK HANNAH	WYZ5243	Chicago	50	10	18	9	87
MATHILDE MAERSK	OUUU2	Long Beach	19	35	10	17	81
MATSONIA	KHRC	Oakland	41	30	40	43	154
MAUI	WSLH	Long Beach	38	51	14	27	130
MAURICE EWING	WLDZ	Newark	33	22	50	26	131
MAYAGUEZ	WZJE	Jacksonville	8	0	0	0	8
MAYVIEW MAERSK	OWEB2	Oakland	15	13	31	23	82
MC-KINNEY MAERSK	OUZW2	Newark	10	9	16	9	44
MEKHANIK KALYUZHNIY	UFLO	Seattle	30	25	50	42	147
MEKHANIK MOLDOVANOV	UIKI	Seattle	3	13	25	18	59
MELBOURNE STAR	GOVL	Newark	58	60	65	78	261
MELVILLE	WECB	Long Beach	82	80	0	30	192
MERCURY	3FFC7	Miami	4	2	0	4	10
MESABI MINER	WYQ4356	Cleveland	86	69	76	53	284
METEOR	DBBH	Houston	542	146	264	181	1133
METTE MAERSK	OXKT2	Long Beach	21	14	31	24	90
MICHIGAN	WRB4141	Chicago	6	7	4	7	24
MIDDLETOWN	WR3225	Cleveland	10	6	5	3	24
MING ASIA	BDEA	New York City	20	25	15	21	81
MING PEACE	ELVR9	Long Beach	1	42	23	25	91

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SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
MOKIHANA	WNRD	Oakland	63	47	76	54	240
MOKU PAHU	WBWK	Oakland	64	58	33	20	175
MONARCH OF THE SEAS	LAMU4	Miami	0	0	0	1	1
MONCHEGORSK	P3NL5	Houston	0	4	0	2	6
MORELOS	PGBB	Houston	34	34	62	40	170
MORMACSKY	WMBQ	New York City	10	27	13	13	63
MORMACSTAR	KGDF	Houston	5	34	37	35	111
MORMACSUN	WMBK	Norfolk	0	1	40	7	48
MOSEL ORE	ELRE5	Norfolk	65	46	62	70	243
MSC BOSTON	9HGP4	New York City	1	0	0	0	1
MSC CALIFORNIA	LAKS5	Seattle	17	17	7	18	59
MSC FEDERICA	C4LV	New York City	17	29	33	20	99
MSC XINGANG	3EHR6	Norfolk	21	2	12	8	43
MUNKEBO MAERSK	OUNI5	New York City	0	13	34	0	47
MV CONTSHIP ROME	ELVZ6	Norfolk	36	22	72	12	142
MYRON C. TAYLOR	WA8463	Chicago	36	36	46	34	152
NAGOYA EXPRESS	P3LE4	Seattle	0	0	0	1	1
NAJA ARCTICA	OXVH2	Miami	113	109	95	105	422
NEDLLOYD HOLLAND	KRHX	Houston	45	52	42	28	167
NEDLLOYD RALEIGH BAY	PHKG	Houston	13	2	2	5	22
NELVANA	YJWZ7	Baltimore	19	17	0	0	36
NEPTUNE RHODONITE	ELJP4	Long Beach	5	7	0	0	12
NEW HORIZON	WKWB	Long Beach	2	2	28	46	78
NEW NIKKI	3FHG5	Seattle	14	0	0	0	14
NEWARK BAY	WPKS	Houston	54	57	76	65	252
NIEUW AMSTERDAM	PGGQ	Long Beach	0	15	20	29	64
NOAA DAVID STARR JORDAN	WTDK	Seattle	48	51	40	99	238
NOAA SHIP ALBATROSS IV	WMVF	Norfolk	7	52	60	84	203
NOAA SHIP DELAWARE II	KNBD	New York City	56	51	126	190	423
NOAA SHIP FERREL	WTEZ	Norfolk	0	0	0	3	3
NOAA SHIP KA'IMIMOANA	WTEU	Seattle	66	57	80	42	245
NOAA SHIP MCARTHUR	WTEJ	Seattle	32	42	19	193	286
NOAA SHIP MILLER FREEMAN	WTDM	Seattle	179	175	182	139	675
NOAA SHIP OREGON II	WTDO	New Orleans	0	88	124	166	378
NOAA SHIP RAINIER	WTEF	Seattle	90	36	75	49	250
NOAA SHIP RONALD H BROWN	WTEC	New Orleans	34	68	106	80	288
NOAA SHIP T. CROMWELL	WTDF	Seattle	42	64	43	55	204
NOAA SHIP WHITING	WTEW	Baltimore	7	11	33	18	69
NOAAS GORDON GUNTER	WTEO	New Orleans	154	75	153	114	496
NOBEL STAR	KRPP	Houston	30	21	8	37	96
NOL STENO	ZCBD4	New York City	16	7	9	10	42
NOLIZWE	MQLN7	New York City	68	64	62	53	247
NOMZI	MTQU3	Baltimore	72	48	49	62	231
NOORDAM	PGHT	Miami	0	0	0	1	1
NORASIA SHANGHAI	DNHS	New York City	38	52	71	47	208
NORD JAHRE TRANSPORTER	LACF4	Baltimore	1	0	0	0	1
NORDMAX	P3YS5	Seattle	64	102	100	42	308
NORDMORITZ	P3YR5	Seattle	50	15	24	41	130
NORTHERN LIGHTS	WFJK	New Orleans	29	23	36	23	111
NORWAY	C6CM7	Miami	1	0	0	44	45
NTABENI	3EGR6	Houston	60	34	56	19	169
NUERNBERG EXPRESS	9VBK	Houston	717	710	714	722	2863
NYK SPRINGTIDE	S6CZ	Seattle	5	4	2	7	18
NYK STARLIGHT	3FUX6	Long Beach	50	38	48	23	159
OCEAN CAMELLIA	3FTR6	Seattle	84	48	84	47	263
OCEAN CITY	WCYR	Houston	11	0	0	10	21
OCEAN CLIPPER	3EXI7	New Orleans	30	48	11	54	143
OCEAN PALM	3FDO7	Seattle	80	55	70	64	269
OCEANBREEZE	ELLY4	Miami	10	2	0	0	12
OGLEBAY NORTON	WAQ3521	Cleveland	3	0	1	4	8
OLEANDER	PJJU	Newark	43	44	13	36	136
OLYMPIAN HIGHWAY	3FSH4	Seattle	12	4	12	14	42
OOCL CALIFORNIA	VRWC8	Seattle	0	31	53	46	130
OOCL FAIR	VRWB8	Long Beach	14	22	0	0	36
OOCL FIDELITY	VRWG5	Long Beach	26	30	26	22	104
OOCL FORTUNE	VRWF2	Norfolk	5	0	0	2	7
OOCL FREEDOM	VRCV	Norfolk	33	0	0	0	33
OOCL FRIENDSHIP	VRWD3	Long Beach	31	26	20	0	77
OOCL HONG KONG	VRVA5	Oakland	24	22	36	35	117
OOCL INNOVATION	WPWH	Houston	33	37	37	55	162
OOCL INSPIRATION	KRPB	Houston	58	55	52	38	203
ORIANA	GVSN	Miami	23	28	44	39	134

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SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
ORIENTE HOPE	3ETH4	Seattle	0	0	0	7	7
ORIENTE PRIME	3FOU4	Seattle	0	33	7	31	71
ORIENTE VICTORIA	3FVG8	Seattle	23	27	48	16	114
OVERSEAS HARRIETT	WRFJ	Houston	9	26	14	33	82
OVERSEAS JOYCE	WUQL	Jacksonville	24	32	38	42	136
OVERSEAS MARILYN	WFQB	Houston	0	9	16	3	28
OVERSEAS NEW ORLEANS	WFKW	Houston	11	6	15	14	46
OVERSEAS WASHINGTON	WFGV	Houston	17	3	0	0	20
P & O NEDLLOYD BUENOS AI	PGEC	Houston	8	9	0	0	17
P & O NEDLLOYD VERA CRUZ	PGFE	Houston	12	4	0	0	16
P&O NEDLLOYD HOUSTON	PGEB	Houston	16	30	67	64	177
P&O NEDLLOYD LOS ANGELES	PGDW	Long Beach	65	79	66	46	256
P&O NEDLLOYD MARSEILLE	MYSU5	Seattle	58	58	48	18	182
P&O NEDLLOYD SYDNEY	PDHY	Seattle	29	38	49	38	154
P&O NEDLLOYD TEXAS	ZCBF6	Houston	54	37	16	24	131
PACDREAM	ELQO6	Seattle	4	18	17	2	41
PACIFIC PRINCESS	GBCF	New York City	9	0	0	0	9
PACIFIC SENATOR	ELTY6	Long Beach	0	0	54	0	54
PACKING	ELBX3	Seattle	16	15	6	18	55
PACOCEAN	ELJE3	Seattle	54	14	41	23	132
PACPRINCE	ELED7	Seattle	9	7	16	11	43
PACPRINCESS	ELED8	Houston	33	20	47	0	100
PAUL BUCK	KDGR	Houston	15	0	12	21	48
PAUL R. TREGURTHA	WYR4481	Cleveland	31	55	37	21	144
PEARL ACE	VRUN4	Seattle	49	49	70	52	220
PEGASUS HIGHWAY	3FMA4	New York City	12	0	3	5	20
PEGGY DOW	PJOY	Long Beach	15	82	89	75	261
PELAGIA	PGRQ	Houston	11	6	21	31	69
PFC EUGENE A. OBREGON	WHAQ	Norfolk	24	17	16	4	61
PHILIP R. CLARKE	WE3592	Chicago	2	0	0	13	15
PIERRE FORTIN	CG2678	Norfolk	0	157	170	202	529
PISCES EXPLORER	MWQD5	Long Beach	35	65	52	2	154
POLAR TRADER	WCZ3758	Long Beach	0	19	15	8	42
POLYNESIA	DNMR	Oakland	0	0	85	71	156
POLYNESIA	D5NZ	Long Beach	28	0	0	0	28
POTOMAC TRADER	WXBZ	Houston	53	94	80	67	294
PRESIDENT ADAMS	WRYW	Oakland	56	51	37	54	198
PRESIDENT GRANT	WCY2098	Long Beach	35	35	46	50	166
PRESIDENT JACKSON	WRYC	Oakland	50	29	44	51	174
PRESIDENT KENNEDY	WRYE	Oakland	56	68	54	59	237
PRESIDENT POLK	WRYD	Oakland	68	67	65	48	248
PRESIDENT TRUMAN	WNDP	Oakland	68	57	47	55	227
PRESIDENT WILSON	WCY3438	Long Beach	2	23	0	33	58
PRESQUE ISLE	WZE4928	Chicago	47	42	41	47	177
PRIDE OF BALTIMORE II	WUW2120	Baltimore	15	14	5	0	34
PRINCE OF OCEAN	3ECO9	Seattle	0	0	0	1	1
PRINCES HIGHWAY	3ERU8	Jacksonville	40	76	71	51	238
PROJECT ARABIA	PJKP	Miami	73	9	27	49	158
PROJECT ORIENT	PJAG	Baltimore	27	4	0	0	31
PUDONG SENATOR	DQVI	Seattle	50	54	47	88	239
PUSAN SENATOR	DQVG	Seattle	48	34	37	37	156
QUEEN ELIZABETH 2	GBTT	New York City	36	65	37	61	199
QUEEN OF SCANDINAVIA	OUSE6	Miami	26	18	16	18	78
QUEENSLAND STAR	MZBM7	Houston	64	66	68	70	268
R.J. PFEIFFER	WRJP	Long Beach	44	24	11	15	94
RAINBOW BRIDGE	3EYX9	Seattle	68	62	69	56	255
RAYMOND E. GALVIN	C6FD6	Oakland	7	3	1	0	11
REBECCA LYNN	WCW7977	Chicago	3	6	7	7	23
REGAL EMPRESS	C6LW2	New York City	24	0	8	2	34
REPULSE BAY	MQYA3	Houston	2	0	3	5	10
RESOLUTE	KFDZ	Norfolk	0	34	17	0	51
RHAPSODY OF THE SEAS	LAZK4	Miami	6	0	0	0	6
RICHARD H MATZKE	C6FE5	Oakland	40	11	15	47	113
RICHARD REISS	WBF2376	Cleveland	16	11	23	16	66
RIO APURE	ELUG7	Miami	33	36	42	44	155
RO RO SENTOSA	9VRL	Jacksonville	0	0	0	1	1
ROGER BLOUGH	WZP8164	Chicago	25	69	68	68	230
ROGER REVELLE	KAOU	New Orleans	49	90	59	73	271
ROSSEL CURRENT	J8FI6	Houston	0	0	0	2	2
ROTTERDAM EXPRESS	S6IG	Long Beach	254	118	644	265	1281
ROYAL PRINCESS	GBRP	Long Beach	22	4	4	4	34
RUBIN BONANZA	3FNV5	Seattle	26	11	47	16	100

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SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
RUBIN KOBE	DYZM	Seattle	48	33	27	17	125
RUBIN PEARL	YJQA8	Seattle	49	64	36	39	188
SABINE PHILADELPHIA	WNFJ	New Orleans	0	11	0	0	11
SAGA CREST	H3FB	Miami	0	76	19	24	119
SALLY MAERSK	OZHS2	Seattle	0	1	28	0	29
SALOME	S6CL	Newark	6	5	7	16	34
SAM HOUSTON	KDGA	Houston	0	25	17	0	42
SAMUEL RISLEY	CG2960	Norfolk	170	137	192	150	649
SAN MARCOS	ELND4	Jacksonville	30	10	30	15	85
SANDRA FOSS	WYL4908	Seattle	0	12	0	0	12
SANKO LAUREL	3EXQ3	Seattle	0	0	0	2	2
SANTA BARBARA	ELOT3	Seattle	1	2	0	0	3
SANTA MONICA	ELNJ3	Seattle	26	44	39	53	162
SAUDI DIRIYAH	HZZB	Norfolk	0	0	0	9	9
SAUDI MAKKAH	HZQZ	Houston	76	56	60	67	259
SC BREEZE	ELOC6	New York City	12	15	23	1	51
SC HORIZON	ELOC8	Houston	0	44	48	15	107
SCL INFANTA	GBSA	Houston	35	50	76	79	240
SEA INITIATIVE	DEBB	Houston	2	8	25	5	40
SEA MARINER	J8FF9	Miami	0	59	21	59	139
SEA PRINCESS	KRCP	New Orleans	0	49	5	27	81
SEA RACER	ELQI8	Jacksonville	19	7	0	3	29
SEA TRADE	ELGH4	Norfolk	0	2	29	33	64
SEA VALOR	WBN9212	Seattle	3	0	0	0	3
SEA-LAND CHARGER	V7AY2	Long Beach	40	22	47	40	149
SEA-LAND DISCOVERY	WZJD	Jacksonville	57	0	0	0	57
SEA-LAND EAGLE	V7AZ8	Long Beach	21	0	0	0	21
SEA-LAND URUGUAY	DGVZ	Norfolk	0	0	0	55	55
SEALAND ANCHORAGE	KGTX	Seattle	56	42	57	62	217
SEALAND ATLANTIC	KRLZ	Houston	30	39	30	18	117
SEALAND CHALLENGER	WZJC	Houston	7	31	46	11	95
SEALAND CHAMPION	V7AM9	Oakland	63	0	0	0	63
SEALAND COMET	V7AP3	Oakland	25	1	0	31	57
SEALAND CONSUMER	WCHF	Houston	24	33	18	32	107
SEALAND CRUSADER	WZJF	Jacksonville	44	47	35	33	159
SEALAND DEFENDER	KGJB	Oakland	35	36	32	32	135
SEALAND DEVELOPER	KHRH	Long Beach	19	29	60	47	155
SEALAND ENDURANCE	KGJX	Long Beach	16	23	13	18	70
SEALAND ENTERPRISE	KRGB	Oakland	79	84	71	62	296
SEALAND EXPEDITION	WPGJ	Jacksonville	17	30	41	73	161
SEALAND EXPLORER	WGJF	Long Beach	56	55	45	57	213
SEALAND EXPRESS	KGJD	Long Beach	21	30	26	0	77
SEALAND FREEDOM	V7AM3	Houston	54	24	59	57	194
SEALAND HAWAII	KIRF	Seattle	62	68	62	65	257
SEALAND HONDURAS	OUQP2	Miami	1	0	9	1	11
SEALAND INDEPENDENCE	WGJC	Long Beach	28	13	1	4	46
SEALAND INNOVATOR	WGKF	Oakland	23	0	0	20	43
SEALAND INTEGRITY	WPVD	Houston	31	104	125	52	312
SEALAND INTREPID	9VWZ	Norfolk	33	0	36	33	102
SEALAND KODIAK	KGTZ	Seattle	51	14	15	13	93
SEALAND LIBERATOR	KHRP	Oakland	37	55	37	5	134
SEALAND MARINER	V7AM5	Houston	19	14	22	40	95
SEALAND MERCURY	V7AP6	Oakland	11	33	43	16	103
SEALAND METEOR	V7AP7	Long Beach	31	26	32	11	100
SEALAND NAVIGATOR	WPGK	Long Beach	54	57	68	66	245
SEALAND PACIFIC	WSRL	Long Beach	40	61	74	74	249
SEALAND PATRIOT	KHRF	Oakland	34	16	31	26	107
SEALAND PERFORMANCE	KRPD	Houston	62	62	32	47	203
SEALAND PRODUCER	WJBJ	Long Beach	63	41	40	41	185
SEALAND QUALITY	KRNJ	Jacksonville	36	27	47	37	147
SEALAND RACER	V7AP8	Long Beach	18	47	6	42	113
SEALAND RELIANCE	WFLH	Long Beach	82	70	60	79	291
SEALAND SPIRIT	WFLG	Oakland	44	56	46	33	179
SEALAND TACOMA	KGTY	Seattle	37	45	49	44	175
SEALAND TRADER	KIRH	Oakland	75	63	50	68	256
SEALAND VOYAGER	KHRK	Long Beach	23	29	54	61	167
SEARIVER BAYTOWN	KFPM	Oakland	0	12	15	12	39
SEARIVER LONG BEACH	WHCA	Long Beach	1	0	0	0	1
SEARIVER NORTH SLOPE	KHLQ	Oakland	10	10	1	0	21
SETO BRIDGE	JMQY	Oakland	43	34	56	30	163
SEVEN OCEAN	3EZB8	Seattle	0	0	0	4	4
SHIRAOI MARU	3ECM7	Seattle	69	85	131	114	399

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SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
SIDNEY FOSS	WYL5445	Seattle	3	8	6	1	18
SKAGEN MAERSK	OYOS2	Seattle	20	0	40	11	71
SKAUBRYN	LAJV4	Seattle	36	65	49	50	200
SKAUGRAN	LADB2	Seattle	45	20	25	22	112
SKODSBORG	OYRJ4	Houston	12	27	0	0	39
SNOW CRYSTAL	C6ID8	New York City	67	75	42	60	244
SOFIE MAERSK	OZUN2	Seattle	7	0	7	28	42
SOL DO BRASIL	ELQQ4	Baltimore	37	43	27	29	136
SOLAR WING	ELJS7	Jacksonville	81	77	81	91	330
SOROE MAERSK	OYKJ2	Seattle	0	0	19	0	19
SOUTHDOWN CHALLENGER	WA4659	Cleveland	81	64	43	48	236
SOVEREIGN MAERSK	OYGA2	Seattle	14	17	0	29	60
ST BLAIZE	J8FO	Norfolk	3	9	10	2	24
STACEY FOSS	WYL4909	Seattle	0	4	0	0	4
STAR ALABAMA	LAVU4	Baltimore	34	0	69	47	150
STAR AMERICA	LAVV4	Jacksonville	23	19	53	0	95
STAR DOVER	LAEP4	Seattle	48	12	37	30	127
STAR EVVIVA	LAHE2	Jacksonville	12	13	0	10	35
STAR FRASER	LAVY4	Houston	36	26	25	56	143
STAR GEIRANGER	LAKQ5	Norfolk	23	31	0	34	88
STAR GRAN	LADR4	Long Beach	0	14	0	22	36
STAR GRINDANGER	LAKR5	Norfolk	28	21	48	0	97
STAR HANSA	LAXP4	Jacksonville	24	23	29	30	106
STAR HARDANGER	LAXD4	Baltimore	14	5	0	8	27
STAR HARMONIA	LAGB5	Baltimore	24	1	0	6	31
STAR HERDLA	LAVD4	Baltimore	35	14	0	58	107
STAR HIDRA	LAVN4	Baltimore	0	0	0	15	15
STAR HIDRA	LAVX4	Seattle	15	0	0	0	15
STAR HOYANGER	LAXG4	Baltimore	5	25	4	10	44
STAR SKARVEN	LAJY2	Miami	45	0	0	0	45
STAR TRONDANGER	LAQQ2	Baltimore	9	9	0	13	31
STATENDAM	PHSG	Miami	0	0	0	7	7
STELLAR IMAGE	3FDO6	Seattle	81	78	9	0	168
STELLAR KOHINOOR	3FFG8	Seattle	0	0	19	23	42
STENA CLIPPER	C6MX4	Miami	65	49	24	26	164
STEPHAN J	V2JN	Miami	123	123	127	93	466
STEWART J. CORT	WYZ3931	Chicago	106	80	57	19	262
STONEWALL JACKSON	KDDW	New Orleans	23	0	0	16	39
STRONG PATRIOT	WCZ8589	Norfolk	0	0	0	6	6
STRONG VIRGINIAN	KSPH	Oakland	0	1	0	0	1
SUN DANCE	3ETQ8	Seattle	25	12	8	0	45
SUNBELT DIXIE	D5BU	Baltimore	21	16	25	14	76
SUSAN MAERSK	OYIK2	Seattle	0	16	1	0	17
SUSAN W. HANNAH	WAH9146	Chicago	6	2	9	15	32
SVEND MAERSK	OYJS2	Seattle	0	1	16	0	17
SVENDBORG MAERSK	OZSK2	Seattle	0	39	0	7	46
T/V STATE OF MAINE	NTNR	Norfolk	35	29	10	0	74
TAI HE	BOAB	Long Beach	24	23	25	41	113
TAIKO	LAQT4	New York City	0	0	0	4	4
TAKARA	LAZN4	Baltimore	0	0	0	1	1
TALISMAN	LAOW5	Jacksonville	0	0	0	12	12
TAMPA	LMWO3	Long Beach	12	0	0	0	12
TANABATA	WCZ5535	Baltimore	27	12	39	34	112
TAUSALA SAMOA	V2KS	Seattle	47	58	77	64	246
TECO TRADER	KSDF	Houston	89	58	72	18	237
TEQUI	3FDZ5	Seattle	19	15	0	18	52
TEXAS CLIPPER	KVWA	Houston	0	53	33	6	92
THORKIL MAERSK	MSJX8	Miami	57	58	45	47	207
TMM MEXICO	3FRY9	Houston	48	38	56	49	191
TOBIAS MAERSK	MSJY8	Long Beach	26	34	43	42	145
TORM FREYA	ELVY8	Norfolk	26	39	25	36	126
TOWER BRIDGE	ELJL3	Long Beach	17	16	10	10	53
TRADE COSMOS	VRUQ2	Miami	0	0	15	69	84
TREIN MAERSK	MSQQ8	Baltimore	47	49	38	37	171
TROJAN STAR	C6OD7	Baltimore	0	25	8	0	33
TROPIC FLYER	J8NV	Miami	16	12	8	4	40
TROPIC LURE	J8PD	Miami	15	30	32	23	100
TROPIC SUN	3EZK9	New Orleans	3	2	0	11	16
TROPIC TIDE	3FGQ3	Miami	4	4	5	8	21
TULSIDAS	ATUJ	Norfolk	0	0	18	12	30
TUSTUMENA	WNGW	Seattle	30	21	25	28	104
UNITED SPIRIT	ELYB2	Seattle	0	0	0	38	38

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SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
USCGC ACACIA (WLB406)	NODY	Chicago	0	1	0	0	1
USCGC ACTIVE WMEC 618	NRTF	Seattle	2	4	0	0	6
USCGC BRAMBLE (WLB 392)	NODK	Cleveland	4	0	20	0	24
USCGC BRISTOL BAY	NRLY	Cleveland	0	0	3	0	3
USCGC COURAGEOUS	NCRG	Norfolk	0	6	7	0	13
USCGC DURABLE (WMEC 628)	NRUN	Houston	0	4	2	7	13
USCGC GENTIAN	NBHF	Norfolk	0	30	3	0	33
USCGC HAMILTON WHEC 715	NMAG	Long Beach	2	0	0	0	2
USCGC HEALY WAGB-20	NEPP	Seattle	99	135	75	28	337
USCGC JEFFERSON ISLAND	NORW	New York City	2	0	1	0	3
USCGC KUKUI (WLB-203)	NKJU	Seattle	14	12	0	12	38
USCGC MACKINAW	NRKP	Chicago	0	0	15	1	16
USCGC MELLON (WHEC 717)	NMEL	Seattle	4	24	6	0	34
USCGC NORTHLAND WMEC 904	NLGF	Norfolk	0	0	24	30	54
USCGC POLAR SEA__(WAGB 1	NRUO	Seattle	0	0	0	6	6
USCGC POLAR STAR (WAGB 1	NBTM	Seattle	1	0	24	75	100
USCGC SUNDEW (WLB 404)	NODW	Chicago	4	4	2	0	10
USCGC VIGOROUS WMEC 627	NQSP	Baltimore	0	2	1	0	3
USNS BRUCE C. HEEZEN	NBID	New Orleans	17	15	8	0	40
USNS GUS W. DARNELL	KCDK	Houston	36	29	15	19	99
USNS NAVAJO_(TATF-169)	NOYK	Long Beach	17	15	31	50	113
USNS PERSISTENT	XXXX	Norfolk	4	0	8	0	12
USNS SUMNER	NZAU	New Orleans	33	42	38	40	153
VEGA	9VJS	Houston	42	12	31	21	106
VICTORIA	GBBA	Miami	10	27	7	0	44
VIRGINIA	3EBW4	Seattle	16	16	22	0	54
VLADIVOSTOK	UBXP	Seattle	57	54	39	67	217
WAARDRECHT	S6BR	Seattle	106	28	47	22	203
WASHINGTON HIGHWAY	JKHH	Seattle	74	131	102	89	396
WEATHERBIRD II	WCT6653	Seattle	13	1	0	4	18
WECOMA	WSD7079	Seattle	10	89	40	51	190
WESTERN BRIDGE	C6JQ9	Baltimore	84	79	77	74	314
WESTWARD	WZL8190	Miami	23	40	1	0	64
WESTWARD VENTURE	KHJB	Seattle	14	31	29	19	93
WESTWOOD ANETTE	C6QO9	Seattle	33	42	51	30	156
WESTWOOD BELINDA	C6CE7	Seattle	49	45	40	42	176
WESTWOOD BORG	LAON4	Seattle	90	24	52	71	237
WESTWOOD BREEZE	LAOT4	Seattle	21	49	64	60	194
WESTWOOD CLEO	C6OQ8	Seattle	31	38	37	24	130
WESTWOOD JAGO	C6CW9	Seattle	24	39	37	39	139
WESTWOOD MARIANNE	C6QD3	Seattle	50	56	51	65	222
WIELDRECHT	S6BO	Seattle	4	1	0	0	5
WILFRED SYKES	WC5932	Chicago	8	2	9	9	28
WILLIAM E. CRAIN	ELOR2	Oakland	9	10	6	30	55
WILSON	WNPD	New Orleans	56	21	16	19	112
WORLD SPIRIT	ELWG7	Seattle	19	25	23	19	86
YUCATAN	3FTA9	Houston	45	65	28	30	168
YURIY OSTROVSKIY	UAGJ	Seattle	48	42	41	42	173
ZIM AMERICA	4XGR	Newark	15	53	19	11	98
ZIM ASIA	4XFB	New Orleans	70	59	21	46	196
ZIM ATLANTIC	4XFD	New York City	24	82	75	60	241
ZIM CANADA	4XGS	Norfolk	33	18	3	23	77
ZIM CHINA	4XFQ	New York City	36	10	23	64	133
ZIM EUROPA	4XFN	New York City	7	1	4	0	12
ZIM HONG KONG	4XGW	Houston	17	13	28	23	81
ZIM IBERIA	4XFP	New York City	20	50	40	18	128
ZIM ISRAEL	4XGX	New Orleans	12	43	41	14	110
ZIM ITALIA	4XGT	New Orleans	62	64	17	3	146
ZIM JAMAICA	4XFE	New York City	18	66	26	19	129
ZIM JAPAN	4XGV	Baltimore	57	37	12	25	131
ZIM KOREA	4XGU	Miami	42	52	18	21	133
ZIM MONTEVIDEO	V2AG7	Norfolk	2	0	0	0	2
ZIM PACIFIC	4XFC	New York City	16	22	45	64	147
ZIM SEATTLE	ELWZ3	Seattle	48	31	39	35	153
ZIM U.S.A.	4XFO	New York City	40	19	35	49	143

Totals	May	24698
	Jun	24878
	Jul	24589
	Aug	24133
Period Total		98298

Buoy Climatological Data Summary —

May through August 2000

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 Systems Operation Division, Stennis Space Center, Mississippi 39529 or phone (228) 688-2840 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)
May 2000													
41004	32.5N	079.1W	731	22.9	23.1	1.1	2.3	30/02	12.2	SW	22.5	30/00	1016.5
41008	31.4N	080.9W	737	23.4	23.5	0.8	2.1	30/07	11.5	S	23.3	30/05	1017.1
41009	28.5N	080.2W	1468	24.5	25.3	0.8	1.7	22/05	10.8	E	20.0	22/05	1017.1
41010	28.9N	078.5W	1470	24.5	25.6	1.1	2.5	31/08	10.4	S	21.8	15/16	1019.3
42001	25.9N	089.7W	731	26.2	26.5	0.9	1.9	26/09	11.5	SE	23.1	26/05	1015.3
42002	25.9N	093.6W	725	26.0	26.3	1.3	2.5	26/23	13.7	SE	32.1	20/22	1013.9
42003	25.9N	085.9W	97	24.5	26.6	1.2	1.7	01/19	15.7	E	21.2	01/16	1016.9
42007	30.1N	088.8W	725	25.3	26.0	0.7	1.4	05/06	12.2	S	21.4	14/07	1016.3
42035	29.2N	094.4W	735	25.1	25.8	1.1	2.2	18/08	12.4	SE	29.3	02/12	1014.0
42036	28.5N	084.5W	734	24.3	24.5				8.3	E	21.8	31/04	1016.4
42039	28.8N	086.0W	736	25.0	25.3	0.8	2.1	31/13	8.9	E	22.3	31/07	1017.2
42040	29.2N	088.2W	737	25.2	25.7	0.8	2.0	31/21	10.8	SE	20.0	31/18	1015.4
42041	27.2N	090.4W	738	25.6	25.7	1.0	1.9	18/21	9.4	SE	19.6	18/07	1014.8
44005	42.9N	068.9W	731	8.8	7.8	1.1	3.4	19/03	10.2	S	34.4	10/21	1013.9
44007	43.5N	070.1W	736	9.8	9.0	0.8	2.4	04/21	9.2	S	27.4	18/15	1013.3
44008	40.5N	069.4W	733	10.2	8.8	1.2	3.3	02/19	10.8	NE	26.8	18/22	1014.6
44009	38.5N	074.7W	725	14.6	13.6	1.1	3.6	29/21	11.4	S	28.8	29/18	1014.6
44011	41.1N	066.6W	737	9.7	8.5	1.4	3.5	02/21	10.6	NE	26.0	02/11	1015.2
44013	42.4N	070.7W	736	10.4	9.2	0.7	2.5	11/05	9.5	SE	28.2	18/20	1013.9
44014	36.6N	074.8W	731	16.1	15.1	1.2	5.4	29/20	11.0	S	35.9	29/18	1014.3
44025	40.3N	073.2W	733	12.3	11.5	1.0	2.9	18/20	10.5	S	30.1	19/15	1013.8
45001	48.1N	087.8W	738	4.9		0.5	2.6	08/18	8.8	SE	25.3	08/17	1010.5
45002	45.3N	086.4W	737	7.2	5.0	0.4	1.4	04/21	9.1	S	21.0	08/15	1011.6
45003	45.4N	082.8W	737	6.4	4.0	0.4	1.6	25/19	8.8	S	21.0	25/17	1011.9
45004	47.6N	086.5W	695	4.8	3.0	0.5	2.1	09/02	9.8	W	25.8	08/16	1011.4
45005	41.7N	082.4W	736	14.1	12.9	0.4	2.7	19/14	9.7	S	26.8	19/15	1012.6
45006	47.3N	089.9W	732	5.2	3.0	0.3	1.6	08/15	8.8	NE	21.6	13/10	1011.2
45007	42.7N	087.0W	190	10.0	6.7	0.2	0.8	08/19	8.9	S	18.7	09/02	1014.7
45008	44.3N	082.4W	737	7.5	5.0	0.3	1.8	19/10	9.2	S	22.5	19/09	1012.5
46001	56.3N	148.2W	735	5.8	6.1	1.7	3.6	11/00	10.6	W	22.2	10/21	1011.8
46002	42.5N	130.3W	728	11.0	10.9	2.3	5.5	03/11	12.5	SW	28.0	10/12	1018.5
46005	46.1N	131.0W	728	8.7	9.2	2.3	7.0	03/05	13.3	SW	27.4	03/08	1016.5
46011	34.9N	120.9W	727	11.8	11.0	2.2	5.0	11/02	13.7	NW	30.1	11/02	1015.2
46013	38.2N	123.3W	707	11.6	10.6	2.3	4.8	30/23	16.9	NW	35.0	31/01	1016.1
46014	39.2N	124.0W	724	11.6	11.1	2.2	4.5	04/06	12.8	NW	31.3	31/00	1016.7
46023	34.7N	121.0W	716	12.2	11.6	2.2	4.2	11/05	15.8	NW	33.6	11/02	1015.6

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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	728	15.5	16.5	1.3	3.0	11/05	6.8	W	23.1	11/04	1012.9
46026	37.8N	122.8W	601	11.2	10.9	2.0	3.8	30/06	12.6	NW	28.8	25/23	1016.2
46027	41.8N	124.4W	654	11.4	11.7	1.9	3.9	03/21	10.4	NW	29.3	31/22	1017.7
46028	35.7N	121.9W	726	12.4	12.2	2.5	5.5	30/16	17.0	NW	32.1	30/14	1015.0
46029	46.1N	124.5W	372	11.4	13.2	1.7	3.1	27/11	10.6	NW	23.9	26/09	1019.3
46030	40.4N	124.5W	732	11.8	11.7	2.0	4.5	04/06	13.4	N	24.9	14/20	1018.6
46035	56.9N	177.8W	628	2.2	3.2	1.3	5.5	13/23	11.7	N	30.7	13/12	1018.5
46041	47.3N	124.8W	689	10.5	11.7	1.9	4.6	03/23	9.1	NW	19.8	26/10	1016.3
46042	36.7N	122.4W	648	12.6	12.7	2.1	4.2	31/08	14.7	NW	27.2	18/23	1016.5
46047	32.4N	119.5W	673	13.4	13.7	2.4	5.3	11/14	14.5	NW	28.8	11/10	1013.8
46050	44.6N	124.5W	712	11.3	12.3	2.0	5.6	03/19	10.3	N	25.5	27/09	1018.2
46053	34.2N	119.8W	727	13.8	13.6	1.4	2.7	10/23	10.0	W	29.5	10/22	1013.0
46054	34.3N	120.4W	716	12.3	12.0	2.1	3.8	11/04	19.3	NW	34.4	11/04	1013.5
46059	38.0N	130.0W	727	12.2	12.7	2.1	4.4	14/15	12.5	NW	27.6	13/08	1019.9
46060	60.6N	146.8W	1430	7.5	7.9	0.4	1.2	01/00	7.9	E	23.1	23/08	1013.0
46061	60.2N	146.8W	1447		7.5	0.9	3.2	01/00	9.8	E	26.0	01/17	
46062	35.1N	121.0W	706	11.9	11.0	2.1	3.8	30/21	14.3	NW	31.7	11/00	1014.6
46063	34.2N	120.7W	731	12.3	11.9	2.3	4.5	31/00	16.0	NW	31.3	11/05	1014.0
46066	52.7N	155.0W	456	5.2	5.3	1.8	3.4	15/04	12.4	W	20.8	22/22	1016.1
51001	23.4N	162.3W	730	24.2	25								

June 2000

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	34.6N	072.6W	682	24.5	25.2	1.3	3.1	06/20	11.9	SW	24.7	06/14	1019.0
41004	32.5N	079.1W	720	25.7	26.2	1.0	2.1	30/01	11.4	S	22.2	06/01	1018.9
41008	31.4N	080.9W	718	26.0	26.8	0.8	1.9	07/10	11.3	S	21.8	07/10	1019.1
41009	28.5N	080.2W	1438	26.2	26.6	0.9	1.6	01/00	10.0	SE	22.0	23/20	1018.8
41010	28.9N	078.5W	1439	26.5	27.0	1.1	1.8	10/23	9.9	SE	26.4	30/20	1021.2
42001	25.9N	089.7W	715	27.8	28.6	0.7	1.5	17/04	8.8	SE	19.2	09/08	1017.1
42002	25.9N	093.6W	716	27.8	28.5	1.0	2.3	10/07	12.1	SE	24.1	09/14	1015.9
42003	25.9N	085.9W	201	28.0	29.0	0.5	0.8	27/05	5.8	E	20.8	27/00	1017.2
42007	30.1N	088.8W	702	27.0	28.3	0.5	1.2	01/00	9.6	S	22.7	26/04	1017.8
42019	27.9N	095.4W	174	27.9	28.5	0.8	1.1	23/18	9.8	S	15.7	24/06	1015.7
42035	29.2N	094.4W	719	27.5	28.4	1.0	2.0	17/07	12.4	S	22.5	09/21	1016.2
42036	28.5N	084.5W	719	26.9	27.8				8.4	E	22.3	18/04	1017.6
42039	28.8N	086.0W	720	27.1	28.0	0.7	1.9	15/18	8.6	E	23.9	15/16	1018.5
42040	29.2N	088.2W	720	27.3	28.4	0.7	1.7	01/00	9.2	SE	19.0	30/01	1016.5
42041	27.2N	090.4W	720	27.6	28.4	0.7	1.7	10/15	7.9	SE	17.3	10/06	1016.6
44004	38.4N	070.6W	504	22.4	22.2	1.4	3.0	27/11	11.7	SW	22.0	27/04	1017.9
44005	42.9N	068.9W	718	13.1	11.7	1.1	4.7	07/09	10.4	S	32.3	06/23	1015.1
44007	43.5N	070.1W	719	13.9	12.3	0.8	2.9	07/01	8.3	S	28.4	07/05	1014.5
44008	40.5N	069.4W	718	13.6	11.6	1.2	3.4	06/19	10.1	SW	27.2	06/18	1016.5
44009	38.5N	074.7W	706	18.9	18.2	1.0	2.2	07/11	10.6	S	24.5	07/08	1016.8
44011	41.1N	066.6W	720	13.2	11.3	1.4	4.0	06/23	10.0	SW	25.3	06/17	1017.4
44013	42.4N	070.7W	719	15.4	13.9	0.7	5.4	07/04	8.9	S	35.6	07/02	1015.1
44014	36.6N	074.8W	718	19.7		0.9	2.2	01/01	9.2	S	19.8	27/22	1017.0
44025	40.3N	073.2W	719	16.9	16.3	1.1	2.5	06/10	10.8	S	26.4	07/00	1015.5
45001	48.1N	087.8W	720	5.8		0.5	2.7	11/03	9.9	SW	25.8	10/21	1012.3
45002	45.3N	086.4W	720	12.2	10.4	0.6	2.9	21/01	10.2	S	30.5	16/10	1013.1
45003	45.4N	082.8W	720	10.8	8.7	0.4	1.7	16/16	8.8	S	23.5	02/17	1013.8
45004	47.6N	086.5W	653	6.1	3.8	0.4	2.7	10/21	9.1	SE	28.0	10/21	1013.2
45005	41.7N	082.4W	696	19.1	18.6	0.4	2.6	05/22	9.6	SW	28.2	06/02	1014.9
45006	47.3N	089.9W	720	7.3	4.5	0.5	2.8	10/17	10.3	SW	28.4	10/16	1012.8
45007	42.7N	087.0W	585	15.2	13.6	0.4	1.4	12/09	10.0	S	21.2	20/17	1013.0
45008	44.3N	082.4W	720	13.0	11.1	0.4	1.6	16/14	9.1	S	22.3	14/22	1014.3
46001	56.3N	148.2W	714	8.4	8.9	1.9	4.8	24/03	11.4	S	30.9	24/03	1013.1
46002	42.5N	130.3W	715	12.7	12.5	2.0	4.0	12/06	13.8	N	25.5	16/02	1021.6
46005	46.1N	131.0W	713	11.0	11.3	1.7	3.8	12/10	11.6	NW	23.9	11/05	1020.5
46011	34.9N	120.9W	712	13.3	13.7	1.6	3.9	12/02	10.2	NW	28.2	11/01	1014.2
46013	38.2N	123.3W	709	11.6	10.6	1.8	4.4	14/11	10.5	NW	28.8	13/05	1014.2
46014	39.2N	124.0W	705	11.5	11.6	2.0	4.3	23/03	9.3	NW	27.6	19/09	1014.5
46022	40.8N	124.5W	597	11.6	10.9	2.3	6.1	16/05	10.5	N	26.2	16/18	1016.0
46023	34.7N	121.0W	710	13.4	13.8	1.6	3.7	11/07	11.9	NW	29.3	11/01	1014.5
46025	33.8N	119.1W	711	17.0	19.0	1.0	2.0	08/07	6.1	W	19.2	08/04	1012.5
46026	37.8N	122.8W	712	11.9	12.0	1.5	3.2	13/22	9.2	NW	25.5	11/04	1014.4
46027	41.8N	124.4W	674	11.1	10.1	2.1	4.8	16/01	13.3	NW	36.5	16/01	1015.1
46028	35.7N	121.9W	708	13.1	13.5	1.9	3.8	11/09	11.3	NW	29.9	13/01	1013.8
46029	46.1N	124.5W	701	12.8	13.5	1.8	4.7	12/11	12.1	NW	30.7	11/18	1018.5
46030	40.4N	124.5W	715	10.9	10.0	2.2	4.7	16/09	11.7	N	26.6	22/11	1016.4
46035	56.9N	177.8W	627	4.7	5.3	1.5	3.4	01/22	13.0	W	28.4	07/00	1010.9
46041	47.3N	124.8W	674	12.3	12.9	1.6	3.9	12/09	9.1	NW	18.7	09/19	1018.5
46042	36.7N	122.4W	709	13.0	12.8	1.8	3.8	14/04	9.2	NW	23.7	13/01	1014.8
46047	32.4N	119.5W	691	14.8	15.8	1.7	3.7	10/10	10.9	NW	24.5	09/12	1013.0
46050	44.6N	124.5W	717	12.6	12.2	1.9	4.5	12/06	13.8	N	29.7	11/18	1018.9
46053	34.2N	119.8W	710	15.6	16.8	1.0	2.0	09/12	8.7	W	23.7	09/04	1012.7
46054	34.3N	120.4W	709	13.9	14.3	1.6	3.2	12/04	15.4	NW	29.1	10/02	1012.9

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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)
46059	38.0N	130.0W	712	14.0	14.4	2.5	6.0	16/14	15.7	N	28.6	15/22	1020.3
46060	60.6N	146.8W	1384	11.2	11.9	0.5	1.6	19/19	7.1	SW	26.0	19/19	1016.1
46061	60.2N	146.8W	1422		11.5	1.1	3.1	19/19	8.3	E	29.0	19/18	1016.3
46062	35.1N	121.0W	710	13.2	13.5	1.6	3.5	12/03	10.7	NW	27.8	11/01	1013.6
46063	34.2N	120.7W	714	13.6	13.7	1.9	3.5	11/07	13.5	NW	25.6	10/08	1013.0
46066	52.6N	155.0W	714	6.8	6.6	2.2	6.8	08/04	13.8	SW	27.2	07/21	1011.9
51001	23.4N	162.3W	656	25.1	26.0	1.8	2.6	05/14	12.0	E	20.2	06/02	1017.5
51002	17.2N	157.8W	221	25.2	25.9	1.9	2.6	30/00	13.8	E	19.6	29/20	1013.2
51003	19.2N	160.7W	712	25.3	26.0	1.6	2.6	06/01	10.5	E	19.4	06/03	1016.2
51004	17.4N	152.5W	704	24.4	25.2	1.9	2.9	06/01	12.6	E	21.0	13/03	1014.7
51028	00.0N	153.8W	707	26.6	26.6	1.9	3.2	04/03	11.2	E	17.9	28/21	1009.9
ABAN6	44.3N	075.9W	720	16.5	14.0				4.9	S	16.6	25/14	1015.1
ALSN6	40.4N	073.8W	719	19.4	17.0	0.8	1.6	06/01	13.4	S	32.2	07/05	1016.4
AUGA2	59.4N	153.4W	1431	9.5					9.7	SE	32.9	07/14	1014.7
BLIA2	60.8N	146.9W	1433	10.6					5.7	NW	24.2	19/23	1017.0
BURL1	28.9N	089.4W	719	27.3					10.2	SE	31.5	16/17	1017.3
BUZM3	41.4N	071.0W	720	16.2		0.8	2.0	07/03	13.3	SW	37.9	07/02	1015.7
CARO3	43.3N	124.4W	714	11.5					10.5	N	34.2	12/13	1019.0
CDRF1	29.1N	083.0W	720	26.6					8.4	W	28.6	27/20	1018.6
CHLV2	36.9N	075.7W	720	21.7	20.2	0.8	1.5	06/04	13.8	S	27.2	19/02	
CLKN7	34.6N	076.5W	720	24.7					10.3	SW	21.4	28/22	1018.9
CSBF1	29.7N	085.4W	715	26.6					7.8	S	20.5	15/18	1018.1
DBLN6	42.5N	079.3W	720	18.0					9.6	SW	26.6	11/14	1015.4
DESW1	47.7N	124.5W	714	12.3					11.3	NW	33.8	09/22	1018.0
DISW3	47.1N	090.7W	717	11.2					11.4	SW	30.7	22/00	1012.7
DPIA1	30.2N	088.1W	718	26.8					8.8	S	23.7	07/06	1018.3
DRFA2	60.5N	152.1W	1428	10.4					8.0	S	19.2	14/23	1014.2
DRYF1	24.6N	082.9W	720	27.7	28.6				8.7	E	20.5	26/05	1017.7
DSLN7	35.2N	075.3W	239	24.0					14.5	SW	28.6	29/18	1018.3
DUCN7	36.2N	075.8W	720	23.5					11.2	SW	24.4	03/18	1018.3
FBIS1	32.7N	079.9W	720	25.8					10.8	SW	22.2	29/04	1019.2
FFIA2	57.3N	133.6W	704	11.1					6.4	S	19.8	04/15	1017.2
FPSN7	33.5N	077.6W	720	25.2		1.0	2.0	30/04	13.4	SW	33.4	06/05	1019.1
FWYF1	25.6N	080.1W	720	27.3	28.2				10.8	E	31.0	30/22	1018.4
GDIL1	29.3N	089.9W	720	27.3	29.2				7.9	SE	18.6	07/11	1017.9
GLLN6	43.9N	076.4W	715	15.2					10.9	SW	29.3	25/15	1015.1
IOSN3	43.0N	070.6W	720	16.2					12.0	S	38.7	07/00	1014.6
KTNF1	29.8N	083.6W	720	25.7					8.3	E	23.9	05/21	1018.2
LKWF1	26.6N	080.0W	316	27.0	28.1				9.9	SE	18.4	09/15	1019.0
LONF1	24.8N	080.9W	720	27.6	29.4				9.4	E	27.3	08/23	1018.3
MDRM1	44.0N	068.1W	691	11.9					12.9	S	32.1	07/09	
MISM1	43.8N	068.8W	720	12.5					13.0	SW	30.6	22/04	1014.7
MLRF1	25.0N	080.4W	78	28.0	29.0				7.8	SE	18.4	27/18	1017.9
MRKA2	61.1N	146.7W	1427	10.4					6.9	NE	19.2	20/02	1016.6
NWPO3	44.6N	124.1W	717	11.5					11.3	N	34.5	12/08	1018.5
PILA2	59.7N	149.5W	1432	10.0					7.9	N	26.6	19/13	1015.1
PILM4	48.2N	088.4W	720	8.0					12.8	W	37.6	20/18	1013.3
POTA2	61.1N	146.7W	1420	10.5					6.6	NE	21.4	11/13	1015.9
PTAC1	39.0N	123.7W	710	11.7					9.1	N	24.1	13/10	1014.5
PTAT2	27.8N	097.1W	711	27.4	28.7				16.3	SE	27.0	09/20	1014.2
PTGC1	34.6N	120.6W	717	13.3					13.5	N	29.1	05/11	1014.1
ROAM4	47.9N	089.3W	234	8.8					13.8	NE	35.0	10/16	1017.7
SANF1	24.4N	081.9W	720	27.5	28.5				9.6	E	23.5	27/03	1017.3
SAUF1	29.8N	081.3W	720	26.4	27.7				10.0	SE	24.0	15/21	1019.0
SBIO1	41.6N	082.8W	720	20.4					10.7	SW	26.4	22/16	1014.7
SGNW3	43.8N	087.7W	380	15.2					11.5	S	27.1	21/21	1015.6
SISW1	48.3N	122.8W	717	12.1					10.3	W	35.4	12/09	1017.5
SMKF1	24.6N	081.1W	720	27.7	29.4				10.7	E	28.9	19/06	1019.2
SPGF1	26.7N	079.0W	720	27.1					7.5	SE	23.0	30/23	1019.4
SRST2	29.7N	094.0W	713	27.5					12.9	S	25.6	17/20	1016.3
STDM4	47.2N	087.2W	720	10.5					14.8	S	33.2	20/18	1012.3
SUPN6	44.5N	075.8W	720	16.3	14.9				8.8	SW	28.0	25/16	1015.1
THIN6	44.3N	076.0W	709	16.4									
TPLM2	38.9N	076.4W	720	22.3	22.1								

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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	34.6N	072.6W	560	25.3	26.7	1.5	2.8	17/07	12.3	SW	29.5	23/08	1014.2
41002	32.3N	075.2W	488	26.6	27.1	1.4	2.4	17/18	11.0	SW	28.6	17/06	1015.2
41004	32.5N	079.1W	741	27.1	27.7	1.0	2.1	06/10	10.4	SW	22.0	06/09	1014.9
41008	31.4N	080.9W	742	27.2	27.9	0.8	1.6	30/23	10.7	S	29.3	12/01	1015.3
41009	28.5N	080.2W	1479	27.0	28.0	0.8	2.1	17/04	9.7	SW	27.6	30/12	1015.5
41010	28.9N	078.5W	1481	27.8	28.2	1.2	2.3	17/04	10.8	SW	26.8	30/09	1016.4
42001	25.9N	089.7W	742	28.9	30.2	0.4	1.1	15/21	5.8	SE	29.5	15/21	1016.2
42002	25.9N	093.6W	736	28.8	29.8	0.5	1.0	10/07	7.1	SE	18.3	24/18	1015.8
42003	25.9N	085.9W	742	28.5	29.5	0.4	1.6	03/22	6.1	NW	21.0	03/15	1015.9

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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)
42007	30.1N	088.8W	736	29.0	29.8	0.3	1.0	14/11	9.5	W	26.4	21/21	1015.4
42019	27.9N	095.4W	744	28.4	29.0	0.7	1.4	03/08	9.0	S	18.1	24/02	1015.4
42020	26.9N	096.7W	507	28.1	28.4	0.8	1.6	11/11	11.4	SE	21.4	27/19	1015.1
42035	29.2N	094.4W	742	28.4	29.4	0.6	1.1	10/12	9.5	S	19.2	04/06	1015.9
42036	28.5N	084.5W	742	28.4	29.3				8.4	W	22.9	24/15	1014.7
42039	28.8N	086.0W	743	28.9	29.7	0.6	1.5	14/19	8.6	W	26.4	21/09	1015.8
42040	29.2N	088.2W	738	29.2	30.3	0.5	1.1	04/19	9.2	W	25.3	30/19	1014.1
42041	27.2N	090.4W	739	28.7	29.9	0.4	1.3	04/15	6.0	W	26.4	31/20	1015.5
44004	38.4N	070.6W	296	23.6	26.9	1.0	1.8	05/09	12.7	N	31.1	10/14	1013.8
44005	42.9N	068.9W	742	17.2	16.5	1.0	2.8	16/15	9.6	S	27.0	16/16	1014.3
44007	43.5N	070.1W	742	16.7	15.7	0.7	2.4	17/01	7.2	S	23.7	17/00	1013.9
44008	40.5N	069.4W	741	17.0	15.8	1.1	2.7	10/18	7.1	E	13.4	31/19	1015.2
44009	38.5N	074.7W	696	22.0	22.2	1.0	2.2	20/13	10.1	S	27.4	20/09	1015.0
44011	41.1N	066.6W	744	16.9	15.9	1.3	3.4	10/15	8.4	W	27.2	10/11	1015.8
44013	42.4N	070.7W	743	17.8	16.9	0.6	1.8	16/18	8.2	SE	21.6	27/14	1014.4
44014	36.6N	074.8W	739	23.8		0.9	2.1	20/17	8.6	S	22.3	17/02	1014.3
44025	40.3N	073.2W	743	21.0	21.1	0.9	2.1	09/23	9.5	S	22.7	15/12	1014.4
45001	48.1N	087.8W	741	12.0		0.3	1.7	17/15	8.1	SE	22.3	17/13	1015.2
45002	45.3N	086.4W	742	17.5	17.1	0.5	2.5	08/21	9.4	NE	32.3	02/08	1015.1
45003	45.4N	082.8W	743	16.7	16.1	0.3	2.4	18/02	8.8	NW	26.8	18/02	1015.1
45004	47.6N	086.5W	743	11.9	10.0	0.3	1.9	17/20	8.2	NW	20.8	18/04	1015.8
45005	41.7N	082.4W	645	21.2	22.3	0.3	1.2	07/11	9.0	NE	19.2	09/22	1014.7
45006	47.3N	089.9W	742	13.6	11.8	0.3	1.3	05/23	8.2	NE	22.3	05/22	1015.7
45007	42.7N	087.0W	742	19.4	19.7	0.4	2.0	31/03	9.4	N	26.0	18/05	1014.6
45008	44.3N	082.4W	740	17.7	17.6	0.3	2.8	18/04	8.3	N	24.5	18/03	1015.2
46001	56.3N	148.2W	741	10.6	11.0	1.4	2.4	06/01	11.1	SW	21.0	21/04	1014.0
46002	42.5N	130.3W	743	15.5	15.3	1.5	2.4	09/13	10.9	NW	23.3	06/17	1022.4
46005	46.1N	131.0W	735	13.8	14.0	1.6	2.9	30/11	11.6	NW	20.0	17/02	1020.8
46011	34.9N	120.9W	741	13.8	14.3	1.8	3.4	20/01	13.8	NW	30.3	19/21	1015.8
46012	37.4N	122.7W	486	13.0	13.4	1.6	2.9	26/04	10.3	NW	19.6	22/05	1016.9
46013	38.2N	123.3W	743	11.9	10.7	1.8	3.5	03/09	16.2	NW	31.1	03/11	1015.6
46014	39.2N	124.0W	731	11.9	11.2	1.8	4.0	03/03	12.0	NW	27.4	03/04	1016.2
46022	40.8N	124.5W	731	12.6	11.9	1.4	3.3	10/09	8.0	N	24.3	10/11	1018.4
46023	34.7N	121.0W	743	14.0	14.7	1.8	3.3	19/23	16.5	NW	30.7	19/19	1016.3
46025	33.8N	119.1W	741	17.6	19.7	1.0	1.8	04/04	5.8	W	15.7	13/22	1013.5
46026	37.8N	122.8W	742	12.2	12.4	1.6	3.2	03/10	12.4	NW	26.4	05/04	1016.0
46027	41.8N	124.4W	727	11.8	11.2	1.4	3.5	03/02	7.7	NW	33.2	02/22	1017.4
46028	35.7N	121.9W	739	13.4	13.5	2.0	3.7	26/10	16.9	NW	30.1	20/03	1015.3
46029	46.1N	124.5W	733	14.2	14.4				8.8	N	22.0	15/22	1018.8
46030	40.4N	124.5W	740	11.8	10.2	1.5	3.4	10/11	12.7	N	22.9	10/10	1018.3
46035	56.9N	177.8W	676	8.1	8.9	1.1	3.1	12/21	10.5	SE	25.3	30/18	1012.5
46041	47.3N	124.8W	735	13.7	13.8	1.2	2.3	17/10					1018.6
46042	36.7N	122.4W	742	13.5	12.8	1.7	3.3	03/15	13.2	NW	25.6	20/02	1016.6
46047	32.4N	119.5W	728	15.7	17.0	2.1	4.0	20/09	15.3	NW	24.7	04/00	1014.2
46050	44.6N	124.5W	739	13.6	12.8	1.4	2.5	11/22	8.4	N	21.6	12/02	1019.5
46053	34.2N	119.8W	743	16.0	17.0	1.1	2.2	04/00	10.0	W	23.7	04/03	1013.7
46054	34.3N	120.4W	724	13.9	14.6	1.7	3.1	20/07	21.3	NW	34.4	20/08	1014.0
46059	38.0N	130.0W	741	16.2	16.7	1.6	3.0	07/13	10.7	N	22.3	07/12	1022.3
46060	60.6N	146.8W	1443	12.6	13.5	0.4	1.2	22/01	8.3	E	23.5	29/14	1014.5
46061	60.2N	146.8W	1467		13.4	0.8	3.3	22/04	8.4	E	29.9	22/05	1014.4
46062	35.1N	121.0W	739	13.5	14.3	1.7	3.0	20/03	15.3	NW	27.0	20/02	1015.3
46063	34.2N	120.7W	743	14.1	14.3	1.9	3.4	19/21	18.0	NW	23.1	04/08	1014.4
46066	52.6N	155.0W	739	9.0	8.7	1.5	2.8	06/19	11.1	SW	22.5	01/20	1017.6
48011	67.5N	164.5W	166	6.3	7.4	1.0	2.6	26/12	12.0	W	25.3	26/11	1006.5
51001	23.4N	162.3W	730	25.4	26.2	2.1	3.4	07/14	15.0	E	23.0	26/16	1017.9
51002	17.2N	157.8W	735	25.6	26.1	2.3	3.3	07/13	17.1	E	25.8	18/19	1014.2
51003	19.2N	160.7W	730	25.9	26.5	1.9	5.0	09/22	12.7	E	21.4	04/21	1016.1
51004	17.4N	152.5W	738	25.1	25.6	2.3	3.4	07/05	15.6	E	22.9	06/13	1014.6
51028	00.0N	153.8W	738	26.2	26.4	1.9	2.8	01/03	11.8	E	19.6	02/17	1009.7
ABAN6	44.3N	075.9W	744	19.1	19.3				3.4	S	12.7	09/23	1015.1
ALSN6	40.4N	073.8W	740	21.2	20.9	0.7	1.7	15/22	11.6	S	29.8	15/13	1015.4
AUGA2	59.4N	153.4W	1479	11.8					10.4	SE	25.8	27/19	1013.3
BLIA2	60.8N	146.9W	1480	11.8					6.4	NW	20.5	29/05	1015.3
BURL1	28.9N	089.4W	742	28.9					9.7	W	37.8	23/03	1015.7
BUZM3	41.4N	071.0W	13	19.2		0.7	0.8	01/01	8.6	NW	16.7	01/00	1014.1
CARO3	43.3N	124.4W	744	13.0					6.0	N	22.4	15/17	1019.7
CDRF1	29.1N	083.0W	740	27.7					8.1	W	21.9	30/22	1015.5
CHLV2	36.9N	075.7W	741	23.1	22.3	0.8	2.4	24/22	11.3	S	36.0	24/21	1016.6
CLKN7	34.6N	076.5W	741	25.7					9.8	SW	23.6	26/00	1015.5
CSBF1	29.7N	085.4W	733	28.5					8.1	W	21.0	14/05	1014.9
DBLN6	42.5N	079.3W	743	20.0					6.7	S	19.7	09/22	1015.4
DESW1	47.7N	124.5W	735	13.1					9.1	NW	28.1	31/03	1018.5
DISW3	47.1N	090.7W	739	16.4					8.9	NE	25.4	06/00	1015.5
DPIA1	30.2N	088.1W	730	28.8					8.0	SW	29.0	21/21	1015.7
DRFA2	60.5N	152.1W	1475	11.6					9.1	S	23.9	17/22	1012.5
DRYF1	24.6N	082.9W	743	28.8	30.4				5.4	SE	19.1	27/21	1016.1
DSLN7	35.2N	075.3W	247	25.4					12.5	SW	34.1	24/18	1015.1

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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)
DUCN7	36.2N	075.8W	741	24.1					9.3	SE	28.6	15/14	1015.6
FBIS1	32.7N	079.9W	742	27.3					9.3	SW	21.8	22/23	1015.2
FFIA2	57.3N	133.6W	742	12.5					6.2	W	18.9	19/23	1015.6
FPSN7	33.5N	077.6W	743	26.3		1.1	2.1	31/07	12.6	SW	35.1	23/01	1015.3
FWYF1	25.6N	080.1W	743	28.5	29.7				9.0	SE	36.0	17/22	1016.1
GDIL1	29.3N	089.9W	743	28.9	30.2				8.0	W	29.4	23/02	1016.2
GLLN6	43.9N	076.4W	740	19.4					9.1	W	27.4	18/18	1015.0
IOSN3	43.0N	070.6W	693	18.3					10.9	S	25.6	16/07	1013.5
KTNF1	29.8N	083.6W	744	27.3					8.4	SW	22.5	21/20	1014.9
LKWF1	26.6N	080.0W	173	27.8	29.3				8.3	E	20.6	30/12	1016.3
LONF1	24.8N	080.9W	741	28.9	31.4				6.7	SE	17.4	26/12	1016.5
MDRM1	44.0N	068.1W	742	14.5					12.0	SW	33.2	16/17	1010.8
MISM1	43.8N	068.8W	742	15.1					11.7	SW	39.3	16/20	1014.1
MLRF1	25.0N	080.4W	742	28.5	29.8				7.3	SW	30.4	18/22	1016.1
MRKA2	61.1N	146.7W	1472	10.8					6.8	NE	19.6	08/00	1015.0
NWPO3	44.6N	124.1W	738	11.8					7.1	N	24.3	12/03	1019.1
PILA2	59.7N	149.5W	1476	11.9					6.9	N	25.1	22/03	1013.4
PILM4	48.2N	088.4W	742	14.1					10.2	W	34.6	17/13	1016.2
POTA2	61.1N	146.7W	1468	11.1					6.5	N	18.8	22/08	1014.4
PTAC1	39.0N	123.7W	742	11.9					10.7	N	20.9	02/10	1016.3
PTAT2	27.8N	097.1W	742	27.3	29.3				11.0	SE	19.6	03/00	1014.4
PTGC1	34.6N	120.6W	738	13.1					17.8	N	29.2	20/09	1015.7
SANF1	24.4N	081.9W	743	28.6	30.1				6.3	SE	25.3	01/23	1015.6
SAUF1	29.8N	081.3W	739	27.0	25.7				8.3	SW	21.8	15/20	1015.6
SBIO1	41.6N	082.8W	743	21.7					7.9	NE	27.3	09/22	1014.4
SISW1	48.3N	122.8W	740	12.8					9.8	W	29.0	31/23	1017.8
SMKF1	24.6N	081.1W	742	28.8	31.1				7.5	SE	25.0	28/09	1017.3
SPGF1	26.7N	079.0W	576	27.7					8.2	SW	27.5	16/09	1016.5
SRST2	29.7N	094.0W	736	28.4					10.7	S	27.5	23/21	1015.5
STDM4	47.2N	087.2W	739	15.1					12.9	NW	29.0	17/16	1015.2
SUPN6	44.5N	075.8W	743	19.4	19.8								

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41001	34.8N	072.8W	202	25.4	26.6	1.5	3.3	30/13	11.6	SE	27.2	25/07	1016.4
41002	32.3N	075.2W	743	26.6	27.6	1.3	2.5	30/07	9.4	SW	24.3	05/15	1017.3
41004	32.5N	079.1W	743	27.0	28.1	1.1	2.3	25/02	10.8	SW	28.4	11/20	1017.0
41008	31.4N	080.9W	742	27.2	28.2	0.9	2.2	30/08	10.6	S	25.1	30/08	1017.3
41009	28.5N	080.2W	1436	27.7	28.8	0.9	1.9	23/06	9.1	SE	25.8	12/18	1016.9
41010	28.9N	078.5W	1486	27.9	28.8	1.3	2.8	24/15	10.0	SE	34.2	12/20	1017.4
42001	25.9N	089.7W	735	28.8	29.9	0.7	1.8	14/18	9.3	E	24.9	30/20	1016.5
42002	25.9N	093.6W	742	28.9	29.9	0.9	2.4	14/08	10.1	E	24.7	14/11	1015.9
42003	25.9N	085.9W	743	28.7	29.4	0.7	1.7	08/17	8.2	E	20.8	12/23	1016.4
42007	30.1N	088.8W	734	29.0	30.0	0.4	0.9	08/07	8.2	SW	23.5	11/06	1016.8
42019	27.9N	095.4W	744	28.6	29.0	0.8	2.6	15/14	8.2	SE	20.2	14/20	1016.2
42020	26.9N	096.7W	743	28.3	28.7	0.9	3.3	15/10	9.3	SE	20.6	15/13	1015.9
42035	29.2N	094.4W	744	28.7	29.9	0.6	1.6	15/06	8.2	S	16.5	15/08	1017.0
42036	28.5N	084.5W	720	28.6	29.8	0.6	1.3	29/18	7.5	W	20.4	12/13	1016.2
42039	28.8N	086.0W	743	28.7	29.9	0.6	1.5	13/05	7.5	E	20.2	01/14	1017.3
42040	29.2N	088.2W	725	28.8	30.2	0.5	1.3	22/21	7.5	SW	23.1	20/13	1016.1
42041	27.2N	090.4W	744	28.7	29.8	0.7	1.5	08/12	7.1	E	22.2	20/19	1016.1
44005	42.9N	068.9W	743	18.5	18.2	1.0	2.3	12/15	9.5	SW	23.9	24/05	1015.6
44007	43.5N	070.1W	741	17.4	16.5	0.7	2.1	24/03	7.2	S	23.7	24/02	1015.0
44008	40.5N	069.4W	743	19.1	18.2	1.2	2.6	12/16	8.5	S	21.4	12/16	1016.4
44009	38.5N	074.7W	734	22.8	23.1	1.1	3.1	13/15	10.8	SW	26.4	13/20	1016.3
44011	41.1N	066.6W	742	18.5	17.0	1.3	3.3	12/15	8.5	SW	23.9	04/09	1017.2
44013	42.4N	070.7W	743	18.9	18.5	0.6	2.1	14/15	8.6	S	21.2	24/02	1015.7
44014	36.6N	074.8W	744	23.7	23.8	1.1	3.1	31/02	10.4	SW	29.5	14/11	1015.8
44025	40.3N	073.2W	741	21.2	21.2	1.0	2.8	13/02	10.4	S	24.3	14/00	1015.7
45001	48.1N	087.8W	742	16.0	15.5	0.5	2.1	16/05	9.5	SE	26.8	16/01	1015.1
45002	45.3N	086.4W	744	19.2	19.8	0.5	2.2	15/08	9.9	S	28.6	15/06	1016.1
45003	45.4N	082.8W	744	17.9	17.9	0.5	2.2	03/02	10.2	NW	28.4	03/01	1016.0
45004	47.6N	086.5W	741	15.6	15.0	0.5	2.6	16/07	9.5	SE	26.8	02/16	1015.9
45005	41.7N	082.4W	681	21.7	23.1	0.4	1.1	12/02	9.4	SW	21.8	27/00	1016.6
45006	47.3N	089.9W	744	18.3	18.0	0.4	1.8	15/01	9.4	S	26.0	15/01	1015.6
45007	42.7N	087.0W	743	20.5	20.8	0.5	2.4	03/00	10.0	S	26.4	03/00	1015.9
45008	44.3N	082.4W	743	18.9	19.2	0.5	2.0	03/04	10.0	S	25.5	03/03	1016.3
46001	56.3N	148.2W	744	12.7	13.0	1.8	4.6	30/14	12.2	W	27.6	30/12	1015.8
46002	42.5N	130.3W	740	17.2	17.5	1.7	3.0	28/19	12.1	N	22.0	29/05	1022.0
46005	46.1N	131.0W	741	15.3	16.0	1.8	3.3	19/07	12.7	N	24.3	19/10	1021.2
46006	40.8N	137.5W	298	17.7	18.9	1.7	3.0	30/16	12.7	N	23.5	30/13	1025.3
46011	34.9N	120.9W	744	14.0	14.5	1.7	3.2	14/02	10.4	NW	25.8	19/00	1014.5
46012	37.4N	122.7W	739	13.3	13.3	1.5	2.9	14/03	8.7	NW	19.6	18/08	1014.9
46013	38.2N	123.3W	744	12.0	10.7	1.8	3.5	14/23	13.6	NW	31.7	14/00	1014.3
46014	39.2N	124.0W	741	12.0	10.8	1.9	3.5	17/02	10.6	NW	27.0	17/02	1015.0

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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)
46022	40.8N	124.5W	736	12.8	12.2	1.7	3.8	03/04	8.2	N	22.2	16/10	1017.1
46023	34.7N	121.0W	743	14.3	15.0	1.7	2.9	21/00	13.0	NW	28.4	20/10	1014.9
46025	33.8N	119.1W	743	18.5	20.6	1.1	1.7	01/13	5.3	W	16.1	11/00	1012.6
46026	37.8N	122.8W	741	12.5	12.6	1.5	3.0	17/05	10.3	NW	24.1	17/23	1014.6
46027	41.8N	124.4W	738	11.8	10.9	1.7	4.0	28/00	7.5	NW	29.7	15/23	1016.2
46028	35.7N	121.9W	742	13.8	13.6	2.0	3.9	15/08	14.0	NW	27.8	18/01	1013.9
46029	46.1N	124.5W	741	15.2	15.7	1.6	2.6	31/21	9.7	N	21.4	22/13	1018.7
46030	40.4N	124.5W	741	11.9	10.2	1.8	3.7	02/15	12.0	N	23.3	02/10	1017.1
46035	56.9N	177.8W	656	9.0	9.4	1.9	6.5	29/06	16.6	S	40.2	29/01	1014.3
46041	47.3N	124.8W	688	14.0	14.0	1.5	2.8	19/22	7.7	NW	17.3	28/01	1018.1
46042	36.7N	122.4W	742	13.7	12.9	1.7	3.1	15/20	10.4	NW	23.5	16/00	1015.2
46047	32.4N	119.5W	727	16.3	17.8	2.0	3.2	21/09	12.3	NW	22.3	20/20	1013.0
46050	44.6N	124.5W	742	14.0	12.7	1.6	2.9	20/02	8.8	N	25.8	01/20	1019.1
46053	34.2N	119.8W	744	16.3	17.9	0.9	2.0	07/01	9.2	SW	21.6	07/02	1012.8
46054	34.3N	120.4W	739	14.2	14.7	1.6	3.0	20/18	17.7	NW	32.1	06/22	1012.9
46059	38.0N	130.0W	743	17.7	18.4	1.8	3.7	02/15	12.3	N	24.3	02/15	1020.9
46060	60.6N	146.8W	1467	13.3	13.7	0.4	1.6	30/01	7.8	NW	26.8	30/02	1014.5
46061	60.2N	146.8W	1480		13.8	0.9	2.4	03/06	9.6	E	29.9	03/07	1014.5
46062	35.1N	121.0W	743	13.9	14.3	1.6	2.6	14/06	11.8	NW	24.9	20/19	1013.9
46063	34.2N	120.7W	743	14.4	14.5	1.8	2.8	18/11					1013.0
46066	52.6N	155.0W	742	11.7	11.3	1.7	4.7	02/16	11.9	W	25.6	02/11	1022.3
48011	67.5N	164.5W	741	7.9	8.5	1.0	2.5	28/02	14.0	SW	27.0	29/15	1011.3
51001	23.4N	162.3W	740	25.8	26.6	2.0	3.7	21/15	14.0	E	20.8	23/14	1017.1
51002	17.2N	157.8W	735	26.1	26.5	2.4	3.8	21/18	17.6	E	26.2	31/15	1013.2
51003	19.2N	160.7W	737	26.3	27.0	2.0	3.0	22/00	12.4	E	19.0	31/23	1015.1
51004	17.4N	152.5W	724	25.5	26.2	2.4	3.4	20/22	16.9	NE	23.1	30/15	1013.5
51028	00.0N	153.8W	740	26.3	26.5	2.2	3.1	19/09	13.7	E	23.3	14/19	1009.3
ABAN6	44.3N	075.9W	743	19.5	21.4				3.4	S	12.8	06/17	1016.3
ALSN6	40.4N	073.8W	743	21.8	21.9	0.8	2.4	12/20	12.6	S	27.8	13/01	1016.8
AUGA2	59.4N	153.4W	1482	12.9					15.3	W	35.8	02/11	1015.9
BLIA2	60.8N	146.9W	1486	12.3					7.3	NW	28.7	15/10	1015.5
BURL1	28.9N	089.4W	744	29.0					7.7	W	25.1	30/12	1017.0
BUZM3	41.4N	071.0W	626	19.8	19.4	0.8	1.8	07/11	12.3	SW	29.8	14/12	1016.5
CARO3	43.3N	124.4W	742	12.7					6.5	NE	25.7	02/18	1019.0
CDRF1	29.1N	083.0W	744	28.0					6.9	W	28.5	06/23	1017.0
CHLV2	36.9N	075.7W	744	23.8	24.0	0.9	2.2	14/04	12.0	S	33.2	14/14	1016.9
CLKN7	34.6N	076.5W	744	25.7					10.6	SW	30.1	30/10	1017.3
CSBF1	29.7N	085.4W	743	28.2					6.4	W	19.5	29/12	1016.7
DBLN6	42.5N	079.3W	744	20.5					7.7	SW	27.0	09/08	1016.8
DESW1	47.7N	124.5W	742	13.3					7.5	NW	24.6	23/02	1018.2
DISW3	47.1N	090.7W	744	19.1					8.6	SW	29.2	08/22	1015.5
DPIA1	30.2N	088.1W	744	28.8					7.5	SW	20.5	10/07	1017.3
DRFA2	60.5N	152.1W	1481	12.3					6.7	S	28.4	30/20	1015.0
DRYF1	24.6N	082.9W	744	28.7	30.1				9.2	E	23.9	08/22	1016.5
DSLN7	35.2N	075.3W	686	25.2		1.1	2.6	30/23	14.6	SW	42.1	19/01	1016.6
DUCN7	36.2N	075.8W	743	24.5					10.7	SW	25.9	30/16	1017.3
FBIS1	32.7N	079.9W	743	26.7					9.3	SW	23.0	04/20	1017.4
FFIA2	57.3N	133.6W	717	12.0					7.7	SE	27.7	31/20	1015.6
FPSN7	33.5N	077.6W	744	26.3		1.1	2.3	30/00	13.1	SW	29.4	30/12	1017.2
FWYF1	25.6N	080.1W	744	28.2	29.5				11.0	E	32.7	27/04	1016.9
GDIL1	29.3N	089.9W	653	28.8	30.5				6.3	SW	20.8	02/13	1017.3
GLLN6	43.9N	076.4W	743	20.3					10.5	S	32.9	09/13	1016.2
IOSN3	43.0N	070.6W	743	19.2					11.1	S	26.2	24/03	1015.2
KTNF1	29.8N	083.6W	743	27.1					6.6	SW	25.7	12/13	1016.6
LKWF1	26.6N	080.0W	744	27.8	29.1				8.5	E	19.3	30/16	1017.2
LONF1	24.8N	080.9W	743	28.5	30.0				9.7	E	28.7	27/04	1017.3
MDRM1	44.0N	068.1W	744	15.5					11.5	SW	24.7	24/05	
MISM1	43.8N	068.8W	744	15.9					10.9	SW	23.6	04/02	1015.4
MLRF1	25.0N	080.4W	739	28.4	29.8				10.0	E	30.0	26/21	1016.7
MRKA2	61.1N	146.7W	1483	11.5					8.2	NE	31.4	15/04	1015.2
NWPO3	44.6N	124.1W	743	12.0					8.0	N	26.1	02/05	1018.5
PILA2	59.7N	149.5W	1486	13.3					10.1	N	38.6	15/11	1014.3
PILM4	48.2N	088.4W	744	16.7					11.1	W	36.1	16/03	1016.3
POTA2	61.1N	146.7W	1484	11.6					9.2	NE	36.4	15/14	1014.5
PTAC1	39.0N	123.7W	742	12.4					10.4	N	24.7	17/15	1015.1
PTAT2	27.8N	097.1W	742	28.2	29.9				10.9	SE	24.0	15/10	1015.4
PTGC1	34.6N	120.6W	744	13.5					15.4	N	28.1	21/05	1014.4
ROAM4	47.9N	089.3W	72	17.6					8.7	S	18.5	05/12	1012.5
SANF1	24.4N	081.9W	744	28.9	29.9				9.9	E	23.2	27/08	1016.0
SAUF1	29.8N	081.3W	744	27.0	26.8				7.5	SW	20.7	22/00	1017.2
SBIO1	41.6N	082.8W	744	21.9					8.2	SW	31.7	02/21	1016.1
SGNW3	43.8N	087.7W	410	20.4	20.6				10.2	S	26.7	05/22	1017.0
SISW1	48.3N	122.8W	743	12.7					8.7	W	25.5	01/00	1017.5
SMKF1	24.6N	081.1W	744	28.6	30.2				10.8	E	26.5	27/09	1017.8
SPGF1	26.7N	079.0W	744	28.0					9.4	E	34.2	14/22	1016.8
SRST2	29.7N	094.0W	743	28.6									

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