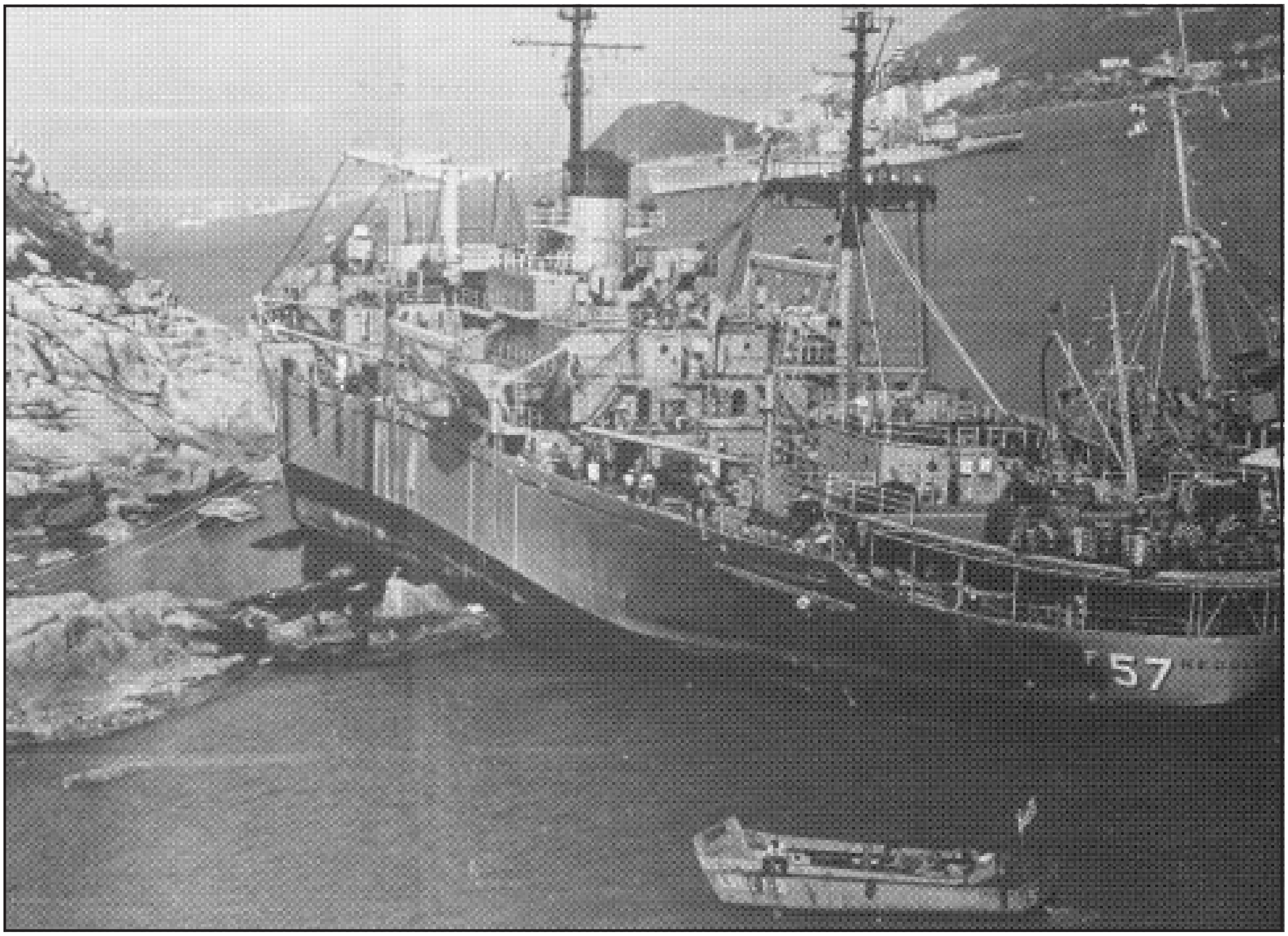
Mariners Weather Log

Vol. 42, No. 3 December 1998



The USS REGULUS, a U.S. Navy ship, aground in the harbor area of Hong Kong with rocks penetrating the hull as a result of Typhoon Rose (August 1971). This incident initiated the requirement for assistance in severe weather port decision-making as described in the article by Sam Brand, page 4.

Photograph courtesy of the U.S. Navy.

Mariners Weather Log

U.S. Department of Commerce
William M. Daley, Secretary

National Oceanic and
Atmospheric Administration
Dr. D. James Baker, Administrator

National Weather Service
John J. Kelly, Jr.,
Assistant Administrator for Weather Services

National Environmental Satellite,
Data, and Information Service
Robert S. Winokur,
Assistant Administrator

United States Navy
Naval Meteorology and Oceanography Command
RADM Kenneth E. Barbor USN, Commander

Editorial Supervisor
Martin S. Baron

Editor
Mary Ann Burke

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this department. Use of funds for printing this periodical has been approved by the director of the Office of Management and Budget through December 1999.

The Mariners Weather Log (ISSN: 0025-3367) is published by the National Weather Service, Office of Meteorology, Integrated Hydrometeorological Services Core, Silver Spring, Maryland, (301) 713-1677, Ext. 134. Funding is provided by the National Weather Service, National Environmental Satellite, Data, and Information Service, and the United States Navy. Data is provided by the National Climatic Data Center.

Articles, photographs, and letters should be sent to:

Mr. Martin S. Baron, Editorial Supervisor
Mariners Weather Log
National Weather Service, NOAA
1325 East-West Highway, Room 14108
Silver Spring, MD 20910

Phone: (301) 713-1677 Ext. 134
Fax: (301) 713-1598
E-mail: martin.baron@noaa.gov

From the Editorial Supervisor

The Mariners Weather Log is now available on the World Wide Web. Beginning with the August 1998 issue, you can find the Log at **http://www.nws.noaa.gov/om/mwl/mwl.htm**. You will need the Adobe Acrobat Reader (available from the web site) to view the magazine.

We are privileged to have another article on the Automated Mutual-assistance Vessel Rescue (AMVER) program, with several dramatic accounts of rescues at sea. In one notable incident, a fishing vessel, the SEA LION, adrift without engine power in the North Pacific during August 1998, began taking on water. In heavy seas, all ten crew members abandoned ship into a lifeboat. U.S. Coast Guard rescue coordinators located the AMVER vessel SOLAR WING a few miles away, and a boat-to-boat transfer was soon completed without loss of life.

We encourage all mariners to participate in the AMVER program. Now in its 40th year, AMVER has 12,000 participating ships from 143 nations. Over the last five years alone, AMVER has rescued over 1,500 people, most of whom would have perished were it not for this extraordinary program. It's very easy to join AMVER. Simply complete an SAR Questionnaire (SAR-Q), available by fax from the AMVER Maritime Relations Office. You then provide AMVER with your sail plan before leaving port and update your position once every 48 hours while underway. Should you require assistance at sea, alert the nearest rescue coordination center in one of several ways, including INMARSAT, Radiotelex, EPIRB, or the distress button on your satellite or DSC terminal.

For Voluntary Observing Ships, the special AMVER/SEAS software is now available to simplify preparation of weather and AMVER messages. When COMSAT receives weather messages formatted by this software, your vessel call sign and position is forwarded to the AMVER center (eliminating the need to send a separate AMVER position update), while the weather message goes to the National Weather Service. There is no cost to vessels using AMVER/SEAS software.

A Y2K compliant version of the AMVER/SEAS software is now available (AMVER/SEAS version 4.51), and vessels are encouraged to obtain free copies. You can download this software from the web at **http://seas.nos.noaa.gov/seas.html**.

For more information about AMVER, contact Mr. Rick Kenney, U.S. Coast Guard Maritime Relations Officer. For more information about the AMVER/SEAS software, contact Mr. Steve Cook, SEAS Program Manager. Both are listed in the back of this publication. Port Meteorological Officers and SEAS Field Representatives can also provide information about these valuable programs.

By the time this issue is in print, Mariners Weather Log readers with complimentary subscriptions will have received questionnaires through the mail. This is to update our mailing list. Please fill out and return the questionnaire promptly, no later than May 30, 1999.

Martin S. Baron⚓

Table of Contents

Severe Weather Port Evaluation Effort at the Naval Research Laboratory

Sam Brand
Naval Research Laboratory
7 Grace Hopper Avenue
Monterey, CA 93943
E-mail: brand@nrlmry.navy.mil

Abstract

The U.S. Navy operates throughout the world and many of the U.S. Navy ships are in port at any instant in time. Environmental phenomena such as strong winds, high waves, storm surge, restrictions to visibility, and thunderstorms can be hazardous to these ships while in these ports, or maneuvering in or out of port. Because the U.S. Navy recognized this as a serious concern to Navy ship captains, the Marine Meteorology Division of the Naval Research Laboratory, Monterey, California, was asked to evaluate the severe weather suitability of numerous ports and document the results. The resulting analyses provide decision-making guidance for ship captains as well as environmental information for operational forecasters. Well over a hundred port evaluations have been completed and disseminated. This article will describe the development strategy for these port studies, provide insight into the details of the presentation of the information, and discuss the future direction and enhancements.

1. Introduction

U.S. Navy ship captains operating throughout the globe often find themselves in new port locations, with experience providing the cornerstone of operational safety, whether in peacetime or in time of conflict. Severe weather decision making can be extremely challenging for these ship captains. For example, when faced with an approaching tropical cyclone, a timely decision regarding the necessity and method of evasion must be reached. In complex regions such as the Mediterranean, the wind systems that are produced challenge the most skilled ship captains. A number of "local" wind events, including the Mistral, Bora, Levante, etc., are characterized by rapid onset and cessation and greatly varying spatial variations. These winds can cause an unprepared ship captain to drag anchor or part mooring lines.

For over 20 years, the Naval Research Laboratory Marine Meteorology Division (formerly Naval Environmental Prediction Research Facility and Naval Oceanographic and Atmospheric Research Laboratory) has been developing severe weather port guidance for the U.S. Navy. The guidance research efforts can be categorized as follows:

1) Tropical Cyclone Haven Studies
2) Mediterranean Severe Weather Port Studies

Continued on Page 5

Port Evaluation
Continued from Page 4

3) Regional Severe Weather Guide Development

The purpose of this article is to describe the development strategy for each of the above categories, provide insight into the details of the presentation of the information in hard copy and electronic form, and discuss future enhancements and requirements.

2. Tropical Cyclone Haven Studies

Tropical cyclones are among the most destructive weather phenomena a ship captain may encounter, whether the ship be in port or at sea. The dilemma to the ship captain is as follows: Should the ship remain in port, evade at sea, or if at sea, should the ship seek the shelter of a nearby port? In general, it is an oversimplification to label a harbor as merely good or bad. Consequently, enough information has to be conveyed for the ship commanding officer to reach a sound decision. The decision often is not based on weather conditions alone because the characteristics of the harbor and the ship itself must also be considered (Brand, 1978).

The Naval Research Laboratory (NRL) Marine Meteorology Division has developed tropical cyclone "havens" handbooks for the western Pacific/Indian Ocean region (Brand, 1996) and the Atlantic Ocean region (Turpin and Brand, 1982; Perryman et al, 1993). Figures 1 and 2 provide locator maps for the two regions and identify ports evaluated. The port evaluations themselves were based on extensive data collection efforts and discussions with local port and meteorological officials. The format for each of the port studies included the following:

1) A brief description of the port location and surrounding topography.
2) A brief description of the harbor and facilities.
3) Tropical cyclone climatological information for the port.
4) Effects of storm surge and wave action within the harbor.
5) Effects of topography on tropical cyclone winds and seas.
6) Evasion rationale, including discussion of pertinent factors to consider in making a decision to remain in port or try to evade a tropical cyclone at sea.
7) General conclusions concerning the harbor as a tropical cyclone haven.

As the typhoon and hurricane haven studies were completed, they were distributed to all U.S. Navy ships and shore locations in the Pacific and Atlantic areas.

3. Mediterranean Severe Weather Port Studies

The complex land and sea distributions in and around the Mediterranean have a strong influence on the synoptic and mesoscale weather affecting many port and harbor areas. In addition, because of the irregular coastline and numerous islands in the Mediterranean, swell can be refracted around barriers and come from directions which vary greatly from those of the wind and wind waves. Anchored ships may experience winds and seas from one direction and swell from a different direction. This can be extremely hazardous for close maneuvering, tending of vessels, refueling, and small boating operations.

During the past decade, the U.S. Navy identified 55 ports of interest in the Mediterranean region to be evaluated with respect to severe weather suitability. The following approach was used to develop the individual studies:

1) A literature search for reference material was performed.
2) Navy cruise reports were reviewed, if available.
3) Navy personnel with current or previous area experience were interviewed.
4) A preliminary report, which included questions on various local conditions, was developed.
5) Port visits were made by U.S. Navy and/or their representatives who gathered information through interviews with local harbor pilots, harbor masters, tug masters, meteorologists, etc. Local reference material was also obtained.
6) The cumulative information was reviewed, combined, and condensed for each port study.

Continued on Page 8

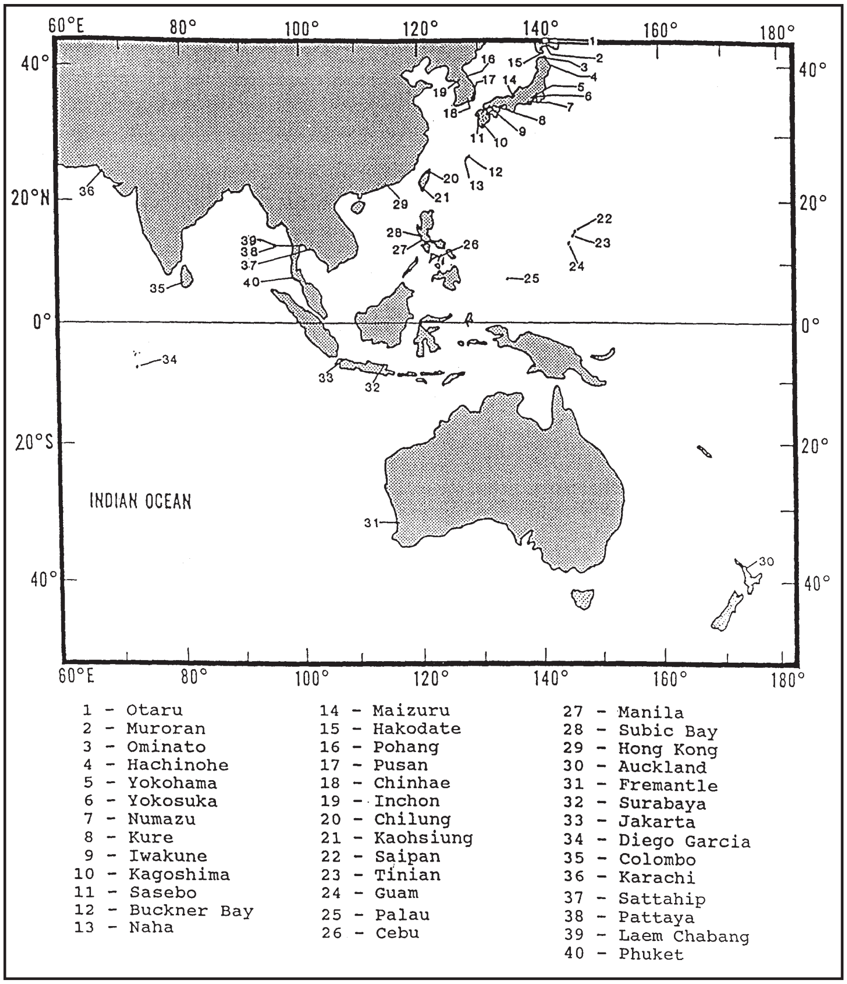
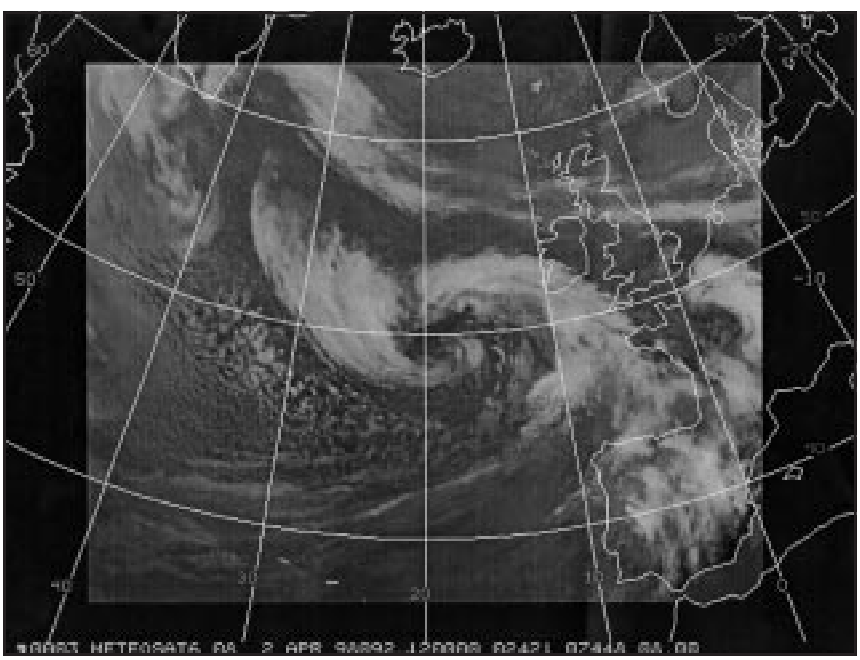


Figure 1. Locator map for the 40 ports evaluated for the typhoon haven studies for the western Pacific/ Indian Ocean regions.



METEOSAT-6 infrared satellite image of early April 1998 storm which affected the eastern North Atlantic. Note the layered frontal cloud band with high (cold) tops wrapping around the south and southeast sides of the center and cumulus-type clouds streaming into the "dry slot" farther to the south. The storm was near maximum intensity and centered near 39N 19W with 958 mb central pressure at the time of the image (1200 UTC 02 April 1998).

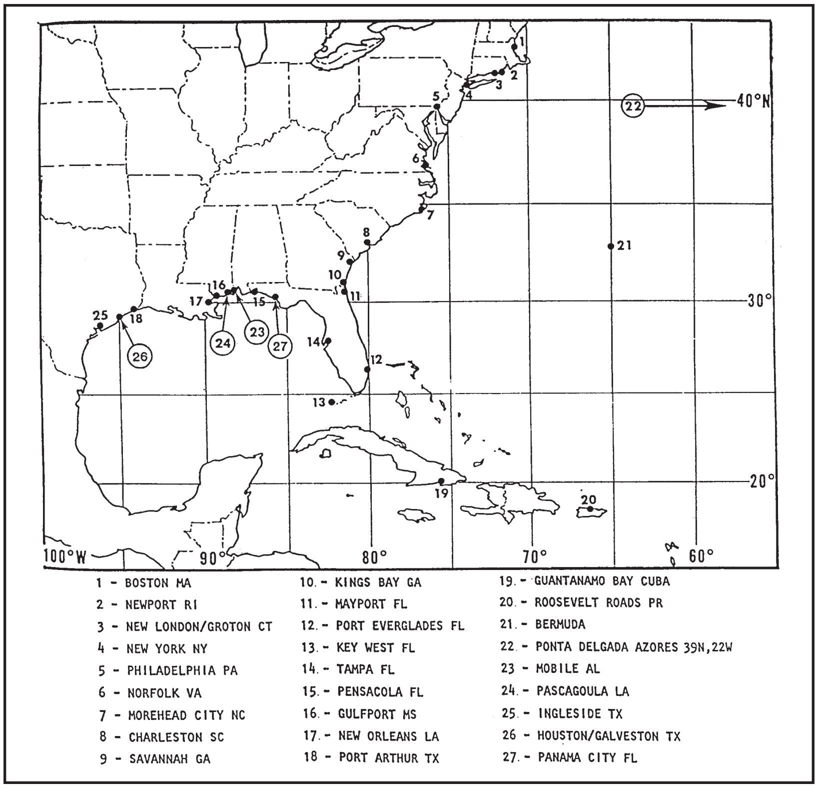


Figure 2. Locator map for the 29 ports evaluated for the hurricane haven studies for the North Atlantic Ocean.

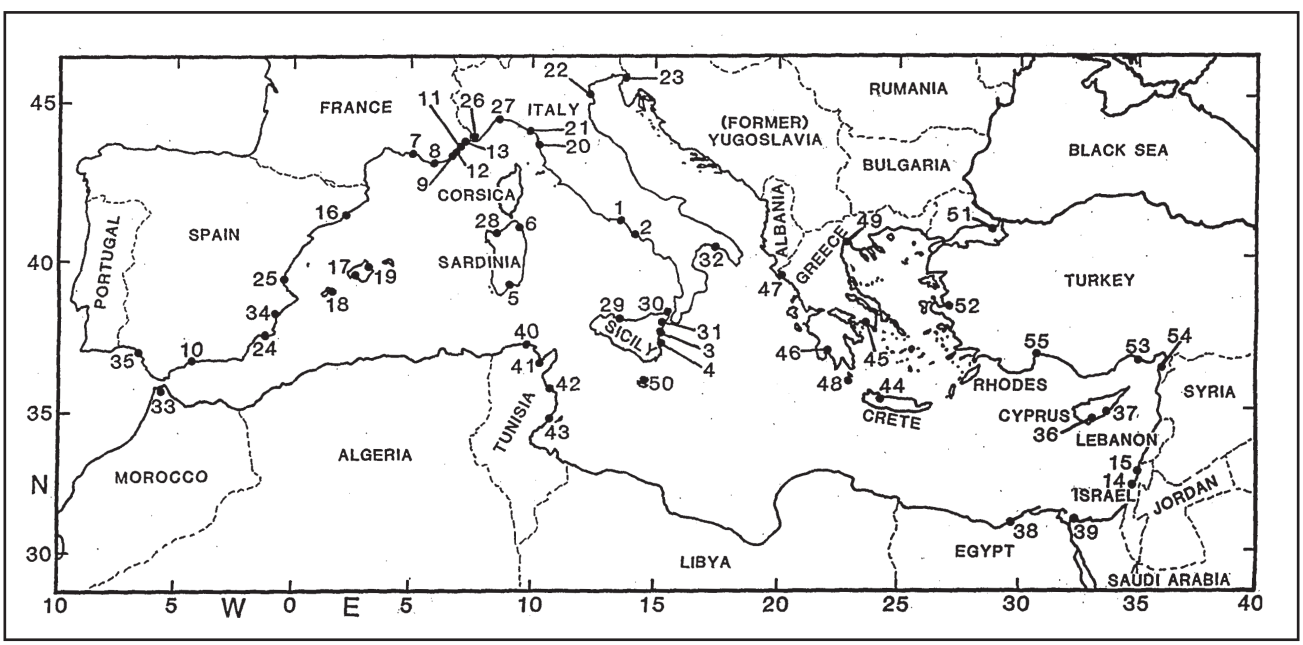


Figure 3. Mediterranean ports evaluated for the severe weather guide series. Port numbers are those listed in Table 1.

Port Evaluation

Continued from Page 5

Hard copy port studies were produced (U.S. Navy, 1988-1995) containing two port-specific information sections (preceded by a brief introduction offering general guidance). The first section summarized harbor conditions and was intended for use as a quick reference guide by ship captains, navigators, harbor officials, or other in-port or at-sea personnel. This section contained the following:

1) A brief narrative summary of severe weather hazards.
2) A table display of vessel location/situations, potential severe weather hazards, advance indicators of the hazards, and effects of hazards and precautionary/evasion actions.
3) Local wind and wave conditions.
4) Tables depicting wave conditions at selected harbor locations resulting from propagation of deep-water swell into the harbor.

The second section of the port study contained additional details and background information on hazardous conditions as a function of season. This section was designed to serve personnel who had a need for additional insights on severe weather hazards and related weather events, and was intended more for use by operational weather forecasters.

The 55 port evaluations were developed during the eight-year period 1988-1995. As they were completed, they were distributed to all U.S. Navy ships and shore locations in the Atlantic and Mediterranean regions in hard copy form. Because of interest in a compilation of the port studies as a ready-reference guide, the evaluations were condensed and disseminated as one handbook (Brand, 1997). In addition, to satisfy the demand for presentations via electronic media, the 55 port studies were also disseminated in CD-ROM form as well (U.S. Navy, 1995).

No.	Port	No.	Port
1	GAETA, ITALY	29	PALERMO, ITALY
2	NAPLES, ITALY	30	MESSINA, ITALY
3	CATANIA, ITALY	31	TAORMINA, ITALY
4	AUGUSTA BAY, ITALY	32	TARANTO, ITALY
5	CAGLIARI, ITALY	33	TANGIER, MOROCCO
6	LA MADDALENA, ITALY	34	BENIDORM, SPAIN
7	MARSEILLE, FRANCE	35	ROTA, SPAIN
8	TOULON, FRANCE	36	LIMASSOL, CYPRUS
9	VILLEFRANCHE, FRANCE	37	LARNACA, CYPRUS
10	MALAGA, SPAIN	38	ALEXANDRIA, EGYPT
11	NICE, FRANCE	39	PORT SAID, EGYPT
12	CANNES, FRANCE	40	BIZERTE, TUNISIA
13	MONACO	41	TUNIS, TUNISIA
14	ASHDOD, ISRAEL	42	SOUSSE, TUNISIA
15	HAIFA, ISRAEL	43	SFAX, TUNISIA
16	BARCELONA, SPAIN	44	SOUDA BAY (CRETE), GREECE
17	PALMA, SPAIN	45	PIRAEUS, GREECE
18	IBIZA, SPAIN	46	KALAMATA, GREECE
19	POLLENSA BAY, SPAIN	47	KERKIRA (CORFU), GREECE
20	LIVORNO, ITALY	48	KITHIRA, GREECE
21	LA SPEZIA, ITALY	49	THESSALONIKI, GREECE
22	VENICE, ITALY	50	VALLETTA, MALTA
23	TRIESTE, ITALY	51	ISTANBUL, TURKEY
24	CARTAGENA, SPAIN	52	IZMIR, TURKEY
25	VALENCIA, SPAIN	53	MERSIN, TURKEY
26	SAN REMO, ITALY	54	ISKENDERUN, TURKEY
27	GENOA, ITALY	55	ANTALYA, TURKEY
28	PORTO TORRES, ITALY		

Table 1. Mediterranean ports evaluated by study number and port name.

4. Regional Severe Weather Guide Development

A good example of a regional severe weather guide is the Puget Sound area port guide (Gilmore et al., 1996). The guide was developed in response to a Navy request to evaluate the severe weather in a region where there were many Navy assets concentrated in one general location. Its prime purpose was to aid ship captains and other Navy officials in evaluating adverse weather situations and assist them in making decisions whether to move to a better anchorage, move to another port in the Puget Sound area, or to remain in a specific harbor.

Continued on Page 9

Port Evaluation

Continued from Page 8

Puget Sound is located in an area of complex topography. Strong southerly winds are common over Puget Sound during late autumn, winter and early spring. The most severe weather conditions are associated with fronts and low pressure systems approaching from the Pacific. The effects of strong winds across the Puget Sound region varies greatly from one location to another. Wind conditions that may adversely affect one area of the Sound may have little or no effect on another. Many of the sites evaluated in the guide are located adjacent to significant topographic features that either shield the port area from strong winds or enhance the wind flow at that location. Figure 4 shows the locations in Puget Sound of interest to the U.S. Navy that were evaluated in the severe weather guide.

The guide presented the following information for each of the port locations shown in Figure 4:

1) A brief description of port location and surrounding topography.
2) A brief description of the harbor and facilities.
3) A description of normal and extreme weather conditions at the port.
4) A description of indicators of hazardous weather conditions.
5) A description of protective/ mitigating measures that can be taken.

In addition to the above, the guide provided a description of general environmental conditions in the Puget Sound area, a discussion of the weather patterns by season, a presentation of extreme weather events, and a section describing sources of weather forecasts and warnings.

Continued on Page 10

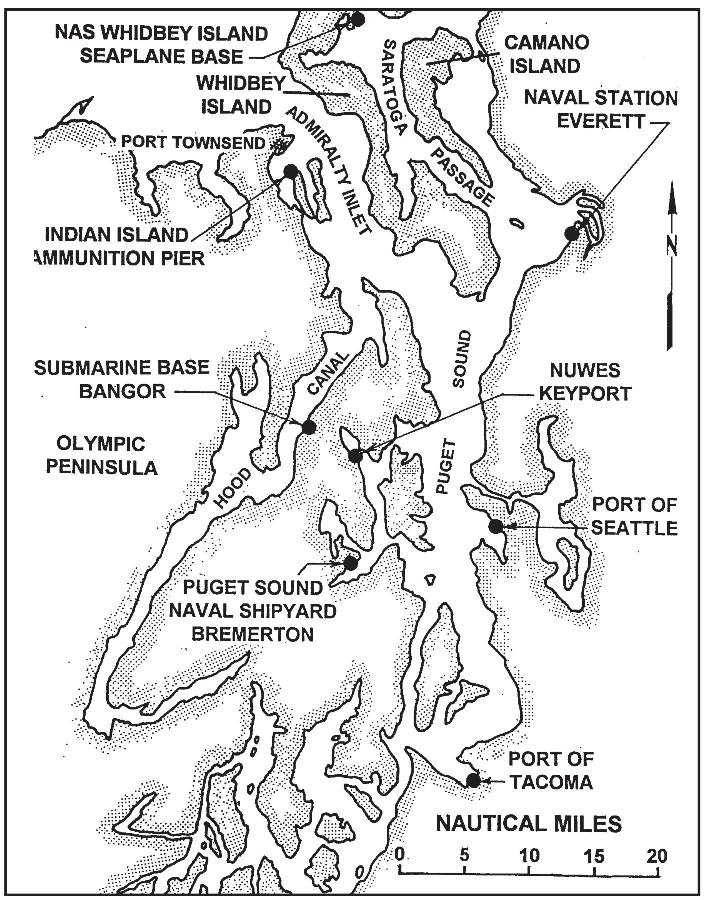


Figure 4. Locations in Puget Sound area (black dots) evaluated in severe weather guide.

Port Evaluation
Continued from Page 9

5. Future Direction

Navy decision makers ashore and afloat are requesting that all of the documents discussed above be placed into electronic format. The electronic implementation could be flexible and allow for both Web and CD-ROM customer demand. Another future enhancement could be the capability to provide ship captains a simulated entry or exit view, in animated form, of the harbor region under a wide variety of conditions, such as day versus night, restricted visibility, etc. This would be extremely useful as a training tool for ship captains not familiar with local reference points or hazards. The CD-ROM is an ideal vehicle for this kind of simulated training or rehearsal, particularly for U.S. Navy ship captains who continuously find themselves in unfamiliar port situations.

Requests for documents discussed in this article should be made in letter form to Naval Research Laboratory, Attn: Sam Brand, 7 Grace Hopper Avenue, Monterey, CA 93943-5502. For electronic examples of the Typhoon Havens Handbook and Hurricane Havens Handbook, refer to **http://www.cnmoc.navy.mil**.

The requirement for new or updates of port evaluations is continuous and will ensure severe weather port studies for many years to come. For example, the Navy recently requested 147 ports be evaluated in the European region. Many will be updates of previous studies, but most were new due to the ever-changing political scene in the European area. Navy ships are visiting many eastern European countries that they never thought they would be visiting a few years ago. In these new locations, the vulnerability to severe weather is still very real and significant.

Acknowledgments

Funding for this effort has been provided by the Commander, Naval Meteorology and Oceanography Command. Numerous U.S. Navy and contractor personnel have been involved in port visits and data gathering for the past two decades. In addition, the author would like to thank the hundreds of port, harbor, and meteorological officials who contributed input, comments, and suggestions to the studies.

References

Brand, S., 1978: Typhoon havens research program at the Naval Environmental Prediction Research Facility. Bull. Amer. Meteor. Soc., 59, 374-383.

Brand, S. (Editor), 1997: Mediterranean Ports Severe Weather Handbook. NRL/PU/7543—97-0030, 766 pp. [Available from Naval Research Laboratory, 7 Grace Hopper Avenue, Monterey, CA 93943.]

Gilmore, R.E., R.E. Englebretson, R.G. Handlers and S. Brand, 1996: Puget Sound Area Heavy Weather Port Guide. NRL/PU/7543—96-0028, 126 pp. [Available from the Naval Research Laboratory, 7 Grace Hopper Avenue, Monterey, CA 93943.]

Brand, S. (Editor), 1996: Typhoon havens handbook for the western Pacific and Indian Oceans, reprint 96. NRL/PU/7543—96-0025, 808 pp. [Available from Naval Research Laboratory, 7 Grace Hopper Avenue, Monterey, CA 93943.]

Perryman, D.C., R.E. Gilmore and R.E. Englebretson, 1993: Naval stations Mobile, Pascagoula, and Ingleside as hurricane havens. NRL/PU/7541—93-0009, 108 pp. [Available from Naval Research Laboratory, 7 Grace Hopper Avenue, Monterey, CA 93943.]

Turpin, R., and S. Brand, 1982: Hurricane havens handbook for the North Atlantic Ocean. NEPRF Technical Report 82-03, 614 pp. [Available from the Naval Research Laboratory, 7 Grace Hopper Avenue, Monterey, CA 93943.]

U.S. Navy, 1988-95: Severe weather guide Mediterranean ports, Nos. 1 - 55. [Available from Naval Research Laboratory, 7 Grace Hopper Avenue, Monterey, CA 93943.]

U.S. Navy, 1995: Marine climatic atlas of the world including Mediterranean severe weather port guides, CD-ROM. [Available from Fleet Numerical Meteorology and Oceanography Detachment, Federal Building, 151 Patton Avenue, Asheville, North Carolina 28801.]⚓

The Sinking of The Argus

Skip Gillham
Vineland, Ontario, Canada

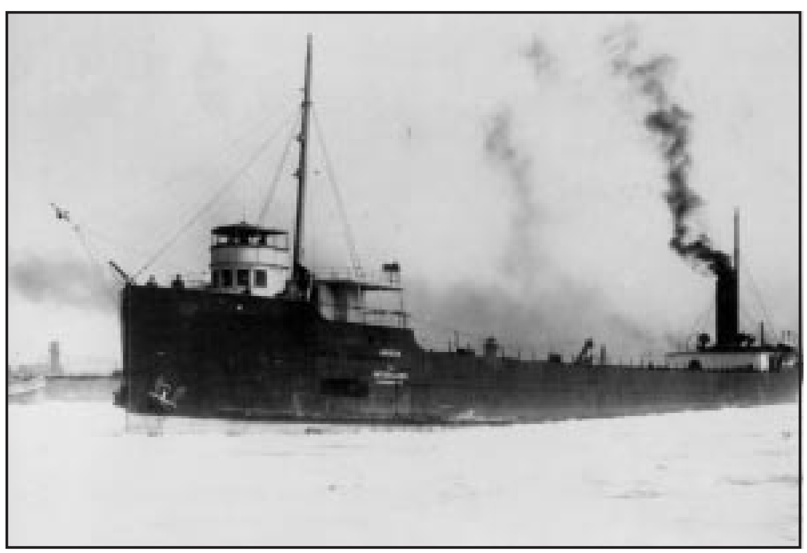
This fall marks the 85th anniversary of the great storm of 1913. For days the winds howled, building mountainous seas and hurling all forms of blinding precipitation. From November 7-11, 1913, the upper Great Lakes offered no safety for ship or sailor. Most avoided confrontation with the elements and waited in port. Others, caught by the wintry blast, found no place to hide. The casualty toll was enormous, with 251 lives lost, 12 ships sunk, and many others damaged. Among those lost with all hands was the ARGUS.

The ship ARGUS was built by the American Shipbuilding Co. and launched at Lorain, Ohio, on August 5, 1903. The 436 foot long freighter, originally known as the LEWIS WOODRUFF, went to work for the Gilchrist Transportation Company. The steam powered carrier could haul about 7000 tons of cargo per trip and usually brought iron ore or grain down the lakes and returned upbound with coal. Gilchrist transportation experienced hard times and when their fleet was disbanded, several vessels joined the Interlake Steamship Company. In 1913 LEWIS WOODRUFF was among the latter and sailed as the ARGUS.

ARGUS departed November 7, 1913, from Buffalo with a load of coal and got as far as Lake Huron. There, on November 9-10, it went down with all hands. Reports from the nearby GEORGE G. CRAWFORD indicated the snow stopped falling long enough to watch the demise. Apparently, ARGUS got caught in the trough and could not pull out. The hull "crumpled like an egg shell" and sank.

A total of 24 sailors perished. The ship was valued at $136,000 (U.S. dollars in 1913).

Note: Skip Gillham is the author of 18 books, most related to Great Lakes ships and shipping. "Seaway Era Shipwrecks," released in 1994, tells the story of 100 ship accidents from the opening of the St. Lawrence Seaway in 1959. Copies are available from the author for a fee.⚓



The ARGUS sank November 9-10, 1913, on Lake Huron. Twenty-four sailors perished. Photo courtesy of Milwaukee Public Library.

The National Hurricane Center Weathers the Storm

Debi Iacovelli
Cape Coral, Florida

Debi Iacovelli is a freelance writer specializing in tropical meteorology. Her stories have appeared in Weatherwise, Mariner's Weather Log, the Navy's "Fathom" magazine, The American Weather Observer, and the Weather Watcher Review.

[Editors Note: This is a look back to 1992 (August 22-25), when the National Hurricane Center withstood the forces of Hurricane Andrew. The article was written in November 1992.]

More than one hundred people stood silent, eyes wide open in sudden fright, as the crash shook the National Hurricane Center (NHC), which was located on the sixth floor of the IRE Building (Gables One Tower) in Coral Gables, Florida. On the roof above the 12th floor, the white dome that enclosed the radar unit shattered in the winds of Hurricane Andrew, shaking the entire building, sending the now-exposed radar unit crashing to the roof. "Hearts stopped for a second and everyone's eyes got real big," remembers Joel Cline, a meteorologist at the NHC who worked in the Tropical Satellite Analysis and Forecasting Unit, all the while thinking to himself, "It sounded like the radar fell off the roof!" The silence that descended on the crowd of media, photographers, weather specialists, and their family members was broken by the lone figure who walked out of the radar room. "I lost the scope" he said, with a look of disbelief.

"Somewhere about 4:45 to 4:50 am or so, all the systems blew away," according to the National Hurricane Center's Director, Dr. Robert Sheets. "The instrumentation blew away, the radome itself shattered and blew away. Even before that, we lost our satellite antennas; they were destroyed by the wind. The radar antenna itself was blown off of something like a little penthouse that sits on our roof. It's about fifteen feet above the normal roof level. So when it blew off, it fell onto the roof. It weighs a couple of tons and shook the whole building. Everybody sort of looked. I knew what it was and what had happened just based on the weight and the thud that took place. We didn't know how much damage that it may have caused on the roof, but fortunately, it did not cause any structural damage itself. The building was shaking from the wind anyway, sort of swaying a little bit."

The NHC and Miami's National Weather Service (NWS) shared the sixth floor of the IRE Building,

Continued on Page 13

Hurricane Andrew

Continued from Page 12

which was the only floor in the building with hurricane shutters. "We had encapsulated ourselves with the exterior shutters we have for our floor," said Sheets. "They were all closed early Sunday evening before the winds ever started to pick up. There we were, concrete floor above us, concrete floor below us, in this engineered building. So we felt reasonably safe from the elements of the hurricane."

Suddenly, around 3:30 am, the NHC lost electricity. Emergency generators roared to life. However, a problem with the generators prevented the Center's air conditioning system from operating. Temperatures climbed to 95 degrees inside the cramped quarters, and stayed there for the next few days. Because of the excessive heat, some of the computer systems had to be shut down.

Around 4:30 am, the eyewall of Hurricane Andrew began to cut a swath of destruction along South Florida's coastline. "Here at the Hurricane Center itself, we were just outside of the eyewall. That meant that we did not get the strongest conditions, but we got strong enough to cause considerable problems here," said Sheets. "On the roof of our building, which is an elevation of 150 feet or so, we measured sustained winds up to 120 to 125 mph, with gusts to 168 mph, about 3:30-4:00 in the morning, as the center approached the coast."

Joel Cline stood in the darkness at the back door of the IRE Building, watching in amazement, as the satellite dishes were blown away in the early morning hours. "The thing that impacted our work the most was the satellite dishes that blew away, because that allows us to see from Africa to Hawaii," says Cline. The duties of the fallen WSR-57 radar unit at the NHC were absorbed by other NWS radars. "We were using the new SR-88D (Doppler) radar out of Melbourne to track the hurricane as it moved across the state." said Sheets. "We had been doing that prior to our own radar failure, but continued that every fifteen minutes that we were bringing in the imagery; we had that in loop form; until it got well out of range, out over the Gulf of Mexico. We also had the Tampa radar that we were monitoring as it was moving along, and then the Key West radar. So, even though we lost our radar, we still had three others that were on it."

Anticipating the worst, early in the morning on Sunday, August 23rd, the NHC sent six of their staff to the National Meteorological Center (NMC, now known as NCEP [National Centers for Environmental Prediction]) Meteorological Operations Division in Washington. Among them were Jerry Jarrell, Deputy Director of the NHC, and hurricane specialist Miles Lawrence. This move was made because the forecast track had Andrew at the front door of the NHC. The NMC is the alternate site used to send out hurricane watches and warnings in case the NHC cannot operate. Although, in the end, the NHC never lost their forecasting abilities, once their satellite dishes were destroyed, they did require help from the NMC to get satellite data. Satellite imagery was sent by Ethernet line from Washington to Wallops Island, Virginia, then on to the NHC. Thus, satellite pictures continued to come in to the NHC, though delayed 40 minutes due to the rerouting. Although radar and satellite data was somewhat disrupted, reconnaissance aircraft flew into the hurricane continuously right up to the Miami coastline. When Andrew emerged in the Gulf of Mexico, the planes picked it up again. "We did not lose (reconnaissance) communications," according to Sheets. "We lost the direct link to the recon through the satellite link, but we were able to link those through Keesler Air Force Base and phone communications. So, we were at a reduced capacity, but continuing with the vital data."

The NHC held steadfastly to the computer forecast models of a possible landfall in the southern part of Florida, even when the hurricane weakened within a few millibars of being dismissed as a tropical system.

Andrew started to increase in forward motion on Saturday, August 22, but the track remained consistent. "In fact, our forecast, some 30 hours or so before the center moved across the coast was

Continued on Page 14

Hurricane Andrew

Continued from Page 13

within eight miles of where it made landfall" said Sheets. "We were about three hours slow in our forecast 30 hours before it struck. We had forecast that the center would cross the coast somewhere around 8:00 am on Monday morning, and it turned out to be closer to 5:00 am. So we were about three hours slow, but right on track with that."

When asked what he attributed to the accuracy in the forecast track of Hurricane Andrew, Cline responded, "It was a straight-moving storm. The synoptic patterns were well forecast by models, and the pattern was not one that was rapidly changing. When you have a straight-moving storm, as opposed to a recurvature, then it doesn't matter which ocean you're in, you're always going to come out with a fairly accurate landfall forecast. You could even look back at forecasts of others that have done that same thing. Hugo was a good forecast. From the time it went around Puerto Rico until it hit Charleston, the course it took was pretty much a straight line." According to Sheets, since pressures were extremely high to the north, that forced Andrew on a westward track rather than the normal recurvature out in the Atlantic. For a hurricane or a tropical storm that gets into that high of a latitude, they would normally start turning toward the north, as this storm did temporarily. Then the high pressure to the north strengthened, and it also got up under an upper level anticyclone, so it was in a favorable area for strengthening.

While the winds and destruction raged outside, the forecasters had to concentrate on their duties inside, not on their personal losses. Many employees had their mates and children, along with other family members, at the NHC to ride out the storm together. This was a policy that Sheets insisted on if ever a hurricane hit the area. Sheets added, "I'd rather have their families up here rather than everyone worrying about them." As positive proof to this statement, after the radar fell and shook the building, Sheets went back to check on all the families huddled at the NHC. Although he was in the middle of what would prove to be the most terrible natural disaster to hit the United States, he never lost sight of the reality that the people under his roof were all living through a terrifying experience.

Even after being severely affected by the hurricane, Sheets and his department could not afford to contemplate what had happened because the West coast of Florida was expecting 120 mph winds as the storm moved out into the Gulf of Mexico. "Even though the hurricane was striking us, we still had the responsibility to put out warnings for Southwest Florida and the North Gulf Coast, because we knew it was going to go out into the Gulf and continue to strengthen," recalled Sheets. "Our primary thoughts were on continuing the forecast and warning process. There wasn't much we could do about this area at that stage. We had already done as much as we could in terms of the forecasts and warnings that took place here."

It is ironic that the forecasters at the NHC can "see" over 8,000 miles of ocean and land, but during this night, they were only left to wonder what terrible devastation was occurring literally in their own back yards. "I knew that my family had been evacuated out of the area to the west part of the county," said Sheets. "I thought that they'd be reasonably safe there in a well constructed cinder block and stucco-type structure. But, I don't think any of us comprehended the degree of damage that had actually taken place until we got out into the community and saw what had happened."

In the rage of Andrew's winds, many NHC and NWS employees faced the terrible truth that they would never see their homes again. "I did what I could, but quite frankly, I live closest to the water," explained Cline. "I took pictures of my house and took my insurance papers with me. Although no employees were injured in the hurricane, many had no homes to come back to. "There were ten whose homes were either destroyed or not livable after the hurricane," said Sheets.

As Hurricane Andrew moved west, many at the NHC reflected on that long night spent battling the storm and the personal price they paid trying to help save lives. "I was on the 4:00 pm to midnight

Continued on Page 15

Hurricane Andrew

Continued from Page 14

shift, and had to be back on at 7:00 am" remembers Cline. "So then, during the height of the storm I could help out, because there was no way I was going to get to sleep. Early in the evening, right after I did the classification of the system at 8:00 pm, I knew a good deal about the hurricane. I got kind of quiet and started thinking about things. I was looking out the window and it's overcast, but not ominous. One of my friends, who is a producer for a TV network, walked over and said, 'What are you thinking about, Joel? What's going through your mind?'" Cline replied, "No matter what we did, no matter how many hours Bob sits in front of your TV cameras, no matter how many interviews he gives, no matter how many times people call here, no matter how many police went out to beat on doors and evacuate people off barrier islands, no matter how many Spanish stations, Haitian radio stations broadcast everything, people are alive now that will not be alive at 8:00 in the morning."

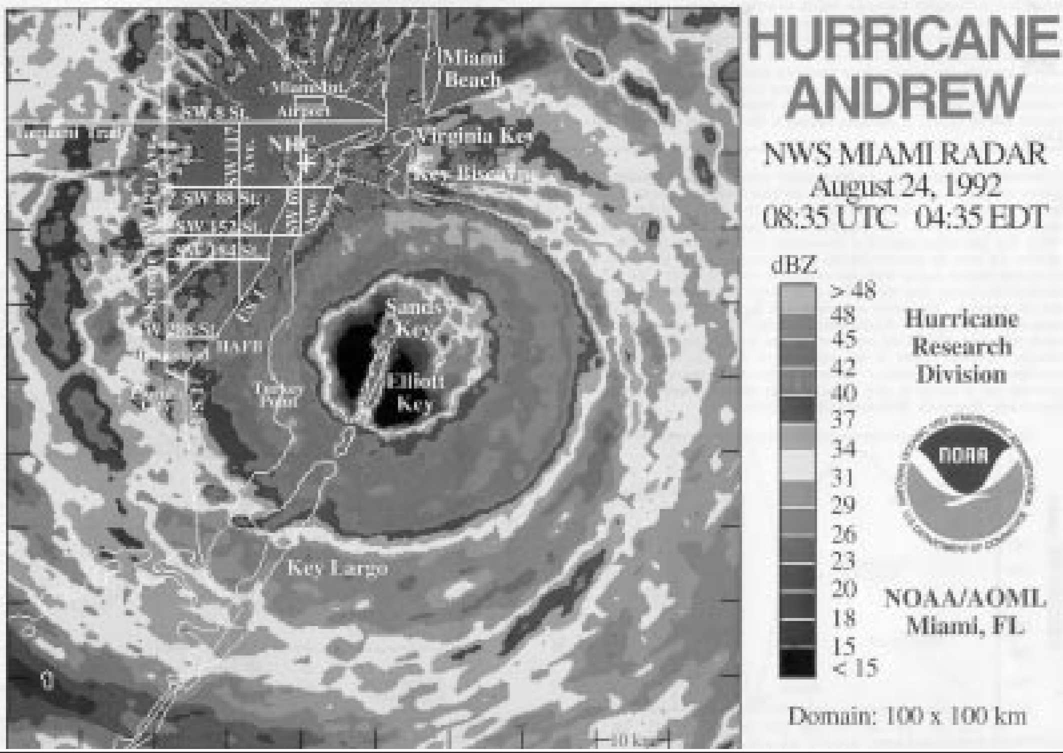
"It's a very sobering and a very true statement," said Cline. "That makes me feel worse than saying goodbye to my house. In essence, you have no control over whether your house is there or not. That's what insurance money is for, to rebuild or whatever. You can't rebuild a human life. Our job is to warn people so they get can out. You're not going to control it and you're not going to stop it from damaging any property. We're not here for that purpose. What we are here for is so people won't die. And you know that no matter what you do, or how good you do it, or how long you let people know, people will die. The next one that hits the United States, people will die. People in Galveston may remember, Mobile may remember Camille, people in Charleston remember Hugo, and people here will remember Andrew for a long time."

Acknowledgments

My gratitude to Dr. Robert Sheets, Joel Cline, and Vivian Jorge, who at the time worked at the National Hurricane Center. My thanks also to NOAA cartographer Kevin Shaw for his research.⚓

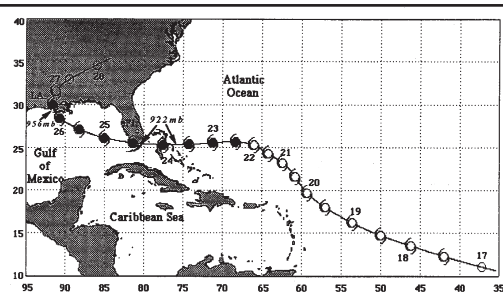
Hurricane Andrew Hits Fowey Rocks C-Man (Coastal Marine Automated Network) Station

In August of 1992, Fowey Rocks C-MAN station (FWIF1) was in the direct path of Hurricane Andrew. The Category four hurricane blew out all the glass in the structure, and most of the weather equipment on this C-MAN station was either destroyed or damaged. The intense winds bent the 30 foot high trolley mast that held the sensor cross arm, wind speed sensors, and remote barometer port. The mast was bent 90 degrees to the west about 5 feet above its base. The cross arm and sensor mounts from the trolley mast were found about 150 feet west of the lighthouse base in 10 feet of water. The GOES antenna was broken off and the outboard solar panel was impacted by debris, leaving only the aluminum frame intact. Although Fowey Rocks took the brunt of Hurricane Andrew, it measured wind speed and direction, peak winds, sea level pressure, and temperature until the station failed due to the intensity of the hurricane. Wind was measured at 140 mph (two-minute average) with a five-second peak of 169 mph. This data helped forecasters verify meteorological information gathered from radar, satellites, and reconnaissance aircraft, along with provided data for further research after the storm.⚓

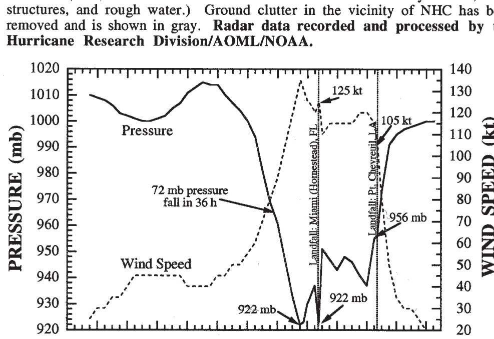


ANDREW became a hurricane on 22 August 1992 and within 36 hours had intensified to Category 4 strength before crossing over the northwestern Bahamas. On the morning of the 24th, Hurricane Andrew struck southeast Florida with maximum sustained surface winds estimated at 145 mph, gusts exceeding 175 mph, and a minimum central pressure of 922 mb (27.23"), which is the third lowest central pressure this century for a hurricane making landfall in the United States. Andrew went on to strike the south-central Louisiana coast on 26 August as a Category 3 storm. Hurricane Andrew was responsible for at least 62 deaths and caused $20-30 billion in damages making it the costliest natural disaster in U.S. history.

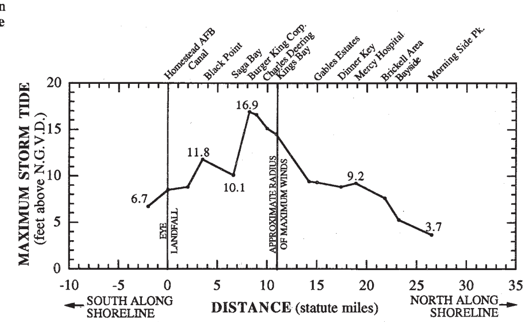
Comments on Hurricane Andrew color radar image (opposite side): The picture is from the last full sweep of the National Weather Service's Miami WSR-57 radar (located at the National Hurricane Center [NHC]) before the radar was destroyed by the storm. The digitized radar imagery shows the eye centered over Elliott Key just before landfall at Homestead Air Force Base (HAFB). As Andrew traveled due west, the heaviest damage occurred in those areas affected by the eyewall (doughnut-shaped region with echoes greater than 42 dBZ). The weather radar measures the power from the portion of the radar beam scattered back by raindrops and ice particles. The colors associated with higher dBZ (i.e., red) correspond to areas with larger amounts of rain, which typically are also regions of stronger winds. Areas with high dBZ in the center of the eye are because of ground clutter from islands. (Ground clutter is the reflection of the radar beam by terrain, large structures, and rough water.) Ground clutter in the vicinity of NHC has been removed and is shown in gray. **Radar data recorded and processed by the Hurricane Research Division/AOML/NOAA.**



Best track positions for Hurricane Andrew (August 16-28, 1992). Positions at 00 and 12 UTC are shown. Dates are at the 00 UTC locations. Tropical depression, tropical storm and hurricane strengths are represented by open circles and open and filled hurricane symbols, respectively. Locations of lowest minimum central pressure are shown. Data for this and other black and white figures are from National Hurricane Center's preliminary report.



Best track minimum central pressures and maximum sustained wind speeds for Hurricane Andrew.



Preliminary storm tide heights (sum of storm surge and astronomical tide) along western shore of Biscayne Bay associated with Hurricane Andrew, 24 August 1992. (Data provided by the U.S. Geological Survey under a mission assignment from FEMA.) Heights in feet above NGVD - National Geodetic Vertical Datum - zero elevation - i.e., mean sea level of 1929.

Fowey Rocks C-MAN station before Hurricane Andrew.

Fowey Rocks trolley mast bent 90° by Hurricane Andrew.

Fowey Rocks C-MAN cross arm and sensor mounts under 10 feet of water.

Rescues Up and Down The Pacific Ocean Demonstrate the Value of AMVER Participation

Rick Kenney
AMVER Maritime Relations Officer
United States Coast Guard

In a dramatic series of rescues stretching the length of the Pacific Ocean, merchant ships were responsible for the recovery of 19 survivors in three emergency incidents over the course of a one month period. Quick location, and the quick reaction of masters and crews, made the literal difference between life and death at sea.

Fishermen Fished Out!

On August 15, 1998, the captain of an 80-foot fishing vessel, the SUN LION (Belize flag), radioed the U.S. Coast Guard in Juneau that his vessel had been adrift for 48 hours. The vessel then began taking on water in its engine room 375 miles south of Dutch Harbor, Alaska. Its Philippine crew of ten abandoned ship into a lifeboat in 10-foot seas and 20-knot winds. A Hercules C-130 aircraft was launched from USCG Air Station Kodiak. At the same time, a Japanese specialized cargo ship, the SOLAR WING, was located by rescue coordinators using the AMVER system. The C-130 vectored the merchant ship three miles to the location of the survivors, where a boat-to-boat transfer was accomplished. The ship carried the survivors to its next port of call in Tokyo, where it was presented with a U.S. Coast Guard Public Service Commendation.

Deliverers Delivered!

A leaking fuel line caused the 44-foot sailboat KATHI II to catch fire 76 nm southeast of Baja, Mexico, on July 20, 1998. Two sailors delivering a friend's boat from Mexico to Newport Beach, California, were forced to abandon the boat, which soon became engulfed in flames. A 406 MHz EPIRB signal was received at the Coast Guard Command Center in San Diego, California, and a C-130 aircraft from the USCG Air Station in Sacramento, on a scheduled patrol nearby, was diverted. It located two persons in a life raft and dropped a radio to establish communications.

Again, rescuers queried the AMVER system and located the American President Lines ship, M/V PRESIDENT HOOVER, only 12 miles away. The two sailors were recovered after only five hours in the raft as the 900-foot ship maneuvered within six feet of the raft and dropped its accommodation ladder. The ship carried Rick Wempe, described as "Captain Calm" by his "terrified" partner Tim Anderson, to Long Beach, California, where they were met by news media and

Continued on Page 20

Grateful survivors from the SUN LION strike a pose with rescuers from the M/S SOLAR WING.

Certificate of Appreciation

Presented in recognition of outstanding assistance to the U.S. Coast Guard

The Master and Crew of M/S Solar Wing

*are recognized for their humanitarian service in rescuing the crewmembers of the fishing vessel "**Sun Lion**" in the North Pacific Ocean in the early hours of 15 August 1998.*

When the Master and Crew of "SOLAR WING" were requested by the U.S. Coast Guard to assist a foundering vessel, they diverted from their course without hesitation, sailed more than 100 miles, lowered their lifeboats in the dark, and successfully rescued all 10 crewmembers from the sinking fishing vessel "SUN LION." They welcomed the rescued sailors aboard their ship for the next 6 days while they completed their westbound voyage, and delivered them safely ashore in Tokyo, Japan. By their selfless actions, the Master and Crew of "SOLAR WING" have upheld the very highest traditions of the sea.

UNITED STATES COAST GUARD 1790

Joseph P. Brusseau, Captain, U.S. Coast Guard
Commander, Activities Far East

Rescues

Continued from Page 18

interviewed about their rescue, which became the lead story on local newscasts that evening.

Anderson described a HOOVER crew member crouched at the bottom of the big ship's ladder as "being dunked as the ship rolled, yet telling me to walk on top of him to get on the ladder – he is the bravest man I ever met in my life!" Captain Peter Arnstadt, Master of the PRESIDENT HOOVER, put his extraordinary ship handling role in perspective during a television interview when he said: "that's what we get paid to do!" The retired Navy Captain also commented that the crew of the Coast Guard C-130 could have won the Navy's aerial bombing competition with their precise radio drop!

Back to the Future–New Ship on Maiden Voyage Saves Seven from Historic Sailing Craft

Combining the best elements of an exciting adventure novel, Coast Guard rescue coordinators in Honolulu relied on today's modern technology to save the crew of an historic mahogany catamaran sailing canoe, which replicated the purported design of ancient sailing vessels. On a voyage in planning for over seven years, the 75-foot FEATHERED SERPENT III was en route from Hawaii to Brisbane, Australia on August 20, 1998, via Fiji, as part of a multi-year circumnavigation expedition to prove suspected sea travel of ancient Peruvians and possible contact with Pacific Islanders. The vessel encountered heavy weather which caused it to capsize and break up 1,400 nm south of Oahu.

The crew scrambled into life rafts, which were secured together with the wreckage. Among contemporary safety equipment carried aboard were VHF and single sideband (SSB) radios, celestial navigation equipment, and a 406 MHz EPIRB. It was the EPIRB's satellite signal that alerted rescue officials to the catamaran's plight. Among the resources marshaled to assist were a U.S. Coast Guard C-130 from Air Station Barbers Point, Hawaii; elements of the U.S. Navy's Pacific fleet and Third Fleet (opportunely returning from deployment); and a French container ship participating in AMVER, the DIRECT FALCON, which diverted from a position 484 nm (or 28 steaming hours) away. An Urgent Marine Information Broadcast (UMIB) was also issued to all ships in the area.

One of those ships, the M/V EVER VICTORY, a Taiwanese bulk carrier on its maiden voyage from its builder's shipyard in Rio De Janeiro to Tokyo, responded to the UMIB and voluntarily diverted at best speed from its position only 195 nm away. The C-130 arrived on scene and dropped an additional life raft and radio to the survivors. At dawn, the EVER VICTORY appeared and picked up the survivors, all in good condition. The expedition's leader is Gene Savoy, a 70-year-old, well-known explorer noted for the discovery of several ancient cities in the Peruvian rain forests since the 1950s.

The Master of the EVER VICTORY, Captain D.M. Huang, normally participates in AMVER, but could not on the maiden voyage because reporting instructions had not yet been placed aboard. The critical difference in response time from a ship identified at a distance of 195 nm as opposed to 484 nm from the position of the emergency points up the advantage of maximum ship participation in AMVER by the world's merchant fleet!⚓

Rick Wempe and Tim Anderson hold a souvenir life ring signed by PRESIDENT HOOVER crew. They were forced to abandon the sailboat KATHI II after she caught fire 76 nm southeast of Baja, Mexico.

Why Are the Tides So Predictable?

Bruce Parker
National Ocean Service

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

Methods for precisely predicting the tide have been known for more than a 100 years, and cruder but still useful methods have been known for centuries, perhaps even back 2000 years. With only a few days of data from a tide gauge, the tide can be predicted at that location for years into the future. With six months of data, such predictions can be accurate to the nearest inch and the nearest couple of minutes.

I should clarify here that by the tide I mean the astronomical tide, namely, the tide that is predicted in national Tide Tables. That may be obvious to most readers of this column, but changes in water level, including the changes due to wind and atmospheric pressure, are sometimes still referred to as the tide. During storms and hurricanes, the term storm tide is often used by the media. Wind and barometric pressure are part of the weather and so their affect on water level can vary greatly. When a tide prediction does not exactly match the measured water level, it is because of the wind and pressure and, in some places, because of river discharge. But the astronomical tide is another story and the key to its predictability is, of course, the word astronomical. The tide is caused by the gravitational effects of the moon and the sun. The rotations, revolutions, and orbits involving the Earth, moon, and sun are all periodic motions with fixed and precisely known time periods. We will see that the predictability of the tide can be traced back to the predictability of these astronomical motions.

To answer the question in the title of this column, we first need to describe how the tides are caused. Let's look at the moon first, because, being much closer than the sun, it is the largest generator of the tides. The Earth and moon both actually revolve around a common point, which, because the Earth is much more massive than the moon, is inside the Earth, but not at the Earth's center (see Figure 1). At the center of the Earth, there is a balance between the gravitational attraction of the moon (trying to pull the Earth and moon together) and the centrifugal force of the revolving Earth (trying to push the Earth outward away from the moon—but see last issue's column for the real explanation of this fictitious force). At a

Continued on Page 22

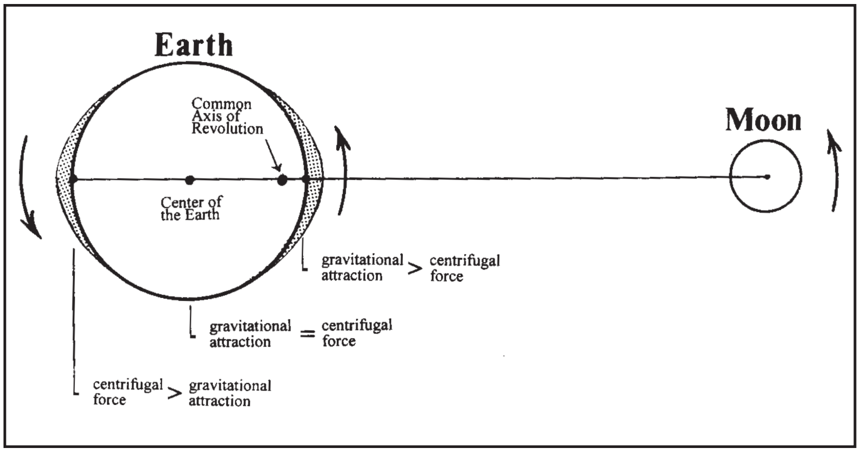


Figure 1. The Earth-Moon system (viewed from above the North Pole) revolving around a common axis (just inside the Earth). The Earth is shown with a hypothetical ocean covering the whole Earth (with no continents) and two bulges, resulting from the imbalances of gravitational and centrifugal forces.

Tides

Continued from Page 21

location on the Earth's surface closest to the moon, the gravitational attraction of the moon is greater than the centrifugal force. On the opposite side of the Earth, facing away from the moon, the centrifugal force is greater than the moon's gravitational attraction. Figure 1 shows a hypothetical ocean (covering the whole Earth with no continents) with two bulges, one facing the moon and one facing away from the moon. These bulges result from the two imbalances of gravitational and centrifugal forces. However, if we look at the side facing the moon, the force vertically upward from the Earth toward the moon overhead (due to the gravitational force of the moon being greater than the centrifugal force of the Earth's revolution) is so small compared to the Earth's gravitational force as to be insignificant.

So what then actually causes the bulges?

If we move away to another point on the Earth that is not directly under the moon, we see that the attractive force is still pointing toward the moon, but is no longer perfectly vertical relative to the Earth. The further away we get from the point under the moon, the less vertical the force is (see Figure 2). At these other points we now have both a vertical component of the force and a horizontal component, the latter one being parallel to the Earth's surface. This horizontal force, though small, has nothing opposing it, and so it can move the water in the ocean. One can see from Figure 2 that all the horizontal components shown tend to move the water into a bulge centered around the point that is directly under the moon. Similarly, on the other side of the Earth (where the centrifugal force is greater than the moon's gravitational attraction) another bulge results.

Continued on Page 23

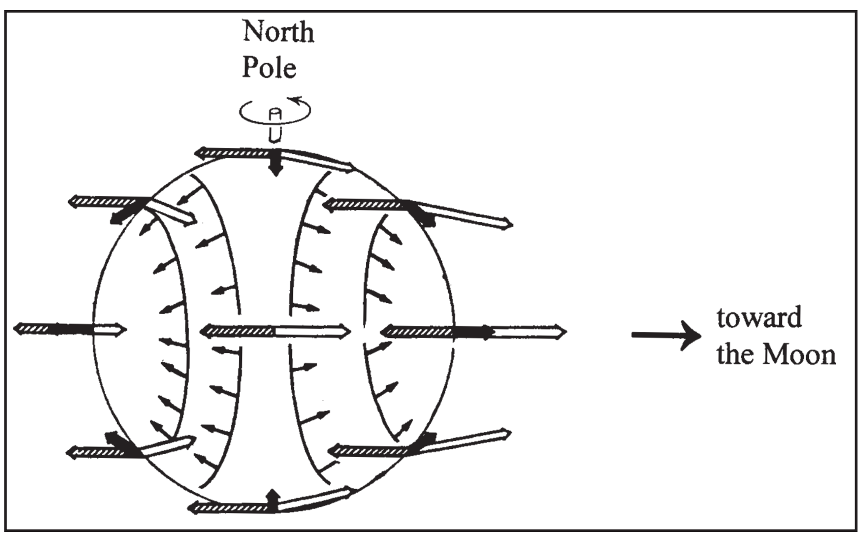


Figure 2. The tide generating forces (the thick black arrows) on the Earth resulting from the difference between gravitational attraction (the open arrows) and centrifugal force (the hatched arrows). The small black arrows are the horizontal components of the tide generating forces, which tend to move the water into the two bulges shown in Figure 1.

Tides

Continued from Page 22

One can envision the Earth rotating under these bulges in this hypothetical ocean that covers the entire Earth. In one complete rotation in one day, there will be two high tides (when under a bulge) and two low tides (when halfway between bulges), and thus one entire tidal cycle would be completed in half a day. However, this is still an extreme simplification. Not only are the continents left out, but this assumes that the oceans respond instantly to the tide-generating force. There is a lot more to explain.

Let's add the continents in and look at one of the oceans, the Atlantic, for example. And lets also look at a bay connected to the Atlantic. The tide-generating force is extremely small, too small to cause a tide directly in the bay. Only in a large ocean are the cumulative effects of the tide-generating force throughout the ocean large enough to produce a tide. What is actually generated is a very long wave with a fairly small amplitude, on the order of a foot or two (see Figure 3). However, when this wave reaches the reduced depths of the continental shelf, there is a partial reflection of the wave, and the part of the wave that continues toward the coast is increased in amplitude. At the coast, another reflection further increases the height of this tidal wave (NOT to be confused with the tsunami caused by an earthquake), now reaching at least a few feet or more along most coasts. When the wave moves up into a bay, there can be even more amplification, depending on the depth and length of the bay, with the highest tidal ranges seen in the Bay of Fundy (on the order of 50 feet).

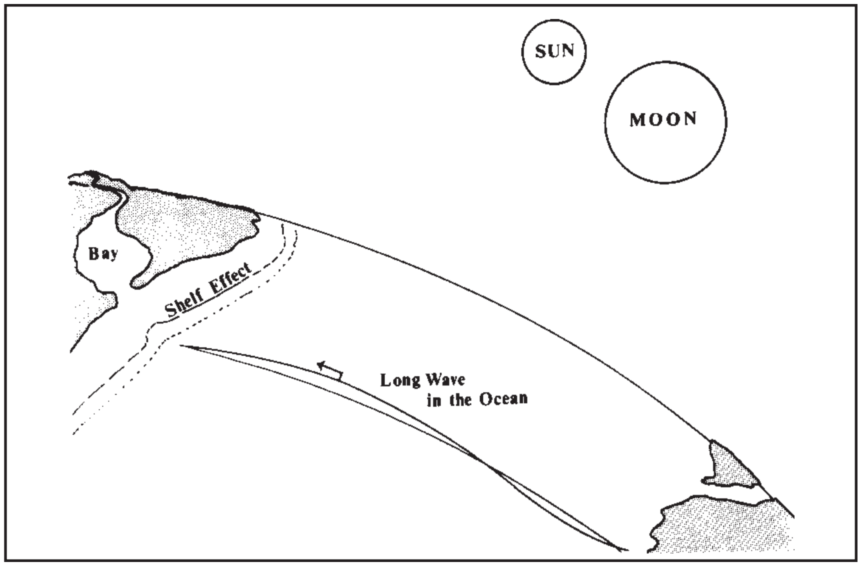


Figure 3. The tide generating forces caused by the moon and sun produce in the ocean a very long wave of relatively small amplitude. When this long wave reaches the continental shelf, then the coast, and finally propagates up a bay, it is amplified by an amount that depends on the length and depth of each of the basins.

At this point I need to talk briefly about pendulums and coffee cups and bath tubs in order to explain what makes tides higher in some places than others, and ultimately to explain why tides are so predictable. There are two main parts in the study of tides, the part dealing with astronomy (which we will get back to in a minute) and the part dealing with the motion of water in a basin, namely, the hydrodynamics, which I will talk briefly about, as soon as we look at the pendulum. If we have a simple pendulum, say a ball hanging on a string, and we hit the ball sideways just once, and then let it swing back and forth, it will always take the same amount of time to complete one oscillation back and forth. This period of oscillation depends only on the length of the string, a longer string producing a longer period of oscillation. If we have a basin of water and we push down once on the water to get its surface oscillating back and forth (like a seesaw, with the center point not moving and the ends moving up and down) it also will have a period of oscillation. This natural period of oscillation of a basin depends both on its length and its depth. The longer the basin, the larger the period of oscillation;

Continued on Page 24

Tides

Continued from Page 23

however, the deeper the basin, the smaller the period of oscillation. The length effect is more dominant. If, for example, we increase both the length and depth of a basin by say 100 times, the period of oscillation will increase by about 10 times (and the frequency of oscillation will decrease by 10 times). Thus, water in a tea cup will have a shorter period of oscillation (and will oscillate back and forth much faster) than water in a bath tub. The bathtub, in turn, has a much shorter of period of oscillation than the Atlantic Ocean (which has a natural period of about 19 hours).

When we hit the pendulum once, and let it go, the resulting oscillation is called a free oscillation. But we could keep hitting the pendulum at a regular time interval. Suppose the natural period of a pendulum is 6 seconds, but we hit the pendulum every 4 seconds, namely, before it has time to do a complete oscillation we send it back in the opposite direction again. If we keep this up, the period of oscillation of the pendulum is 4 seconds, and this is called a forced oscillation.

The same is true for water in a basin; if we push down on the water at a regular interval, we can cause the water to have a forced oscillation with a period that matches our interval of pushing. This is essentially what the tide-generating forces do in the Atlantic Ocean, except that it is not a single push downward; it is continuous horizontal pushing of the water everywhere over the entire ocean with the direction varying over a 12.42 hour period (why this is more than twelve hours will be explained below when we get back to the astronomy part of the story). The small arrows in Figure 2 show the horizontal tide generating forces at one instant in time. As the Earth rotates, and we follow one point on the Earth's surface around, we can see that the direction of the force will rotate completely around the compass.

How large the tide range is depends on how close the natural period of the basin is to the period of the tide-generating force. Look again at the pendulum. If the pendulum does one complete oscillation from right to left and back again, and is just beginning to move to the left again as we hit it to the left, we impart the additional energy at just the right time and the pendulum swings higher than it would have. Likewise, if the natural period of the basin is the same as the period of the tide-generating force, then the energy from the tidal forcing will be input just at the right time and the tide range will be larger. This is called resonance. The Atlantic Ocean is too wide for there to be resonance (its 19-hour natural period being much longer than 12.42 hours). [There may, however, have been a time in Earth's history, before continental drift got as far as is has today, when the Atlantic was smaller, and perhaps the tides were larger.] The largest tide ranges in the world are in shallower basins with just the right length and depth combination, like the Bay of Fundy, or along ocean coasts with very wide continental shelves and the right depth, like off southern Argentina.

There is not enough space in this column to explain all aspects of the hydrodynamics of the tides, but for the purposes of answering the question in the title of this column, we really don't need to know any more about the hydrodynamics. It doesn't matter how the hydrodynamics has affected the tide range or the times of high water and low water. All that matters is that, because this is a forced oscillating system, the tide will oscillate with the periods determined by the relative motions of the Earth, moon, and sun. Then all we need to do is to analyze a few days (or months) of water level data in order to accurately predict the tide at the location where the data were taken. However, we need to go back to the astronomy because there is not just a single tidal period to consider. There are many different periods involved due to the complex nature of the orbit of the moon around the Earth and of the orbit of the Earth around the sun. To accurately predict the tide, one must consider the most important of these periods.

Let's start with the most important tidal period, the 12.42 hour period already mentioned. The Earth rotates on its axis, taking approxi-

Continued on Page 25

Tides

Continued from Page 24

mately 24 hours to go through a complete day-night cycle. If the moon was standing still, then the two high water bulges on the Earth mentioned above (see Figure 1 again) would be 12 hours apart. However, the moon is moving around the Earth in the same direction that the Earth is rotating. By the time the Earth has made one complete rotation (in 24 hours) the moon has moved a little, so it actually takes 24.84 hours before that same point on the Earth is directly under the moon again. And thus the two high water bulges are really separated by 12.42 hours (the principal lunar period). The tidal constituent representing this lunar period is called M2 (for moon, twice a day).

Another tidal period comes from the effect of the sun. Although the sun is much more massive than the moon, it is so far away that the tide generating force of the sun is less than half that of the moon. The principal solar constituent (called S2) has a period of exactly 12 hours, as one would expect. There are two times of the month when the moon and sun are in line with the Earth, at which time they both work together to produce higher tides, called spring tides (see Figure 4). This occurs when the sun and moon are on opposite sides of the Earth (full moon), or on the same side (new moon). When the moon is in first quarter or third quarter, the moon and sun work against each other and so the result is tides that are not as high, called neap tides.

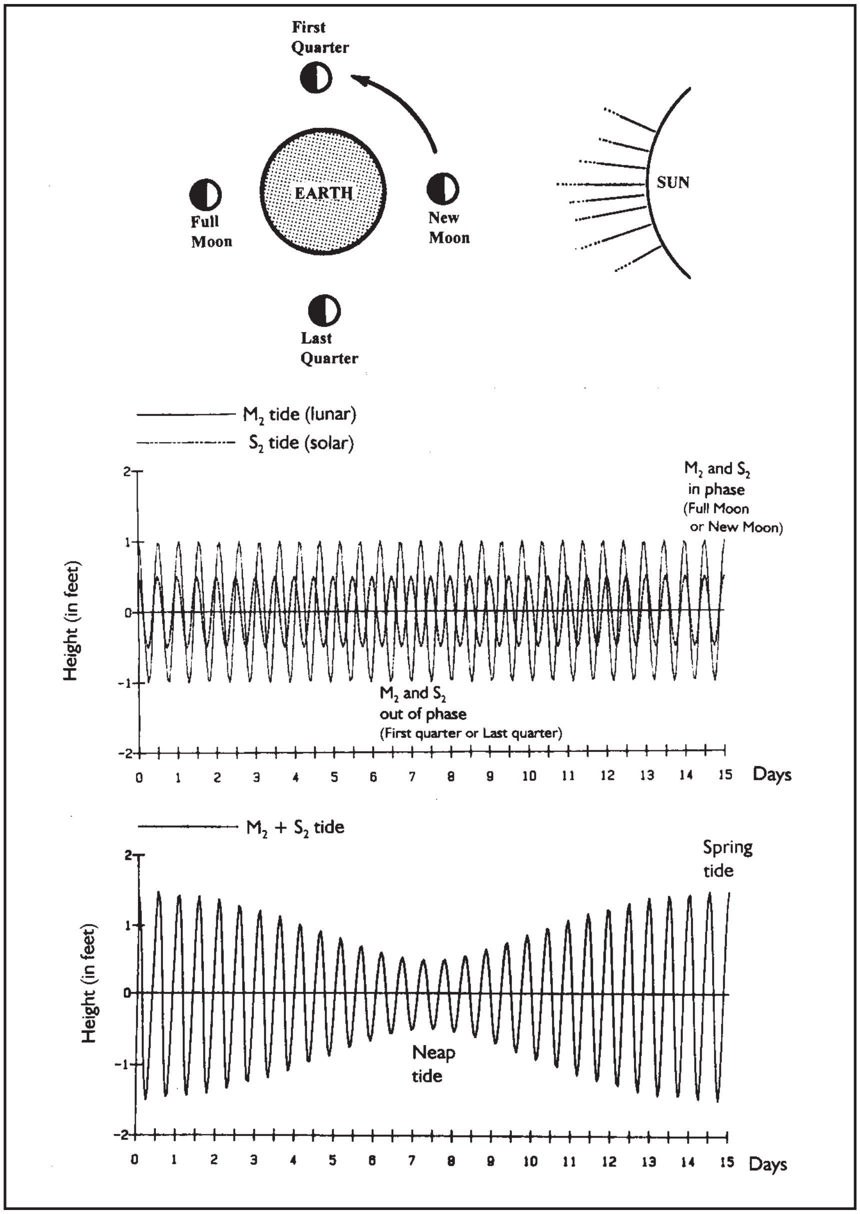


Figure 4. The combined effect of the moon and sun varies throughout the month. When the moon and sun are working with each other (at Full Moon and New Moon), one sees the highest tides (spring tides). At First Quarter and Last Quarter, the moon and sun work against each other, resulting in smaller tides (neap tides).

Another tidal period comes from the fact that the moon's orbit around the Earth is not a perfect circle, but is an ellipse. Thus the moon moves closest to the Earth (called perigee) and then to a point

Continued on Page 26

Tides

Continued from Page 25

farthest away (called apogee) and then to the closest point again in the orbit, the whole cycle taking 25.5 days. The tides will be larger when the moon is closest to the Earth (perigean tides) and smaller when the moon is farthest from the Earth (apogean tides). The period of this elliptical tidal constituent (called N2) is 12.66 hours, and it is a little trickier to understand where this number comes from. If two waves are added together, one with a larger amplitude and a period of 12.42 hours and one with a smaller amplitude and a period of 12.66 hours, the result will be a wave with a 12.42-hour period that slowly varies in amplitude over a 25.5-day period. In order words, one can represent the variation in tide range due to the changing distance of the moon from the Earth by simply adding a wave with 12.66-hour period to the

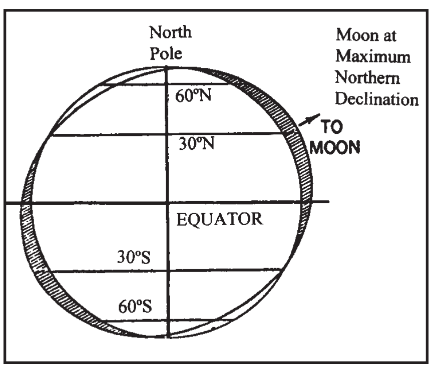


Figure 5. When the moon is at maximum declination north or south of the equator, the tidal bulge also shifts north or south. When this happens, certain locations on the Earth would rotate under only one high water bulge.

principal lunar wave with period of 12.42 hours. We can use Figure 4 to illustrate this, if, in that figure, we replace S2 with N2, spring tide with perigean tide, and neap tide with apogean tide. The difference is that with the M2 plus S2 case there really are two distinct effects being added, but in the case of the changing distance between the moon and Earth, this directly varies the amplitude of the tide; and N2 is merely a convenient way (in combination with M2) to represent this variation of amplitude.

There are many other variations in the moon's orbit, the Earth's rotation, and the Earth's orbit about the sun, and these all can be represented by other tidal constituents with appropriate periods to represent the various affects on the tide's amplitude. I will mention only two others, because at some locations on the Earth they can lead to (with some help from hydrodynamics) only one high water per day instead of two. The moon is directly over the Earth's equator only two times a month. Half the time it moves north of the equator, and half the time it moves south of the equator. At the point when the moon is the farthest north of the equator (or farthest south) the bulge is shifted also. In Figure 5, one can see places north of 30°N where the Earth would rotate under only one high water bulge. In the real world, the size of a particular basin would determine whether these diurnal tidal periods would dominate over the semidiurnal periods described above. In many places there are still two high waters a day, but one is larger than the other (and likewise for the low waters); this is referred to as a mixed tide.

Knowing the periods of these and other smaller tidal constituents, which are derived from the relative astronomical motions of the Earth, moon, and sun, one can analyze a data series of water level observations from a particular location. The result of such a harmonic analysis is an amplitude and phase for each of these tidal constituents, which represent how large each effect is at that particular location, and when in time the peak of each effect will take place [for example, relative to when the moon passes over (transits) that location]. The hydrodynamics affect both the amplitude and phase (timing) of each tidal constituent, but we really don't need to know the details of how it happened, only that it did happen. And, as long as the hydrodynamics stay the same, the tide predictions from these calculated harmonic constants (the amplitudes and phases) will be accurate. The hydrodynamics will stay the same as long as the length and depth of the basin stays the same. For small bays, shoaling or dredging can change the hydrodynamics and thus change the tide range and times of high and low waters.

The method of harmonic analysis was first invented by Sir William Thomson (Lord Kelvin) in 1867 and later refined by George

Continued on Page 27

Tides

Continued from Page 26

Darwin (son of Charles Darwin). To carry out a tide prediction in that era, long before computers, machines were built with gears and pulleys connected by a wire to a pen. Each tidal constituent had a different size rotating gear and a pin and yoke system connected to a pulley (see Figure 6). The pin and yoke system turned the rotating motion of the gear into a vertical up and down motion of the pulley, which moved the wire over it and thus moved the pen up and down on a roll of moving paper. The wire ran over a number of pulleys so all the constituent effects could be added together. The first tide predicting machine was a wooden model built for Kelvin in 1872, but later models were huge brass machines with dozens of finely made gears and pulleys. The first one built in the U.S. was by William Ferrel in 1885.

Prior to the use of harmonic analysis, there were other less sophisticated methods based upon recognized relationships between the tides and the movements of the moon and sun. For example, for a particular place, high tide might occur a certain number of hours after the moon was directly overhead, and the highest (spring) tide might occur a certain number of days after full moon or after new moon. In many of the early maritime nations, tide prediction schemes were treasured family secrets passed on to the next generation. One of the earliest tide tables discovered was for London Bridge in the early 1200s.

The earliest recognition of the connection between the tides and the moon appears to be by a Greek geographer, Pytheas of Massilia, around 325 B.C. Pytheas had traveled from his home in the Mediterranean Sea, which does not have a noticeable tide, to the British Isles, where he observed significant tides and even tried to measure them. Other Greek and Roman thinkers went on to describe many patterns in the tides and their similarity to motions of the moon and sun. Yet no one could come up with an explanation of how the moon and sun actually caused the tide. They were especially confused by there being two high waters a day, one of those occurring in the day when the moon was nowhere to be seen. A variety of strange ideas were proposed. Some regarded the Earth as an animal and attributed the tides to its respiration or to its alternate drinking in and spouting out of water. Others attributed it to the heat of the sun or to river discharges or to winds caused by the sun or moon striking the water. Even those that believed that the moon had to be the cause did not know how. In 1609, Kepler proposed that the tides were due to the gravitational attraction of the moon, but he seemed to think that the second high tide was due to the waters rushing back after the moon had pulled them westward, where they had hit a continent and were freed from the moon's pull as it continued around to the other side of the Earth. It was not until 1687 that Newton, in his book *Principia*, finally explained the cause of the tides, including the reason for two high waters per day.⚓

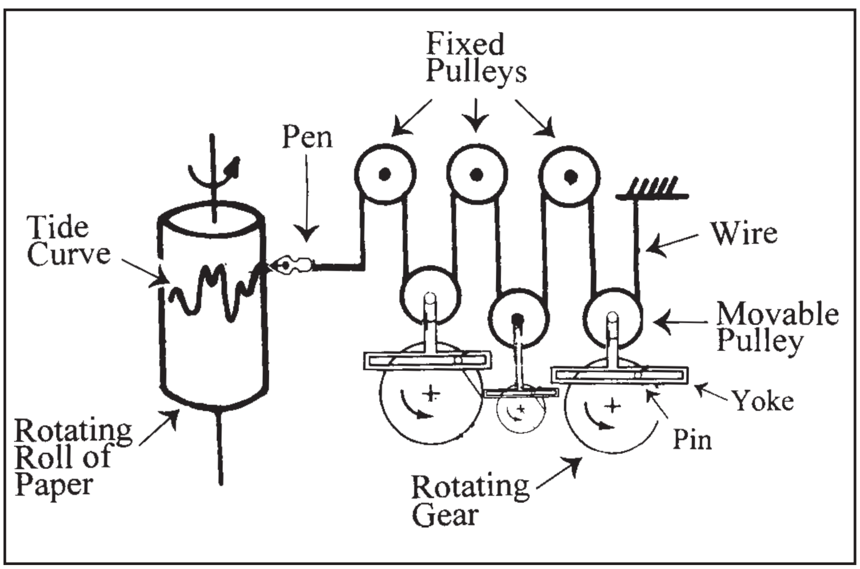


Figure 6. A schematic of an early tide prediction machine. Each gear and pulley combination represented one tidal constituent. The wire running over every pulley summed the motions and moved a pen on a moving roll of paper to draw a tide curve.

Marine Familiarization Float on Board the S/S ARCO FAIRBANKS—January 16-21, 1998

Dave Hefner, Marine Forecaster
Fairbanks, Alaska

The S/S ARCO FAIRBANKS was built by Bethlehem Steel in 1974. The ship is 880 feet long, and on this trip was carrying about 800,000 barrels of oil. This was trip number 556 for the ship. A typical journey of this type from Valdez, Alaska, to Cherry Point, Washington, can be completed in about three and one-half days with good sea conditions. However, this trip took just over five days, as we encountered rough weather and sea conditions along the way.

My trip began at 0400 from Valdez on Friday, January 16, 1998. The weather was beautiful with partly cloudy skies and plenty of stars out. The area was in a typical winter pattern of high pressure over the interior, providing some cold northeast winds.

With a complement of escort vessels, and a harbor pilot on board, we headed out through the Valdez Narrows into Prince William Sound. With the slower speed limits in the sound, we did not reach Hinchinbrook entrance to the Gulf of Alaska until noon on Friday.

The S/S ARCO FAIRBANKS receives marine facsimile data from both Kodiak and Point Reyes. From Kodiak, they receive the surface analysis and a 36-hour surface forecast, both prepared by the Anchorage forecast office. From Point Reyes, they receive a North Pacific surface analysis (from Japan to California), and a 12- and 24-hour forecast of winds and seas. These charts are all prepared by the National Centers for Environmental Prediction (NCEP), Marine Prediction Center (MPC). They also have access to marine text forecasts via INMARSAT-C SafetyNET.

Second Mate Statler spent quite a bit of time with me talking about weather. He has quite an interest in weather and considers himself an amateur observer. He was quite knowledgeable of general weather conditions. He said the ship takes an 18Z observation everyday. Their observation equipment consists of a barometer, barograph, thermometers for both air temperature and wet-bulb temperature, and a weather vane and cup anemometer.

Twenty-four hours into the trip, we started hitting swells of 10 to 15 feet. These were obviously swells generated by a distant storm, as we were under partly cloudy skies, with just a hint of layered clouds to the far south. Winds were only 15 to 20 kts. For a while, the swells were hitting us head on, with beautiful displays of water spraying high into the air off the bow. But soon the swells started to hit us at a bit of an angle and the water really started to wash over the main deck. By the time we reached about 55 north

Continued on Page 29

Fam Float

Continued from Page 28

latitude, we hit the back side of a strong storm, and winds increased northwest to 50 kts. The seas became quite chaotic, increasing to about 15 to 20 feet. In addition to the seas washing across the deck, we were receiving quite a bit of sea spray, even up to the windows on the bridge.

The normal cruising speed for this tanker is around 15 kts. For most of Saturday and Sunday we had only been traveling between 5 and 10 kts, putting us quite a bit behind schedule. By 1000 Sunday, we were only abreast of the northern Queen Charlotte Islands, which is a little short of half way to Cherry Point, Washington. The seas did begin to smooth out, though swells remained 10 to 15 feet. By Monday evening we were only about 150 miles from Port Angeles.

Photo of inbound tanker in Prince William Sound heading for Valdez to pick up a load of crude oil. Picture taken from the bridge of the outbound S/S ARCO FAIRBANKS.

Photo taken from the bridge of the S/S ARCO FAIRBANKS during a storm in the North Pacific en route to Cherry Point, Washington.

We reached the Straits of Juan de Fuca Tuesday evening. We made a quick stop to pick up the harbor pilot near Port Angeles.

We reached Cherry Point at 0600 Wednesday. Cherry Point is very remote, located on the Washington coast north of Bellingham, and only about 10 miles from the Canadian border. The facilities are located out from moderately sized cliffs, and pipes carry the oil to a refinery at least one-half mile inland. There are two other unloading piers in the area, both being about one-half mile apart. One pier was for unloading bulk cargo, and the other one was for unloading oil. It takes about 24 to 28 hours to unload one of these tankers. Some of the crew told me that the return trip back to Valdez becomes significantly rougher given the same sea conditions, due to riding so much higher out of the water.

I truly enjoyed the trip as it was a real learning experience for me to see how marine conditions can vary on the open sea, especially the north Pacific. I appreciated the opportunity to sail with the crew of the S/S ARCO FAIRBANKS on this trip.⚓

Northeast Pacific Cooperative Drifter Program

Michael K. Burdette
National Data Buoy Center

United States and Canadian forecasters are continually challenged in their efforts to prepare accurate forecasts for the coastal areas of the Northeast Pacific. The Gulf of Alaska and the North Pacific are well known as areas for development and intensification of major storm systems which pose a moderate to severe threat to the coastal and land areas of the U.S. and Canada. Although the Northeast Pacific is well served by U.S. and Canadian moored buoys and Voluntary Observing Ships, large expanses of ocean still exist where little meteorological information is available to forecasters.

This noted lack of meteorological observations, along with the associated risk, was severely felt on October 11, 1984, when an under-forecasted, rapidly deepening storm, a "marine bomb," struck the West Coast of Canada, resulting in the loss of seven fishing vessels and five lives. Subsequent investigation into the incident, known as the "Le Blonde Report," highlighted the importance of understanding the physics of rapidly deepening storms, and developing methods for early detection. One action addressing requirements identified in the report was to supplement the existing moored buoy networks on the west coast with drifting buoys that could measure needed parameters such as wind speed and direction, pressure, and sea state, as future developments allowed. Since that time, Environment Canada has attempted to maintain a network of 10-12 drifting buoys in the Northeast Pacific as an early warning network. The National Data Buoy Center (NDBC) has also deployed a few drifters in the area for other unrelated projects. Over the years, however, it has been difficult for Environment Canada to maintain the network with little or no assistance.

In 1997, the Atmospheric Environment Branch of Environment Canada contacted NDBC, recommending a joint effort to deploy and maintain a drifter array for three years. The resulting network would be larger, more reliable, and

Continued on Page 31

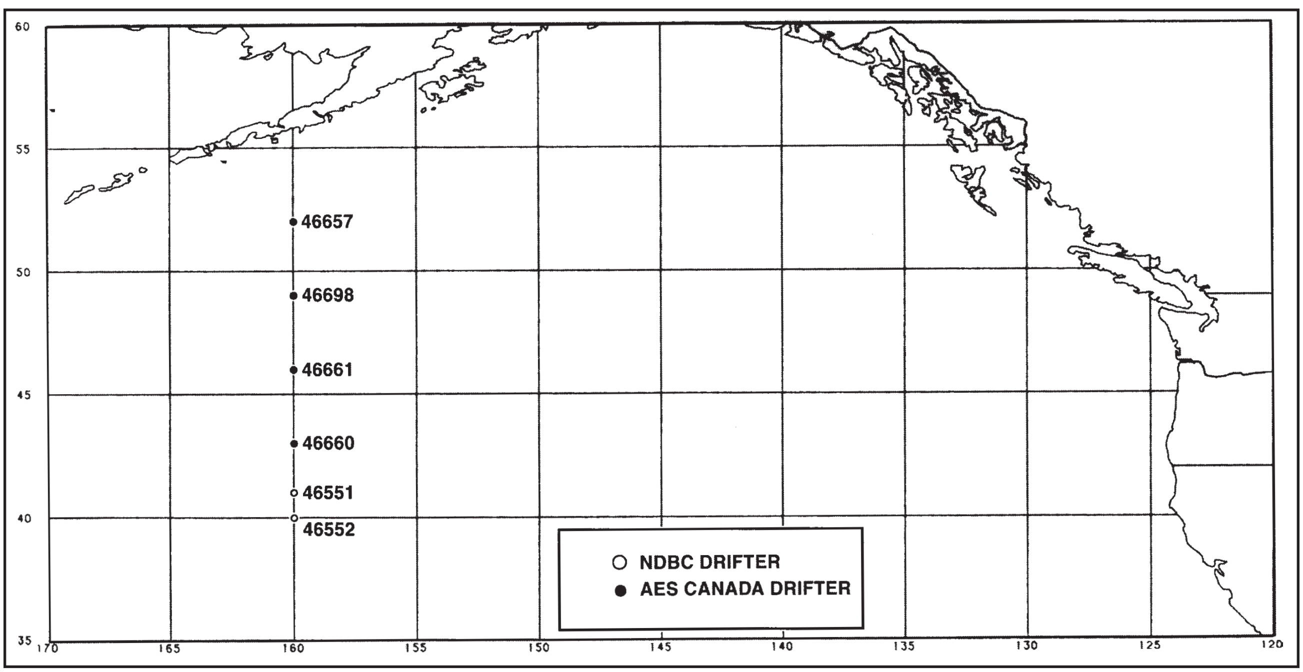
Drifter Program

Continued from Page 30

more valuable than either could support individually.

In September 1998, the first six deployments were successfully made. Drifters measuring wind speed and direction, barometric pressure, air temperature, sea temperature, and location were placed along 160W longitude, at 40N, 41N, 43N, 46N, 49N, and 52N latitudes. The buoys are expected to slowly drift towards the west coast of the U.S. and Canada over the next two years. They will report through the Polar Orbiting Environmental Satellites, with data being distributed through Service Argos to the Global Telecommunications System. Data will be available to all west coast forecasters on the SSVX08 header. Marine interests should note that the data will also be plotted on standard National Centers for Environmental Prediction (NCEP) Surface Analysis Charts. One important point to be kept in mind when analyzing the data is that the winds are measured at one meter above the sea surface and contain no adjustment to the standard 10-meter observation height. If not adjusted to 10-meter height for use, the data will show a low wind speed bias.

NDBC and Environment Canada are expecting to add additional buoys to the array over the next two years. As current buoys drift slowly towards the coastlines of the U.S. and Canada, additional buoys will be deployed behind them. The result will be a comprehensive buoy array stretching from 160W toward the coastlines in 1999 and 2000.⚓



Under the Northeast Pacific Cooperative Drifter Program, six drifting buoys were deployed in September 1998. This is a joint U.S. and Canadian effort. More buoys will be depoloyed over the next two years.

Marine Weather Review North Atlantic Area April—July 1998

George P. Bancroft
Meteorologist
Marine Prediction Center

Like the North Pacific, the North Atlantic experienced its most active weather early in April. A series of frontal waves moved east or southeast from near the Canadian Maritimes, into the base of a mean upper low (trough) southeast of Greenland and amplified. The strongest of these became an intense storm in the eastern Atlantic, dropping 31 mb in 24 hours from 12Z April 1 to 12Z April 2, therefore qualifying as a meteorological "bomb" (see Figure 1). In the second panel or part of Figure 1, the storm has almost finished deepening, and actually bottomed out at 954 mb at 18Z April 2. This was the most intense storm in the North Atlantic during this April to July period. Note the 60 kt west wind southwest of the center. It is conceivable that this storm produced hurricane force winds in the strongest portion of the storm. The third panel of Figure 1 shows the storm slowing. The system subsequently became stationary over Great Britain, increasing in size and dominating much of the eastern North Atlantic until April 8. This storm developed seas of 16 ft or higher from Great Britain south to near 40N in the eastern North Atlantic, with a maximum of 43 ft (13 meters) in the Bay of Biscay on April 3.

Figure 1 also shows a change in the upper air pattern in the western Atlantic to a trough near the U.S. east coast which continued into June, supporting a series of lows moving off the east coast, while a ridge developed in the eastern North Atlantic. Split flow over the western North Atlantic and parts of North America was apparent during this period, with separate northern and southern jet streams, perhaps the remnants of El Niño. This also led to cutoff lows at southern latitudes. Figure 2 is an example from this period, showing a separate 500 mb northern stream sending short wave troughs east and northeast toward the Greenland area, with associated surface development. A low is moving off the east coast and a cutoff low is shown forming near 33N 35W, with developing gale conditions. East coast low pressure developments beginning late in April remained below storm strength. However, one long-lasting low, cut off at southern latitudes, off the Carolinas on May 11 remained for several days, resulting in a large area of north-

Continued on Page 35

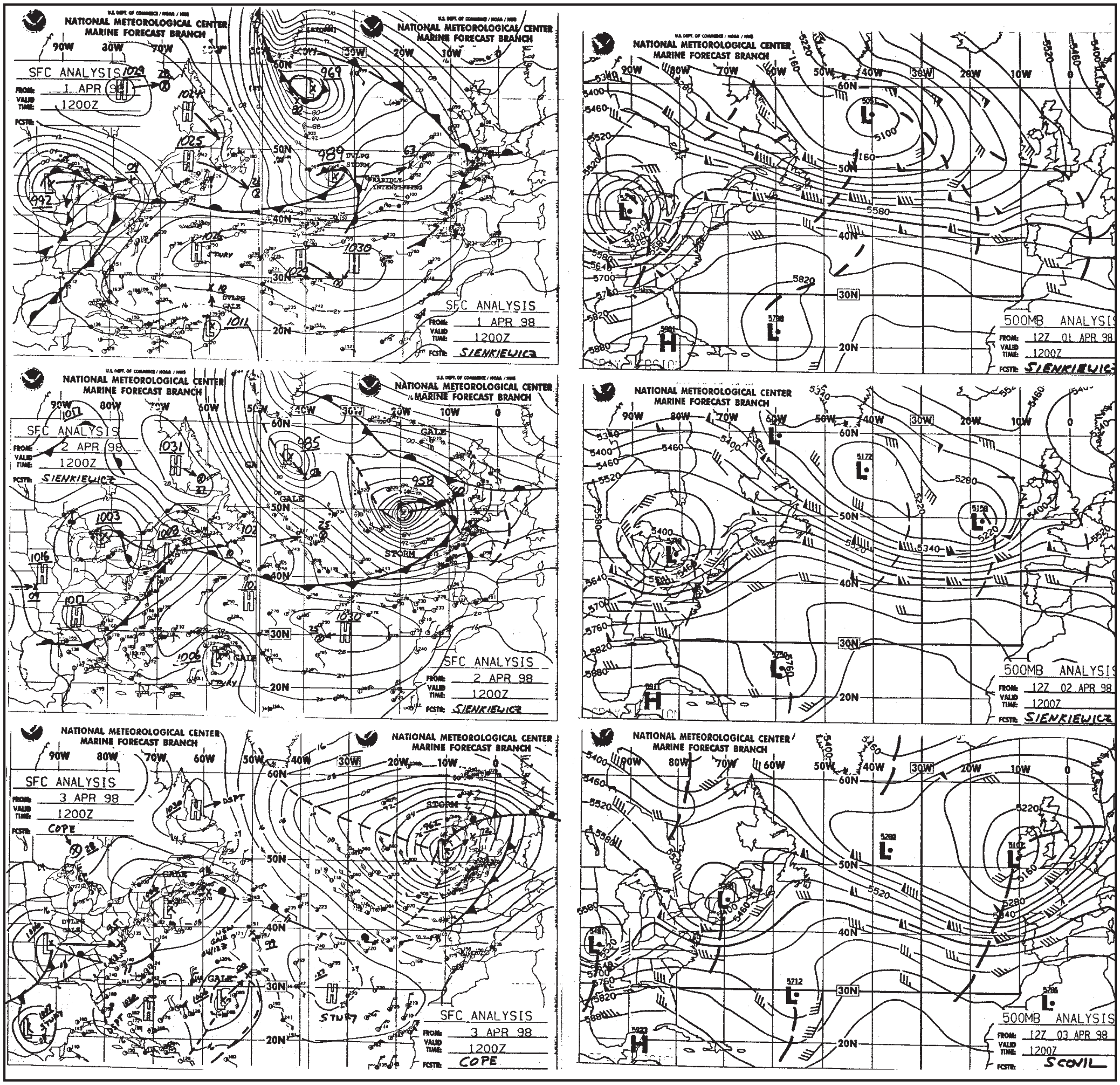


Figure 1. Three-panel display of surface and 500-mb analysis charts produced by the MPC for the dates April 1, 2, and 3, valid at 12Z, showing development of the most intense storm of the April to July 1998 period.

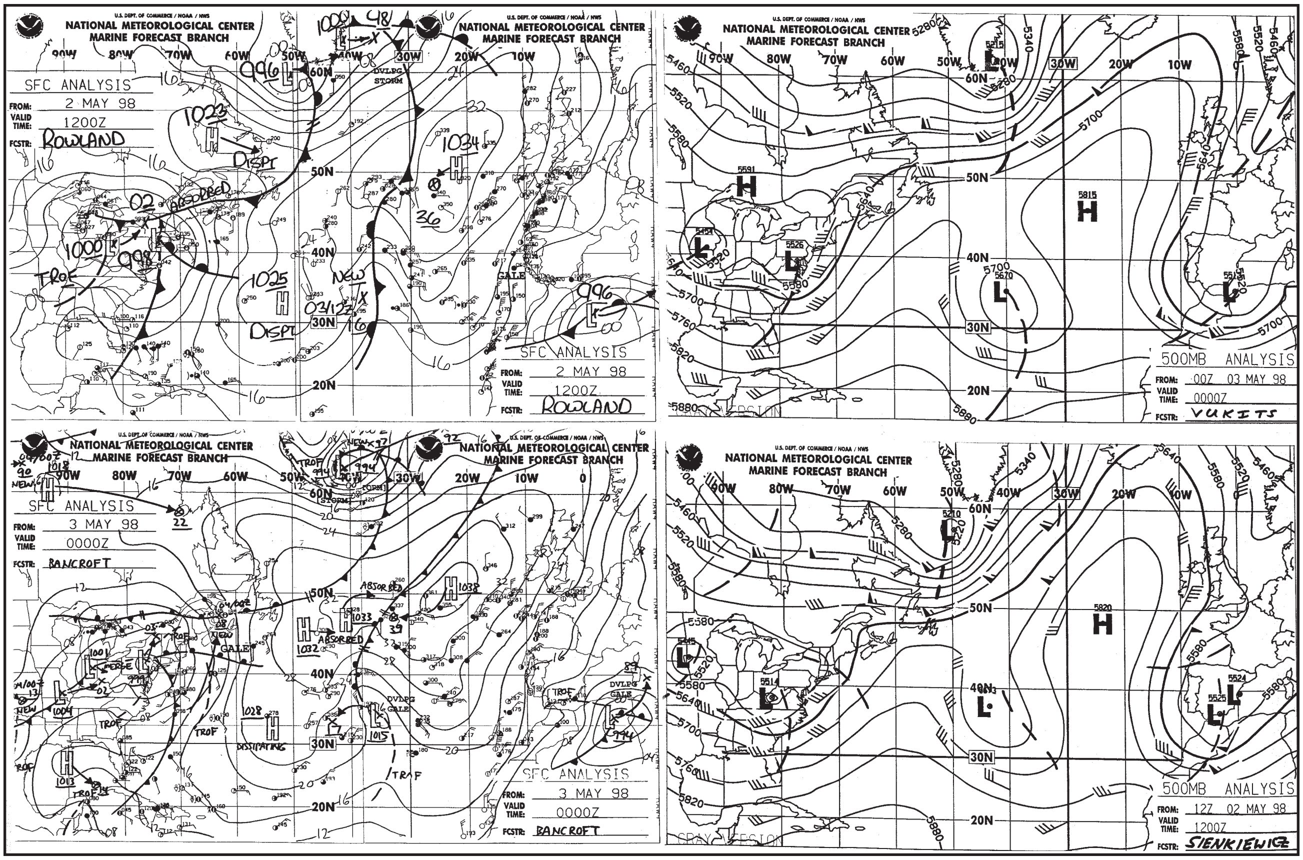


Figure 2. Two-panel display of surface analysis and corresponding 500-mb charts for 12Z May 2 and 00Z May 3, 1998, showing "split flow."

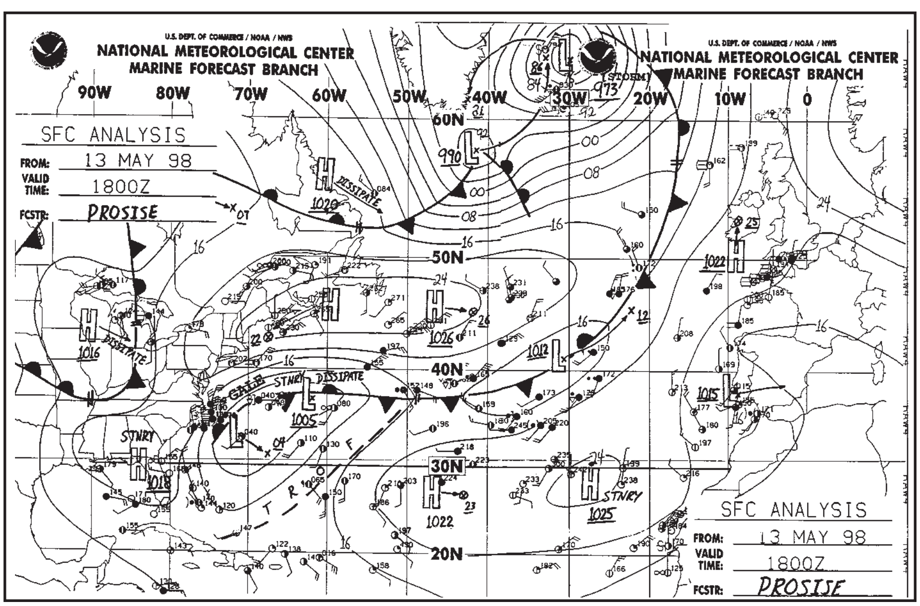


Figure 3. Surface analysis for 18Z May 13, 1998, showing a large cutoff low with gale winds off the east coast of the U.S.

North Atlantic Area

Continued from Page 32

east gales over the western and northern offshore waters (Figure 3). Highest reported seas were 16 to 23 ft (5 to 7 meters). This sytem started to weaken on the 15th, but took until the 18th of May to move out and pass east of Newfoundland.

By early June, a blocking area of higher pressure in the Greenland area resulted in slow moving systems out of the northeastern U.S. to the Canadian Maritimes with winds of gale strength or less. One of these moved slowly from New England on June 3 as a complex gale, taking a week to reach Great Britain. The blocking receded north by the middle of June, allowing systems to turn north toward the Labrador Sea. The strongest of these moved off the New England coast on June 27 and intensified. Figure 4 depicts this development over a period of 30 hours to a mature system with strong gales reported around the south, west, and north sides at 06Z June 29. This was the system closest to being a storm in MPC's portion of the North Atlantic during the June to July period, a time when cyclonic activity is approaching a minimum for the year.

Reference

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

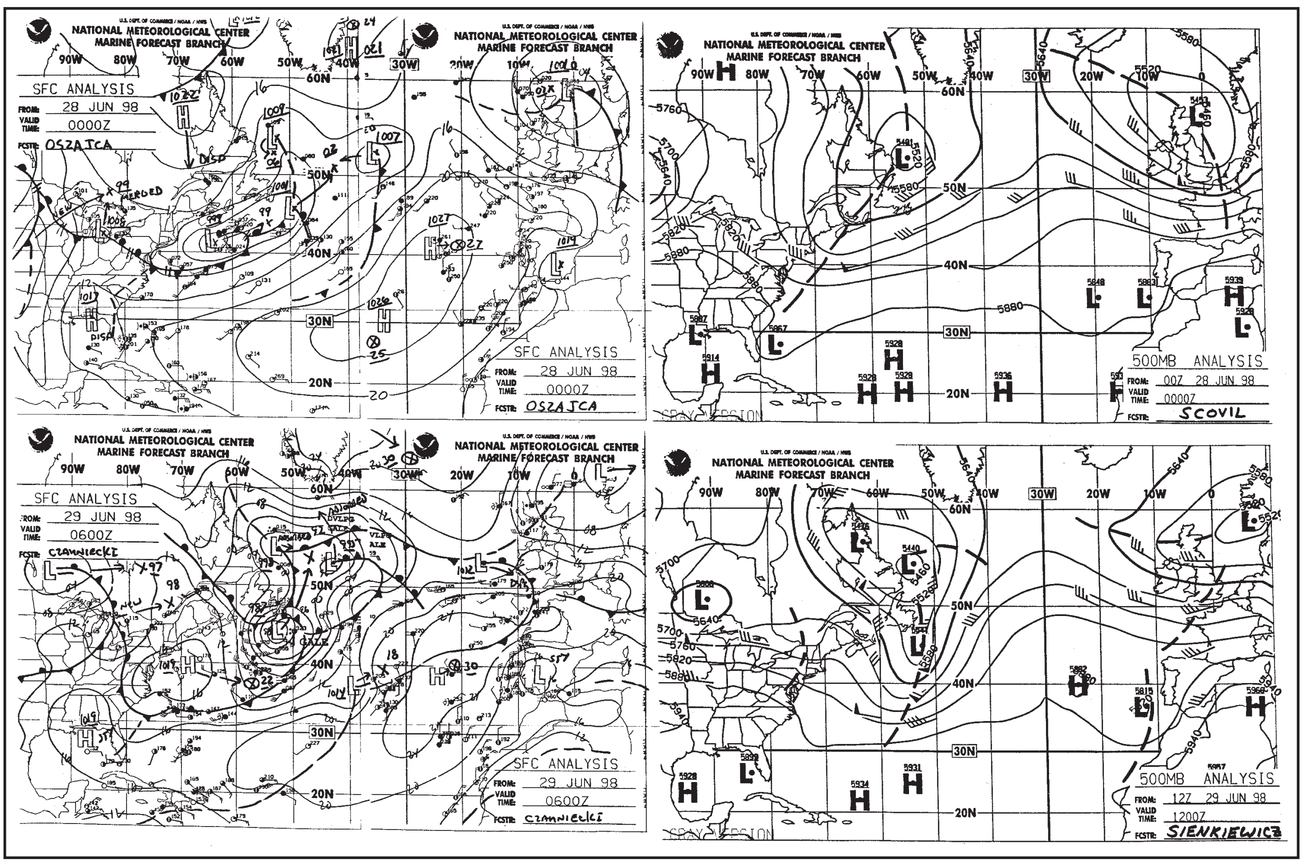


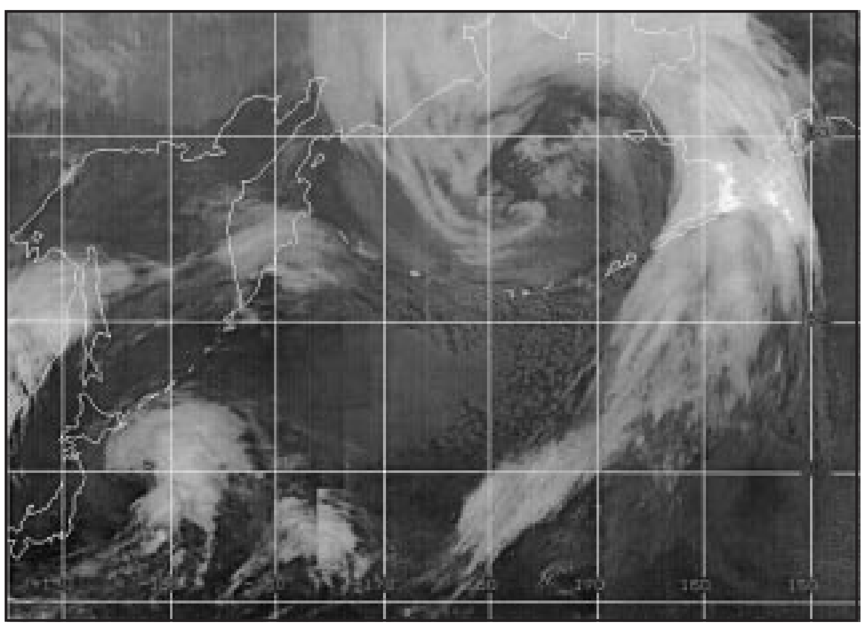
Figure 4. Two-panel display of surface and 500-mb analysis charts showing the development of a strong gale of June 28 at 00Z to June 29 at 06Z. The analysis time of 06Z was chosen for the second-panel surface analysis to show the system at maximum development.

Marine Weather Review North Pacific Area April—July 1998

George P. Bancroft
Meteorologist
Marine Prediction Center

The weather pattern over the North Pacific was unusually active in April and May, with developing lows frequently tracking from near Japan to the Bering Sea, with some of these passing or redeveloping south of the Alaska Peninsula. April began with a weakening gale, formerly a storm, in the northern Bering Sea, with residual swells reported in the 20 to 32 ft range (6 to 10 meters) around the eastern Aleutians both on the North Pacific and Bering sides. The ships at 54N 170W and 54N 163W both reported 32 ft seas (10 meters) and west winds of 40 kt. This system was soon replaced by a rapidly intensifying developing storm, depicted in the first panel

Continued on Page 40



GMS infrared satellite image of Bering Sea storm of April 9-10, 1998. Note the broad frontal cloud band with high (cold) tops northwest, north, and east of the storm center. The storm was near maximum intensity and centered near 58N 177W with 956 mb central pressure at the time of the image (2345 UTC 09 April 1998).

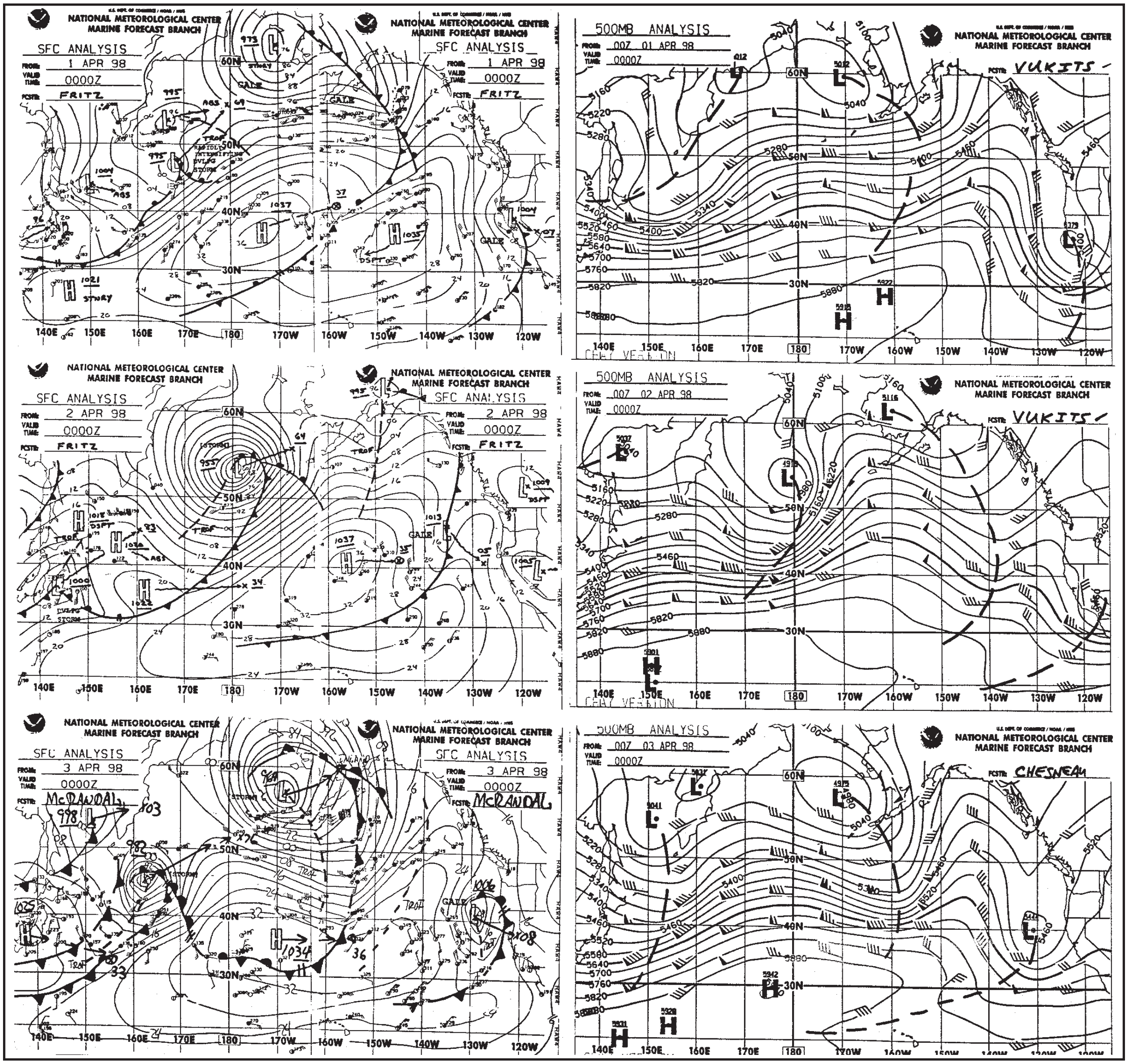


Figure 1. Three-panel display of surface and 500-mb analysis charts produced by MPC for the dates April 1, 2, and 3, 1998, with valid time 00Z.

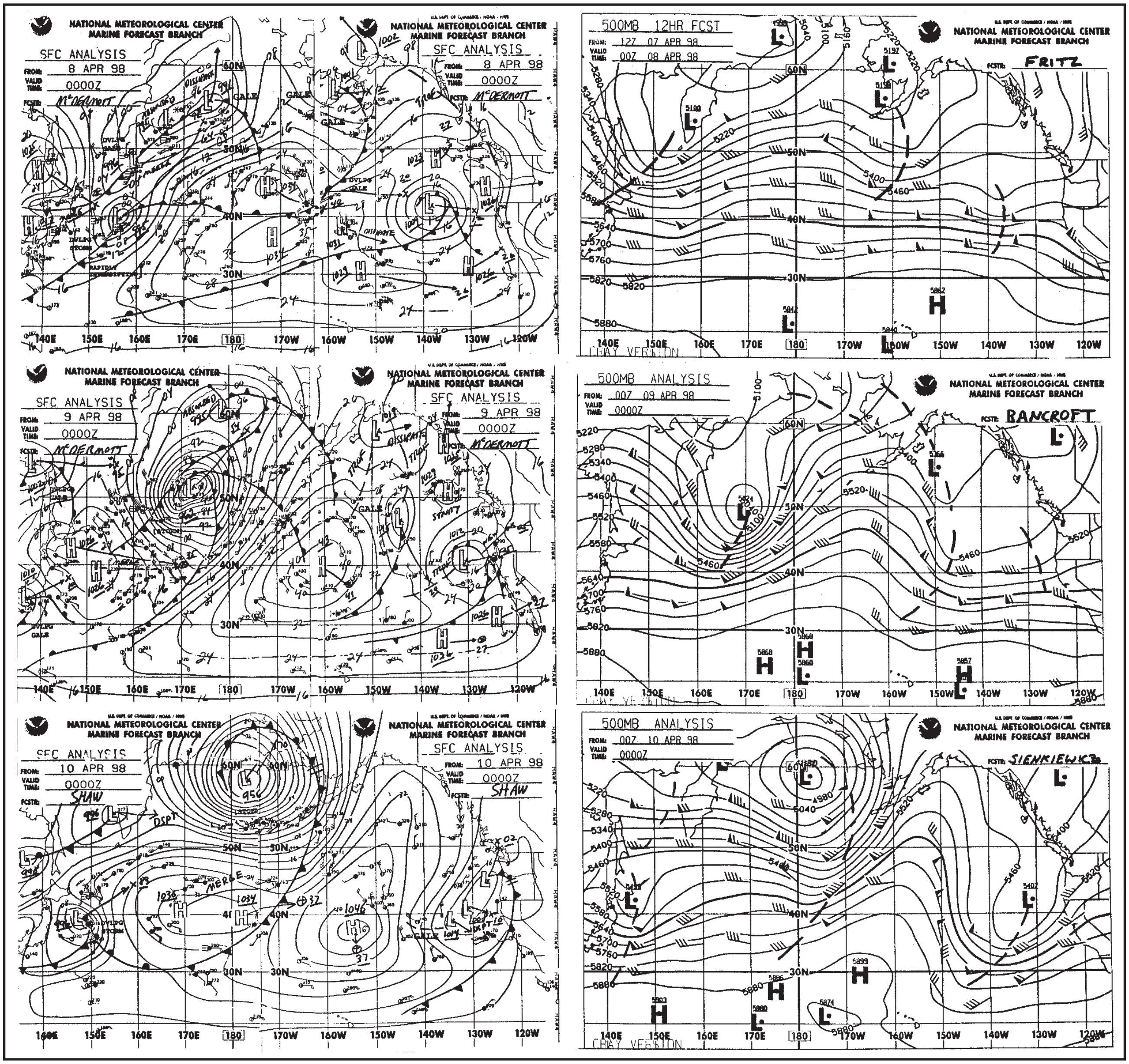


Figure 2. Three-panel display of surface and 500-mb analysis charts produced by MPC for the dated April 8, 9, and 10, 1998, with valid time 00Z. The 500-mb chart valid for 00Z April 8 is a 12-hour forecast from a computer model used in this case in lieu of a 500-mb.

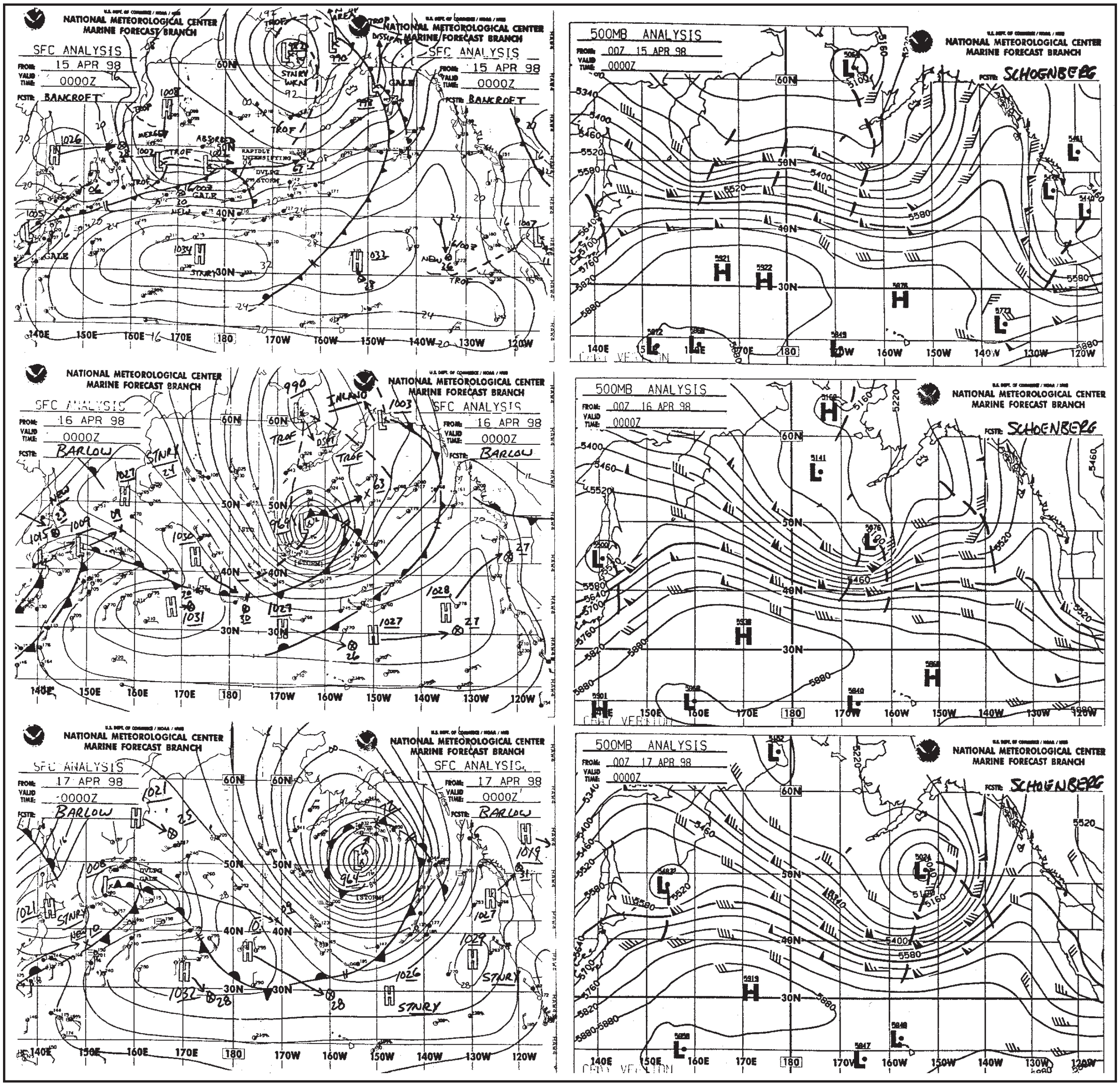


Figure 3. Three-panel display of surface and 500-mb analysis charts produced by the MPC for the dates April 15, 16, and 17, 1998, with valid time 00Z.

North Pacific Area

Continued from Page 36

of Figure 1, approaching the western Aleutians at the start of April. The second two panels of Figure 1 show intensification of a 500 mb low. Storm force winds were observed by 12Z April 1 ahead of the front south of the center near 50N 173E. Central pressure dropped from 995 mb at 00Z April 1 to 955 mb at 00Z April 2, bottoming out at 954 mb at 06Z April 2, with the center moving through the southern Bering Sea. A southwest wind of 60 kt was observed southeast of the center at 53N 176W along with 43 ft seas (13 meters). Note the ship reports in the third panel of Figure 1 with 45 to 60 kt in the southern Bering Sea at 00Z April 3. The ship at 54N 174W reported west winds 60 kt and also reported the highest seas in this event, 56 ft (17 meters). At 00Z April 2, buoy 46035 56N 178W reported an 8-minute average wind of NE 45 kt. By 00Z April 3, gale force winds and seas to 23 ft (7 meters) extended down to 42N south of the eastern Aleutians as this system started to weaken in the southeast Bering Sea.

A similar rapid development in the western Pacific occurred on April 8-10 as depicted in Figure 2. A storm developed 18 hours later near 50N 167E at 978 mb with a ship reporting NW 55 kt winds and 30 ft seas (9 meters) southwest of the center at 48N 163E (not shown). The storm center moved northeast and deepened to 958 mb by 18Z April 9. Winds of 45 to 60 kt and 33 to 50 ft seas (10 to 15 meters) were reported from ships around the central and eastern Aleutians and southwest Gulf of Alaska on April 9. The third panel of Figure 2 shows the system near maximum intensity at 00Z April 10. By 18Z April 10, the system was weakening to a

Continued on Page 41

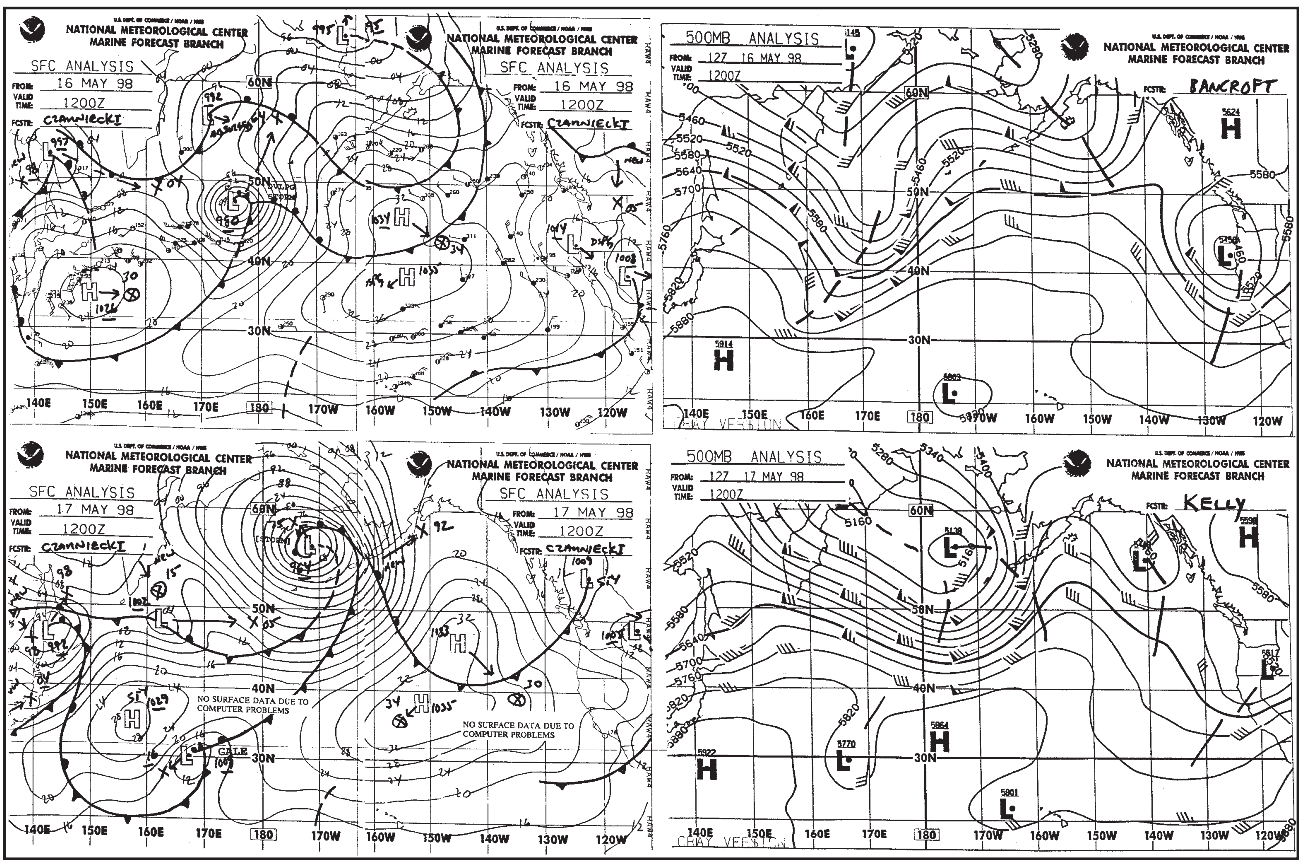


Figure 4. Two-panel display of surface and 500-mb analysis charts valid May 16 and 17, 1998, at 12Z.

North Pacific Area

Continued from Page 40

gale in the northern Bering Sea, but a ship south of the center was still reporting a SW wind of 45 kt and 52 ft seas (16 meters).

In mid-April the only storm of the month to move into the northeast Pacific and pass south of the eastern Aleutians developed from a frontal wave south of the western Aleutians on the 14th near 47N 174E. The storm developed rapidly by 18Z on the 15th near 47N 169W, with a pressure of 975 mb. Figure 3 shows this development. At 00Z April 17, ship reports show winds of 45 to 55 kt south of the center, and seas were 23 to 36 ft (7 to 11 meters). The lowest pressure was 958 mb six hours before map time of the third panel of Figure 3. The center then drifted northeast into the Gulf of Alaska and weakened on the 18th, while secondary development on a front southwest of the old system subsequently spun up another storm near 48N 145W, although not as strong (976 mb at 06Z April 20).

Subsequent storm development occurred in the northwest Pacific late in April and into May, with systems tracking northeast into the Bering Sea. The strongest of these is shown in Figure 4 as northern and southern systems combine to form a storm, unusually intense for May, in the southeast Bering Sea by 12Z on May 17. Ship reports showed 50 kt winds near the eastern Aleutians at 00Z May 17 (not shown) and seas up to 25 ft (8 meters) in the eastern Bering Sea on May 17th and 18th. This was the last system of the 1997-98 fall-winter-spring period with storm force winds in MPC's North Pacific area.

In June, lows tracked east along the latitude of Japan then turned northeast toward the eastern Aleutians and western Gulf of Alaska, blocked by an upper ridge over the eastern Pacific. The strongest of these intensified to 975 mb as it moved north to the Alaska Peninsula and developed winds of 35 to 45 kt and seas 20 to 25 ft (6 to 8 meters) on June 7-8. See Figure 5. The north portion of

Continued on Page 42

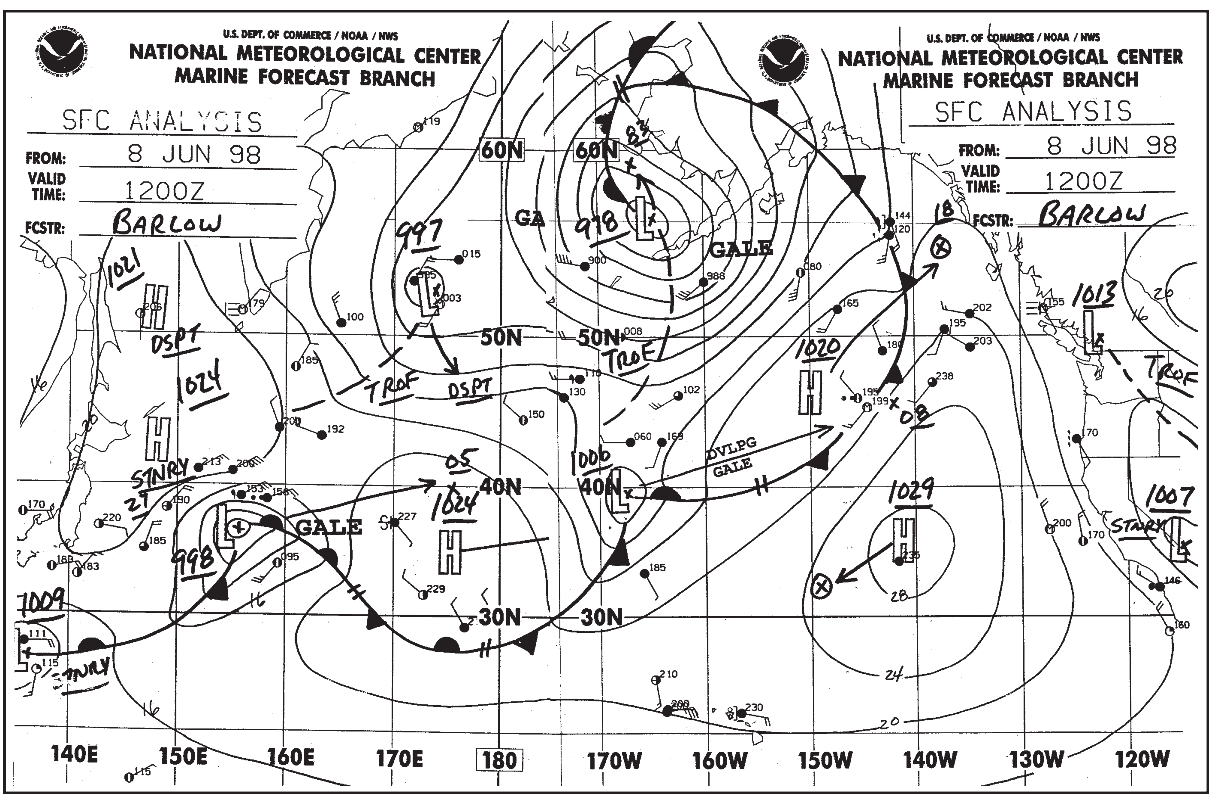


Figure 5. Surface analysis valid at 12Z June 8, 1998.

North Pacific Area

Continued from Page 41

the upper ridge weakened in mid-June, allowing lows to move into the eastern Gulf of Alaska. By June's end, cyclonic activity weakened and much of the North Pacific was dominated by high pressure.

In July, the eastern Pacific ridge shifted west and allowed the westerlies to shift unusually far south for July off the west coast of North America. A series of lows moved from well west of northern California to the coast near Vancouver Island. The first panel of Figure 6 shows the pattern, a deep trough aloft over the north-east Pacific. The strong short wave trough approaching the coast is associated with the gale center approaching the British Columbia coast (second panel of Figure 6) with 40 kt south winds reported in the Vancouver Island and Washington offshore waters. Around this time, another deep upper trough was near Japan and supported the development of the deepest low of July on a front off Japan. The low deepened briefly to 984 mb when over the warm Kuroshio Current (third panel of Figure 6) before moving north toward the Kamchatka Peninsula and weakening.

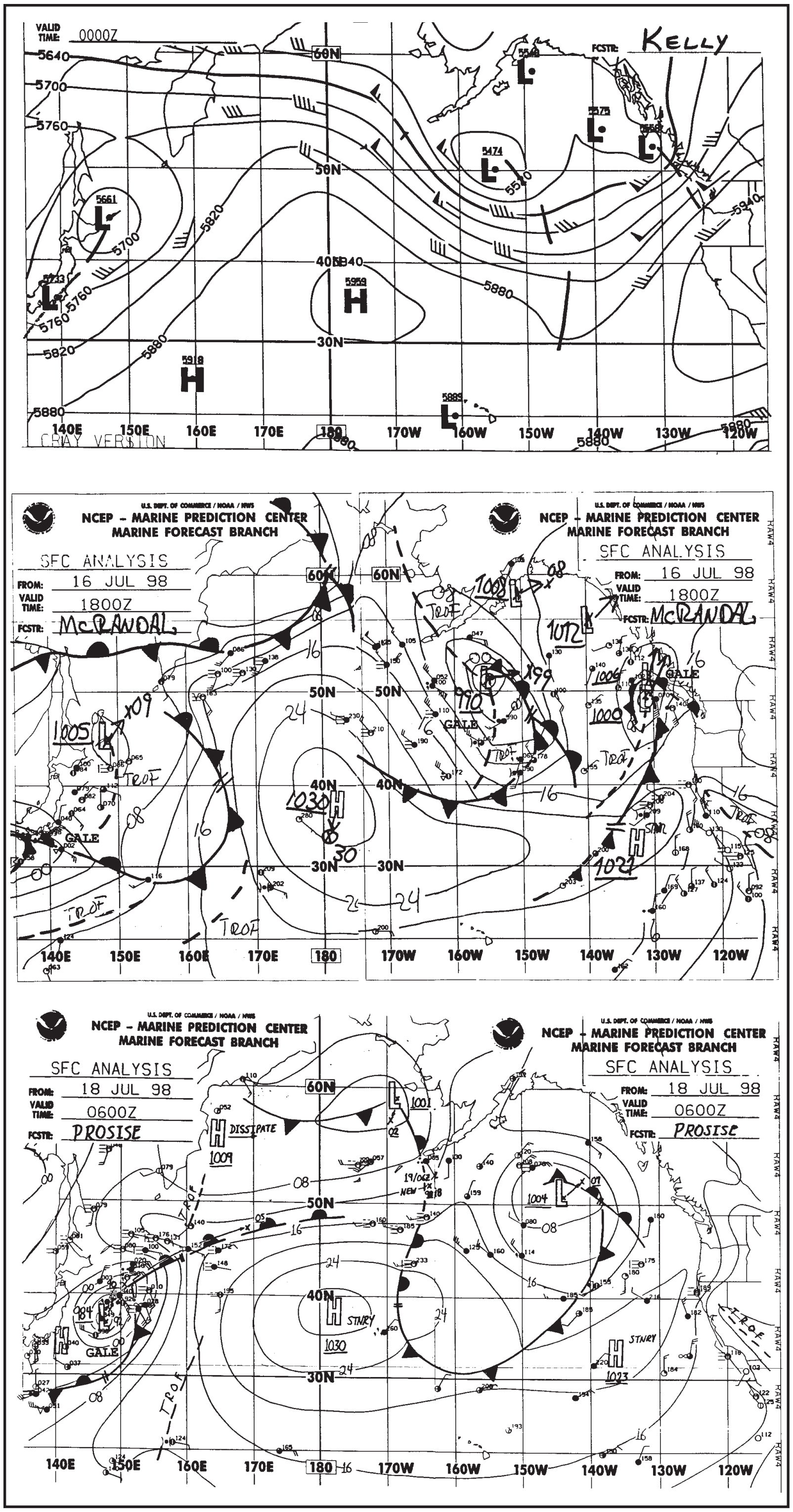


Figure 6. A 500-mb analysis valid at 00Z July 17, 1998, plus a surface analysis valid six hours prior to this time, and a third chart which is a surface analysis valid at 06Z July 18, 1998, showing significant July weather events.

Reference

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

Marine Weather Review
Tropical Atlantic and Tropical East Pacific Areas
May—August 1998

Dr. Jack Beven
Andrew R. Shashy
Tropical Prediction Center
Tropical Analysis and Forecast Branch
Miami, Florida

I. Introduction

A combination of a waning El Niño and the normal northward movement of the jet stream ended the series of strong winter storms in the TPC area. The Atlantic and Eastern Pacific Hurricane seasons both started slowly; however, by the end of August, both basins were showing near normal activity.

II. Ship Encounters with Tropical Cyclones

Ships generally avoid tropical cyclones, especially the central core region. Forecasts and warnings transmitted by radio facsimile and the International SafetyNET service usually enable ships to take evasive action long before encountering the storms. However, ships occasionally wind up in the core of a tropical cyclone. The greatest example of this occurred on 18 August 1927, when a ship measured an 887 mb pressure in a western Pacific typhoon. This is apparently a record low pressure measured by a ship. All lower pressures in tropical cyclones have been measured by reconnaissance aircraft.

A more recent example was on 6-7 September 1995, when the TEAL ARROW sailed into the eye of Atlantic Hurricane Luis. The ship reported a minimum pressure of 942 mb at 1800 UTC 6 September, which was very close to that reported by aircraft. It estimated 125 kt wind gusts and 50 ft seas as it passed through the eyewall.

Another example occurred on 25 August 1998, when the BRITISH HAWK sailed through the center of Hurricane Bonnie (Table 1). The ship reported maximum sustained winds of 75 kt at 1200 UTC, with a minimum pressure of 965.8 mb three hours later. The data suggest the ship was inside Bonnie's large and poorly defined eye. However, no maximum wind or minimum pressure data is available between the observations. Maximum combined seas reported by the ship were 33 ft at 1800 UTC.

If a ship does encounter the core of a tropical cyclone, the crew should try to document the encounter as best as possible. The TPC normally asks for three hourly ship reports within 300 nm of a tropical cyclone. However, a ship in the core should try to report every hour to provide the TPC (or other warning centers) with the best possible information. Peak conditions between reports

Continued on Page 44

Time (UTC)	Lat. (^{O}N)	Lon. (^{O}W)	Wind Dir./ Speed (kt)	Pressure (mb)
0900	29.7	74.7	050/60	997.7
1200	29.7	74.9	060/75	980.3
1500	29.2	75.3	290/50	965.8
1800	29.1	74.9	200/70	991.0
2100	29.3	74.2	180/50	1001.9

Table 1. Meteorological data reported by the BRITISH HAWK during its encounter with Hurricane Bonnie, August 25, 1998.

Tropical Prediction Center

Continued from Page 43

should be noted in plain language remarks whenever possible. If such observations are not possible, the ships' Captain or weather observer could mail the TPC (or other warning centers) a log of the observations after the fact. This would prove useful in the TPC's post-analysis of the storm.

Continued on Page 45

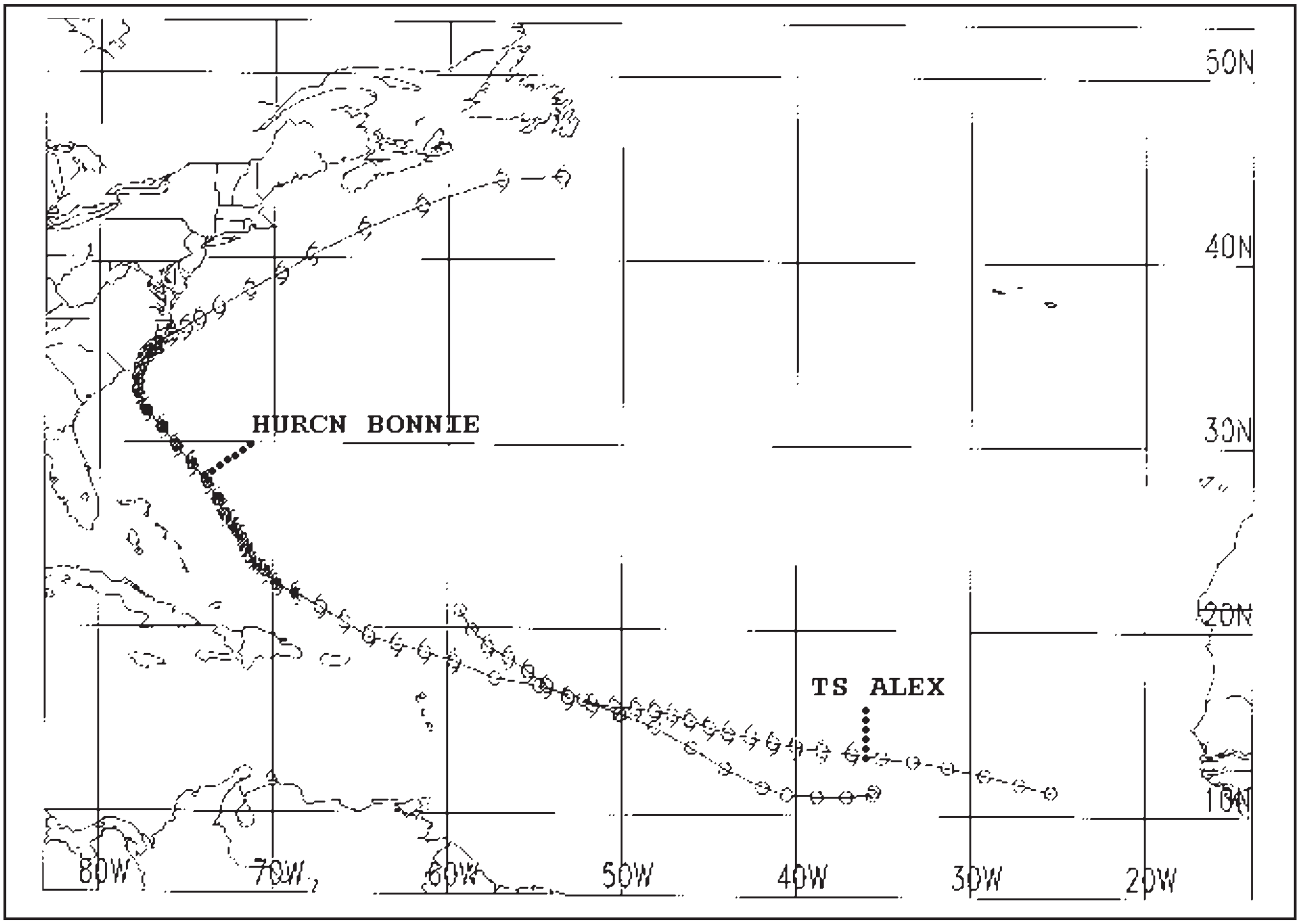


Figure 1. Preliminary tracks for Tropical Storm Alex and Hurricane Bonnie. Open circles represent tropical disturbance or tropical depression phase. Open symbols are tropical storm phase, while shaded symbols are hurricane phase.

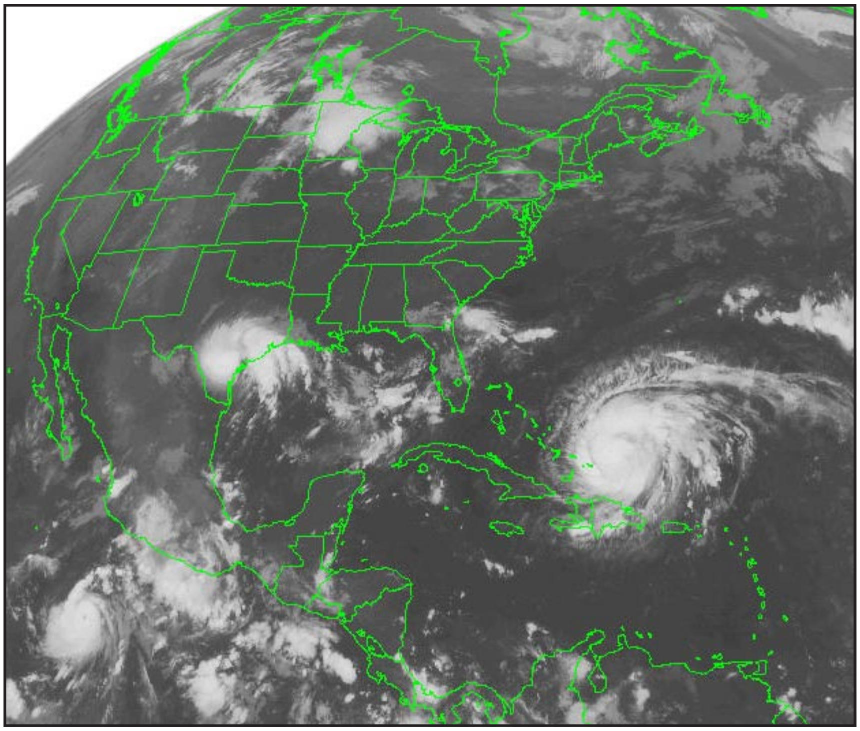


Figure 2. GOES-8 infrared image at 1215 UTC 22 August. Hurricane Bonnie is near the southeastern Bahamas, while Tropical Storm charley is making landfall in Texas. Hurricane Howard is intensifying in the Pacific. Image courtesy of the National Climatic Data Center.

Tropical Prediction Center
Continued from Page 44

III. Significant Weather of the Period

A. Tropical Cyclones: The Atlantic produced two hurricanes and three other tropical storms during the May-August period, with the third storm (Earl) reaching hurricane strength in September. The Eastern Pacific produced eight named storms, of which five reached hurricane strength. There was also one Eastern Pacific tropical depression.

All information on the storms is preliminary and all times are UTC.

1. Atlantic

Tropical Storm Alex: A tropical wave moved off the African coast on 26 July (Figure 1). It became Tropical Depression One near 12N 27W the next day. Moving generally west, the cyclone reached tropical storm strength early on 29 July. Alex continued generally west through 31 July, then turned west-northwest on 1 August. An unfavorable environment limited strengthening, and Alex reached a peak intensity of 45 kt during the 30 July-1 August period. Steady weakening then occurred, and Alex dissipated near 21N 60W late on 2 August. Alex never affected land during its life, and most ships avoided the cyclone. However, ship FNPH (FORT DESAIX) reported 64 kt winds (believed to be convective gusts) north of the center at 1800 UTC 1 August. Ships ELLE9 (CAPE HORN), 3ENX9 (ROYAL STAR), and ELVV2 (name unknown) encountered Alex just as it was developing, and their observations were invaluable in determining that a depression had formed.

Hurricane Bonnie: A large tropical wave gradually organized over the eastern and central tropical Atlantic in mid-July. It became Tropical Depression Two near 16N 51W on 19 August (Figure 1). Moving rapidly west-northwest, the system reached tropical storm strength just northeast of the Leeward Islands on 20 August. Bonnie continued a slower west-northwest track on 21-22 August, with the storm reaching hurricane strength on 22 August (Figure 2). The hurricane slowed to an erratic northwest drift on 23-24 August while just east of the Bahama Islands. It reached its peak intensity of 100 kt on 24 August and maintained this intensity until it made landfall. A north-northwest motion developed on 25 August, with a turn to the north on 26 August. This brought Bonnie's center to the North Carolina coast at Cape Fear late on 26 August.

Bonnie slowed again as it made landfall and turned northeast. It

Continued on Page 46

Tropical Prediction Center

Continued from Page 45

was not until early on 28 August that the center moved back into the Atlantic near Manteo, North Carolina. Bonnie weakened to a tropical storm over land, but regained minimal hurricane strength as it moved offshore. Slow weakening occurred as Bonnie moved generally northeast, with the storm passing just south of Sable Island early on 30 August. Bonnie became extratropical later that day near 45N 52W.

Bonnie's large circulation affected the Leeward Islands, the Virgin Islands, Puerto Rico, the Bahamas, and the eastern parts of North and South Carolina. It also affected many ships, buoys, and automated stations besides the BRITISH HAWK. The Coastal Marine Automated Network (C-MAN) station at Frying Pan Shoals, North Carolina, reported a 10-minute average wind of 76 kt, with a gust to 90 kt between 2000-2100 UTC 26 August. The station reported a minimum pressure of 964.6 mb at 1700 UTC. The SABRINA reported 60 kt winds with 75 kt gusts on 26 August, along with 23-26 ft seas. An oil rig near Sable Island reported 65 kt winds above the surface at 0300 UTC 30 August. Finally, a reconnaissance plane reported a 954 mb central pressure at 0151 UTC 24 August.

Bonnie is blamed for three deaths at this time. Damage figures are still incomplete, but may be in the hundreds of millions of dollars.

Bonnie was one of the most researched hurricanes in history. Five NOAA and NASA research planes flew experimental missions in and around the storm. They were aided by the NASA Tropical Rainfall Measuring Mission (TRMM) satellite.

Tropical Storm Charley: A tropical wave accompanied by a broad area of low pressure moved into the southeast Gulf of Mexico on 19 August. The low moved west-northwest and organized into a tropical depression near 26N 95W on 21 August (Figure 3). The depression continued west-northwest and became Tropical Storm Charley later that day. Charley steadily strengthened to a peak intensity of 50 kt as it made landfall on 22 August just north of Port Arkansas, Texas (Figure 2). The storm turned west and weakened to a low pressure area over south Texas later that day. While this was the end of Charley as a tropical cyclone, the remnant low continued to spread heavy rain through south Texas, causing severe flooding in Del Rio and elsewhere along the Rio Grande.

Oil Rig K7R8 reported 40 kt winds with gusts to 50 kt above the surface at 1647 UTC 21 August. Several additional reports of 40-60 kt gusts were received from the middle and upper Texas coast. Rockport, Texas, reported a 1000.7 mb pressure at 1053 UTC 22 August. There are no known ship reports of tropical storm-force winds.

Charley is blamed for 21 deaths, mainly due to the severe flooding around Del Rio.

Continued on Page 47

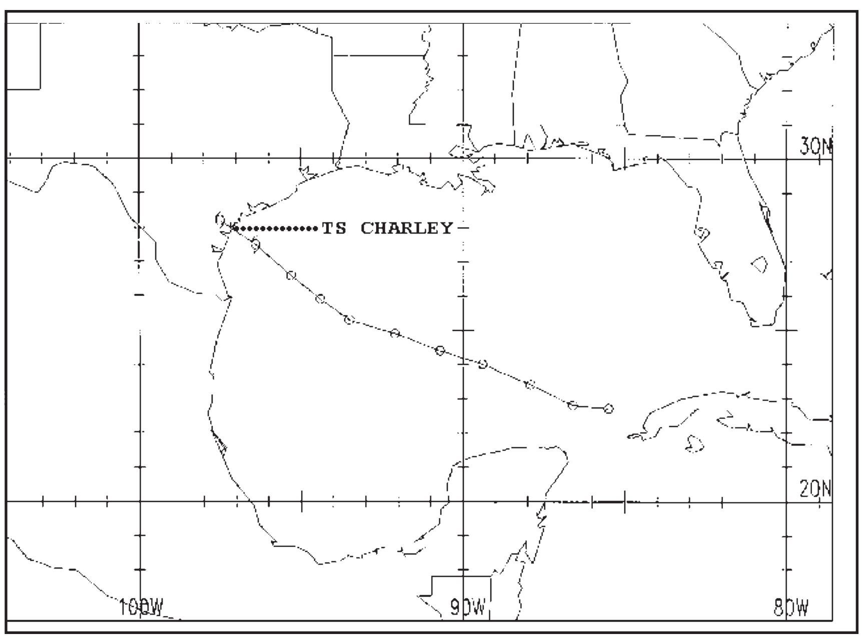


Figure 3. Preliminary track for Tropical Storm Charley. Open circles represent tropical disturbance or tropical depression phase. Open symbols represent tropical storm phase.

Tropical Prediction Center

Continued from Page 46

Hurricane Danielle: A tropical wave over the eastern Atlantic organized into Tropical Depression Four near 14N 37W on 24 August. The cyclone moved steadily west-northwest through 29 August. The depression reached tropical storm strength later on 24 August and hurricane strength the next day. A peak intensity of 90 kt was estimated from satellite imagery on 26 August. Danielle slowly weakened to a minimal hurricane by 30 August due to a combination of unfavorable upper level winds and cold water left in the wake of Bonnie. Later on 30-31 August, Danielle gradually turned from a west-northwest to north-northeast track and re-intensified. At this time the storm was between the southeast United States and Bermuda (Figure 4).

Danielle was a smaller storm than its predecessor Bonnie, and ships generally avoided it during this period. The ship P3ZH4 (HYUNDAI TAKOMA) reported 35 kt winds at 0600 UTC 31 August.

Hurricane Earl: A tropical wave that moved off the African coast in mid-August moved into the southwest Gulf of Mexico on 30 August. An associated broad low pressure system organized into Tropical Depression Five near 22N 94W on 31 August, and became Tropical Storm Earl later that day (Figure 4).

Continued on Page 48

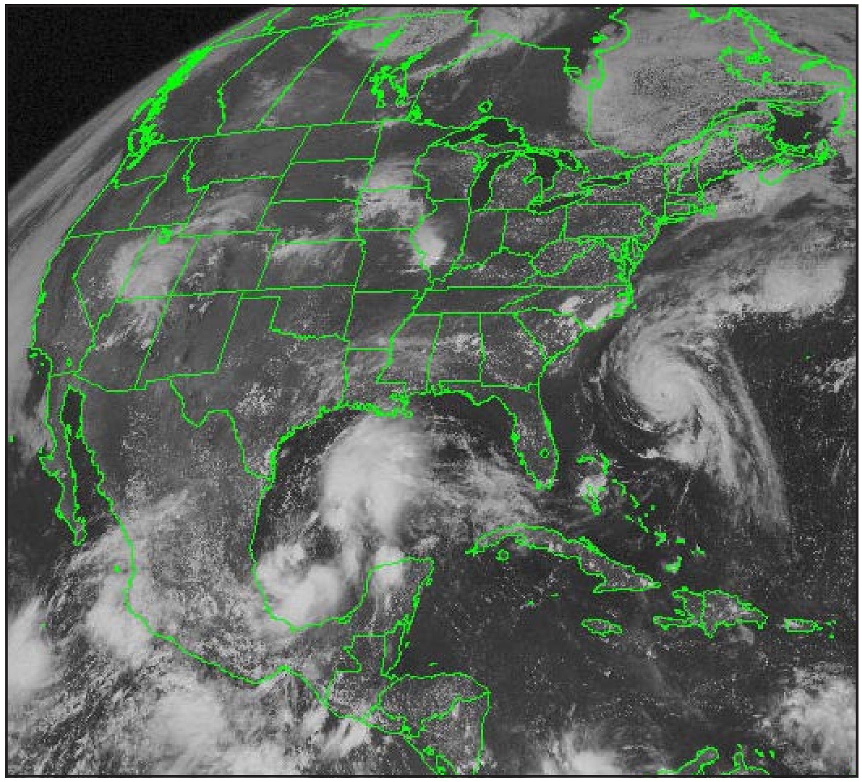


Figure 4. GOES-8 visible image at 1815 UTC 31 August. Hurricane Danielle is off the southeast U.S. coast. Tropical Storm Earl is developing over the Gulf of Mexico. The cyclone forming south of Baja, California, would become Hurricane Isis in September. Image courtesy of the National Climatic Data Center.

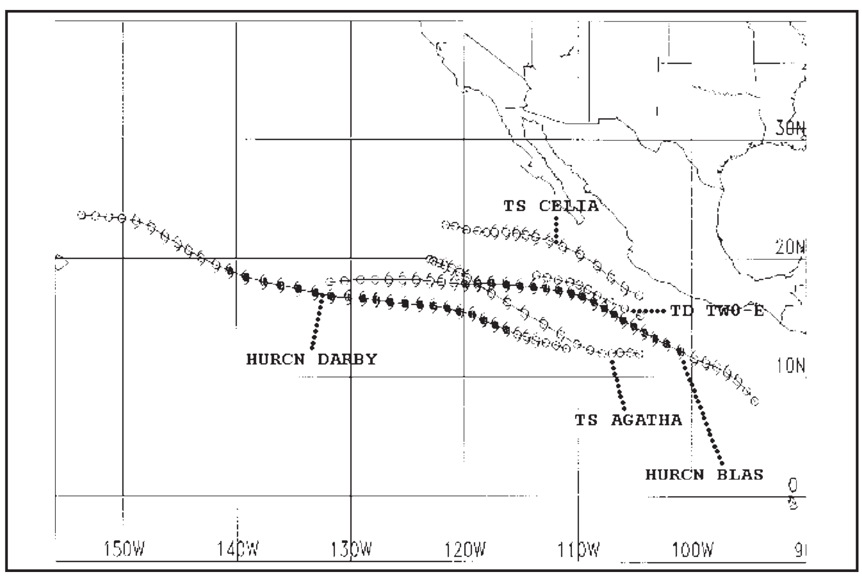


Figure 5. Preliminary tracks for Tropical Storm Agatha, Tropical Depression Two-E, Hurricane Blas, Tropical Storm Celia, and Hurricane Darby. Open circles represent tropical disturbance or tropical depression phase. Open symbols are tropical storm phase, while shaded symbols are hurricane phase.

Tropical Prediction Center

Continued from Page 47

2. Eastern Pacific

Tropical Storm Agatha: A tropical wave crossed Central America on 7-8 June. This system slowly organized into Tropical Depression One-E near 12N 105W on 11 June (Figure 5). Further strengthening was slow, and the cyclone did not reach tropical storm strength until 13 June. Agatha reached a peak intensity of 55 kt on 14 June, then steadily weakened until it dissipated near 20N 123W on 16 June.

Agatha was far from land, and no known ships encountered the storm.

Tropical Depression Two-E: Tropical Depression Two-E formed near 15N 106W on 19 June (Figure 5). The cyclone followed a general west-northwest track until it dissipated near 19N 114W on 22 June. Maximum sustained winds were estimated at 30 kt.

Hurricane Blas: A tropical wave caused increasing convection off the Pacific coast of Central America on 19 June. The activity gradually organized and became Tropical Depression Three-E near 8N 95W early on 22 June (Figure 5). Moving generally west-northwest to northwest, the cyclone reached tropical storm strength later that day and hurricane strength the next day. Blas continued strengthening to a peak intensity of 120 kt on 25 June. Weakening started on 26 June as Blas turned west, and Blas was downgraded to a tropical storm by 28 June. The cyclone dissipated near 18N 132W on 30 June, with the residual low cloud swirl continuing west to south of the Hawaiian Islands by 5 July.

Ships avoided Blas, so there are no reports of tropical storm-force or greater winds. Blas may have indirectly enhanced rainfall over southern Mexico which led to mudslides that caused four deaths.

Tropical Storm Celia: A tropical wave spawned a tropical disturbance south of the Gulf of Tehuantepec on 13 July. The disturbance tracked west-northwest with little development for the next three days. It became better organized on 17 July, and it became a tropical depression near 17N 105W early that day. The cyclone reached tropical storm strength later that day. Celia turned west on 19 July as it reached a peak intensity of 50 kt. Weakening occurred after that, and Celia dissipated near 23N 122W on 21 July.

Several ships were caught between Celia and the Mexican coast. Ship KGTI (GREEN LAKE) reported 45 kt winds at 1200 UTC 17 July, which was the basis for naming Celia. Ship 4XGX (ZIK ISRAEL) reported 50 kt winds at 1700 UTC that day.

Hurricane Darby: A tropical wave started showing increased organization south of Acapulco on 19 July. Further development was slow, with the disturbance becoming a tropical depression early on 23 July near 12N 111W. This system would follow a general west to west-northwest track during its lifetime. The cyclone reached tropical storm strength later on 23 July and hurricane strength on 24 July. Darby twice reached a peak intensity of 100 kt, first on 25 July then from 26-28 July. The hurricane weakened to a tropical storm as it crossed into the Central Pacific Hurricane Center's area of responsibility on 29 July. Further weakening occurred, and Darby dissipated on 1 August near 24N 154W.

Darby was far from land and no known ships encountered the storm.

Hurricane Estelle: Tropical Depression Six-E formed near 15N 101W on 29 July. The depression moved west and reached tropical storm strength the next day. Estelle reached hurricane strength on 31 July while continuing west through 1 August. A peak intensity of 115 kt and a turn to the west-northwest occurred on 2 August. A turn back to the west took place on 4 August as Estelle weakened to a tropical storm. Estelle weakened to a depression the next day, and the system dissipated over the Central Pacific near 23N 149W on 8 August.

Estelle remained far from land and there are no reports of damage or casualties.

Continued on Page 49

Tropical Prediction Center

Continued from Page 48

Tropical Storm Frank: A persistent area of disturbed weather associated with a tropical wave organized into a tropical depression near 17N 112W on 6 August. The depression moved generally north and reached tropical storm strength on 8 August. Frank reached a peak intensity of 40 kt early on 9 August just west of Baja California. The storm weakened and turned northwest later that day. It dissipated near 29N 117W on 10 August.

Ship C6LF9 (DOMINICA) reported 30-35 kt winds on 8-9 August, which was the basis for upgrading the depression to a tropical storm. Frank affected southern and central Baja California and the adjacent Gulf of California with locally gusty winds and heavy rains. There are no reports of damage or casualties at this time.

Hurricane Georgette: Tropical Depression Eight-E formed near 12N 110W on 11 August. Moving west-northwest, the cyclone reached tropical storm strength later that day. Georgette followed a general west-northwest to northwest track for the rest of its life. The storm reached hurricane strength on 12 August and a peak intensity of 100 kt on 14 August. Steady weakening then developed, with Georgette becoming a tropical storm and then a depression on 16 August. The system dissipated early on 17 August near 25N 127W.

Ship KGTI (GREEN LAKE) reported 35 kt winds at 0600 UTC 14 August. It and several other ships encountered large swells (up to 24 ft) generated by Georgette. There are no reports of damage or casualties at this time.

Hurricane Howard: Tropical Depression Nine-E formed near 11N 97W on 20 August. Moving west-northwest, the cyclone reached both tropical storm and hurricane strength the next day. Howard continued west-northwest as it strengthened to a peak intensity of 130 kt on 23 August. After a slight weakening, Howard reached a secondary peak intensity of 115 kt while turning west on 25 August. The hurricane turned west-northwest and weakened on 27 August. It fell to tropical storm status on 28 August and tropical depression status on 29 August. Howard dissipated on 30 August near 20N 134W.

An unidentified ship reported 40 kt winds and a 1005 mb pressure at 0000 UTC 21 August. There are no reports of damage or casualties at this time.

B. Other Significant Events: A complex low pressure system centered north of the TPC area of responsibility affected the Atlantic north of 25N and west of 50W between 9-16 May. The lows produced 20-30 kt winds and 8-13 ft seas across this region.⚓

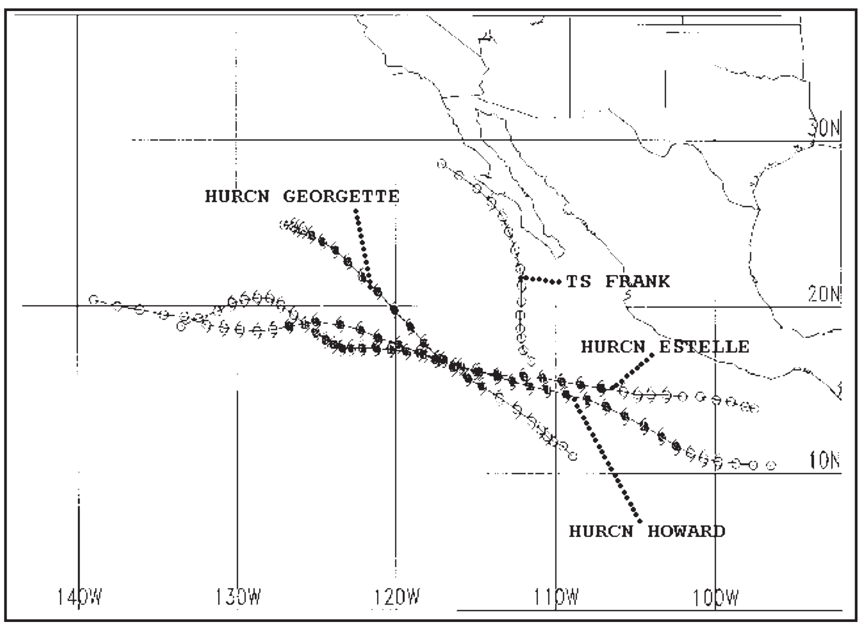
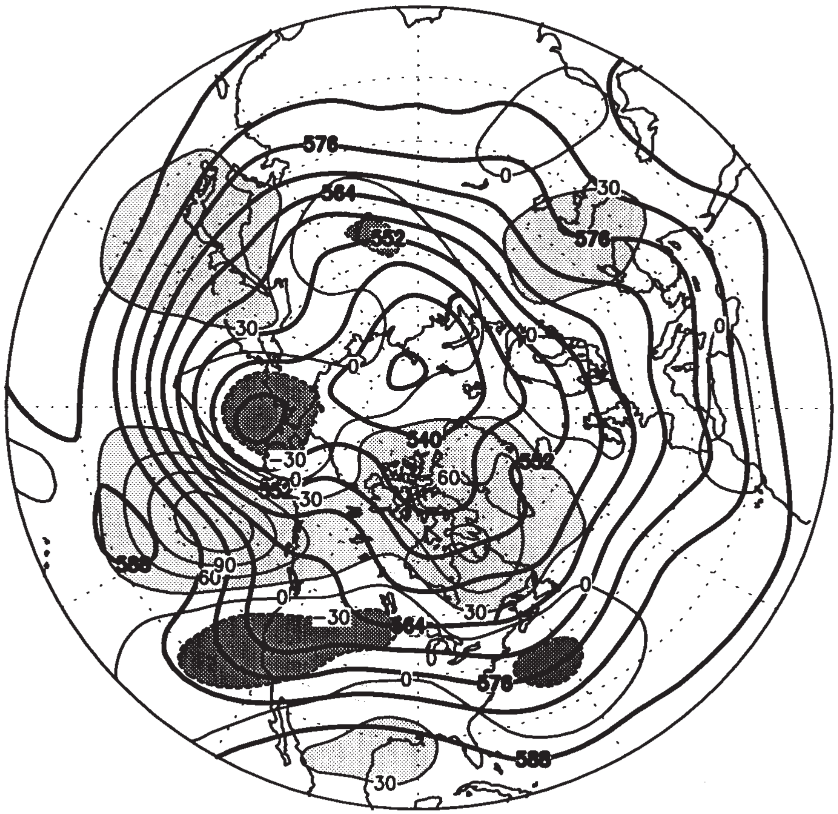


Figure 6. Preliminary tracks for Hurricane Estelle, Tropical Storm Fran, Hurricane Georgette, and Hurricane Howard. Open circles represent tropical disturbance or tropical depression phase. Open symbols are tropical storm phase, while shaded symbols are hurricane phase.

May–June 1998

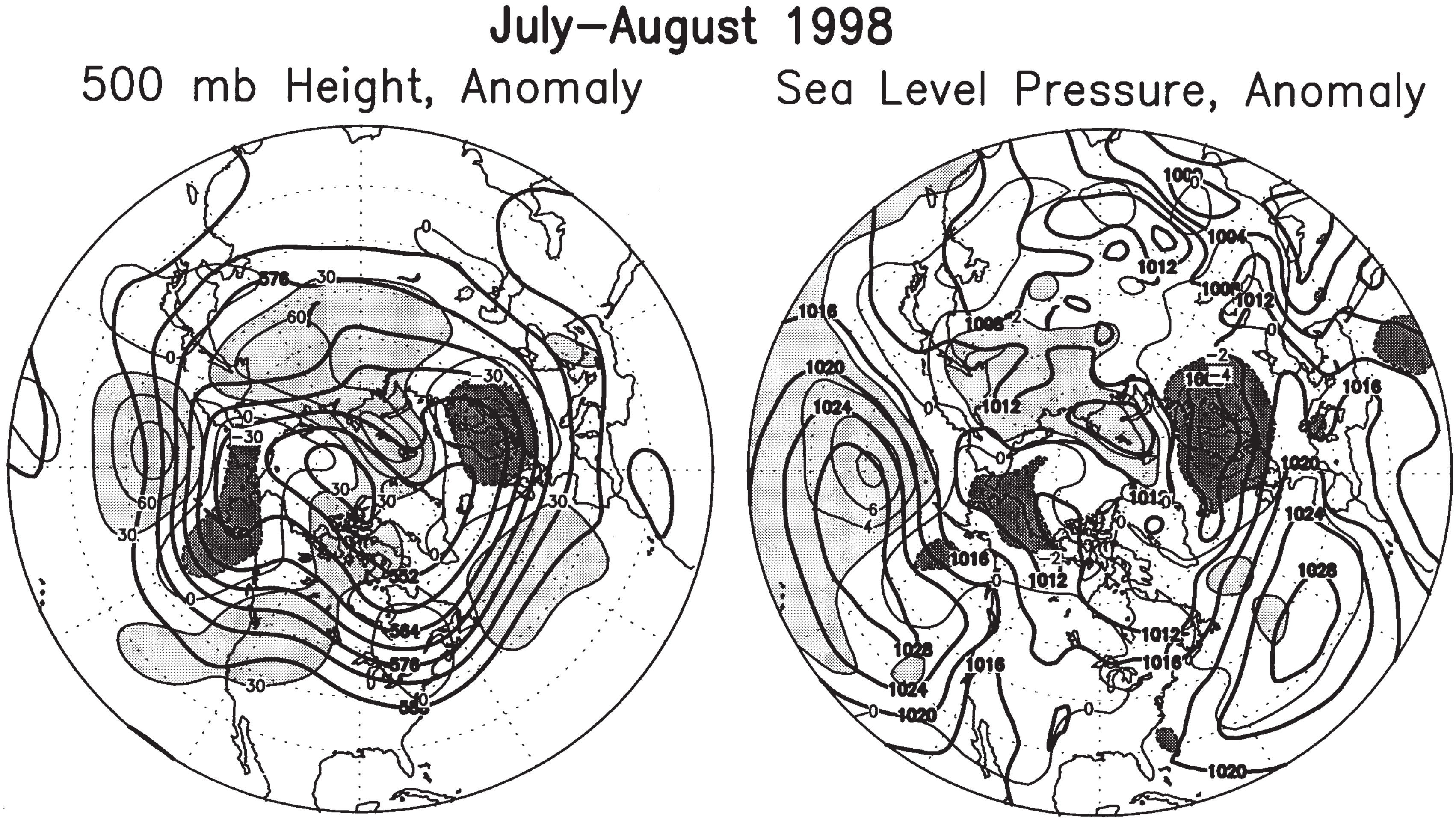
500 mb Height, Anomaly



Sea Level Pressure, Anomaly

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

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



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.

Voluntary Observing Ship Program

Martin S. Baron
National Weather Service
Silver Spring, Maryland

NWS Observing Handbook No. 1 to be Updated

We are working to update the 1995 edition of NWS Observing Handbook No. 1, Marine Surface Weather Observations. The revised edition should be ready Fall 1999.

While there have been no code changes since the 1995 edition was published, we are making some corrections and adding new material. As a result of GMDSS implementation, there have been many changes to Shipboard communication methods, so we have rewritten Chapter 3, "Transmitting The Observation." Here are highlights of the changes to be incorporated in the new edition.

Pages 2-7 — We have corrected a mistake here: i_w is reported as 3 or 4, not as 03 or 04 as indicated in the August 1995 edition. Under How To Code, the new text will be:

U.S. VOS Program vessels report wind speed in knots. Use 3 when estimating wind speed in knots, or 4 when measuring wind speed with an anemometer in knots.

Some vessels in foreign VOS programs report wind speed in meters per second. These vessels should use 0 when estimating wind speed in meters per second, or 1 when measuring wind speed with an anemometer in meters per second.

Code Figure	
0	Wind speed estimated in meters per second
1	Wind speed obtained from anemometer in meters per second
3	Wind Speed estimated in knots
4	Wind Speed obtained from anemometer in knots

Pages 2-40 — We have added information on how Great Lakes vessels should report sea level pressure. The text being added is:

For Great Lakes vessels: PMOs in Cleveland and Chicago calibrate your barometers to read sea level pressure using the elevation of Lake Erie in the correction factor. From other Great Lakes, to obtain sea level pressure

Continued on Page 53

VOS Program
Continued from Page 52

you must know the difference in elevation between Lake Erie and the lake your on, and add or subtract a correction.

From Lake Huron or Lake Michigan (both 10 feet above Lake Erie), please add .4 hp to your pressure reading before reporting. For Lake Superior (30 feet above Lake Erie), add 1.1 hp. For Lake Ontario (325 feet below Lake Erie), subtract 12 hp.

Chapter 3, "Transmitting The Observation" — We have rewritten the entire chapter. Highlights from the new chapter include:

STATIONS ACCEPTING VOS WEATHER OBSERVATIONS

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

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

INMARSAT

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

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

   The 5 periods indicate the end of the message, and must be included after each report. Do not request a confirmation.

Continued on Page 54

VOS Program

Continued from Page 53

Land-Earth Station Identify (LES-ID) of the U.S. INMARSAT stations Accepting Ships Weather (BBXX) and Oceanographic (JJYY) Reports

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

Use abbreviated dialing code 41.
Do not request a confirmation

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

Some common mistakes include: (1) failure to end the message with five periods when using INMARSAT A, (2) failure to include BBXX in the message preamble, (3) incorrectly coding the Date, Time, Latitude, Longitude, or quadrant of the globe, (4) requesting a confirmation (which increases cost to NWS).

Using The SEAS/AMVER Software

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

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

Common errors when using the AMVER/SEAS include sending the compressed binary message via the code 41 or a plain text message via the X.25 address. Only COMSAT can accept messages in the compressed

Continued on Page 55

VOS Program

Continued from Page 54

binary format. Text editors should not be utilized in sending the data in the compressed binary format as this will corrupt the message.

Telephone (Landline, Cellular, Satphone, Etc.)

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

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

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

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

Reporting Through United States Coast Guard Stations

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

U.S. Coast Guard High Seas Communication Stations

Location	(CALL)	Mode	SEL CAL	MMSI #	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
Boston	(NMF)	Voice		003669991	424	4134	4426	Night[3]
Boston	(NMF)	Voice		003669991	601	6200	6501	24Hr
Boston	(NMF)	Voice		003669991	816	8240	8764	24Hr
Boston	(NMF)	Voice		003669991	1205	12242	13089	Day[3]
Chesapeake	(NMN)	SITOR	1097		604	6264.5	6316	Night[2]
Chesapeake	(NMN)	SITOR	1097		824	8388	8428	24Hr
Chesapeake	(NMN)	SITOR	1097		1227	12490	12592.5	24hr
Chesapeake	(NMN)	SITOR	1097		1627	16696.5	16819.5	24Hr
Chesapeake	(NMN)	SITOR	1097		2227	22297.5	22389.5	Day[2]
Chesapeake	(NMN)	Voice		003669995	424	4134	4426	Night[2]

Continued on Page 56

VOS Program

Continued from Page 55

Location	(CALL)	Mode	SEL CAL	MMSI #	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
Chesapeake	(NMN)	Voice		003669995	601	6200	6501	24Hr
Chesapeake	(NMN)	Voice		003669995	816	8240	8764	24Hr
Chesapeake	(NMN)	Voice		003669995	1205	12242	13089	Day[2]
Miami	(NMA)	Voice		003669997	601	6200	6501	24Hr
Miami	(NMA)	Voice		003669997	1205	12242	13089	24Hr
Miami	(NMA)	Voice		003669997	1625	16432	17314	24Hr
New Orleans	(NMG)	Voice		003669998	424	4134	4426	24Hr
New Orleans	(NMG)	Voice		003669998	601	6200	6501	24Hr
New Orleans	(NMG)	Voice		003669998	816	8240	8764	24Hr
New Orleans	(NMG)	Voice		003669998	1205	12242	13089	24Hr
Kodiak	(NOJ)	SITOR	1106		407	4175.5	4213.5	Night
Kodiak	(NOJ)	SITOR	1106		607	6266	6317.5	24Hr
Kodiak	(NOJ)	SITOR	1106		807	8379.5	8419.5	Day
Kodiak	(NOJ)	Voice		003669899[1]	***	4125	4125	24Hr
Kodiak	(NOJ)	Voice		003669899[1]	601	6200	6501	24Hr
Pt. Reyes	(NMC)	SITOR	1096		620	6272.5	6323.5	Night
Pt. Reyes	(NMC)	SITOR	1096		820	8386	8426	24Hr
Pt. Reyes	(NMC)	SITOR	1096		1620	16693	16816.5	Day
Pt. Reyes	(NMC)	Voice		003669990	424	4134	4426	24Hr
Pt. Reyes	(NMC)	Voice		003669990	601	6200	6501	24Hr
Pt. Reyes	(NMC)	Voice		003669990	816	8240	8764	24Hr
Pt. Reyes	(NMC)	Voice		003669990	1205	12242	13089	24Hr
Honolulu	(NMO)	SITOR	1099		827	8389.5	8429.5	24hr
Honolulu	(NMO)	SITOR	1099		1220	12486.5	12589	24hr
Honolulu	(NMO)	SITOR	1099		2227	22297.5	22389.5	Day
Honolulu	(NMO)	Voice		003669993[1]	424	4134	4426	Night[4]
Honolulu	(NMO)	Voice		003669993[1]	601	6200	6501	24Hr
Honolulu	(NMO)	Voice		003669993[1]	816	8240	8764	24Hr
Honolulu	(NMO)	Voice		003669993[1]	1205	12242	13089	Day[4]
Guam	(NRV)	SITOR	1100		812	8382	8422	24hr
Guam	(NRV)	SITOR	1100		1212	12482.5	12585	Night
Guam	(NRV)	SITOR	1100		1612	16689	16812.5	24hr
Guam	(NRV)	SITOR	1100		2212	22290	22382	Day
Guam	(NRV)	Voice		003669994[1]	601	6200	6501	Night[5]
Guam	(NRV)	Voice		003669994[1]	1205	12242	13089	Day[5]

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

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

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

Continued on Page 57

VOS Program

Continued from Page 56

Note that some stations share common frequencies.

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

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

U.S. Coast Guard Group Communication Stations

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

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

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

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

Reporting Through Specified U.S. Commercial Radio Stations

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

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

Continued on Page 58

VOS Program

Continued from Page 57

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

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

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

Globe Wireless

Location	(CALL)	Mode	SEL CAL	MMSI#	ITU CH#	Freq	Ship Xmit Freq	Ship Rec Watch
Slidell,	(WNU)	SITOR			401	4172.5	4210.5	24Hr
Louisina	(WNU)	SITOR				4200.5	4336.4	24Hr
	(WNU)	SITOR			627	6281	6327	24Hr
	(WNU)	SITOR			819	8385.5	8425.5	24Hr
	(WNU)	SITOR			1257	12505	12607.5	24Hr
	(WNU)	SITOR			1657	16711.5	16834.5	24Hr
Barbados,	(8PO)	SITOR			409	4176.5	4214.5	24Hr
	(8PO)	SITOR			634	6284.5	6330.5	24Hr
	(8PO)	SITOR			834	8393	8433	24Hr
	(8PO)	SITOR			1273	12513	12615.5	24Hr
	(8PO)	SITOR			1671	16718.5	16841.5	24Hr
San	(KPH)	SITOR			413	4178.5	4216	24Hr
Fransisco,	(KPH)	SITOR			613	6269	6320	24Hr
California	(KPH)	SITOR			813	8382.5	8422.5	24Hr
	(KPH)	SITOR			822	8387	8427	24Hr
	(KPH)	SITOR			1213	12483	12585.5	24Hr
	(KPH)	SITOR			1222	12487.5	12590	24Hr
	(KPH)	SITOR			1242	12497.5	12600	24Hr
	(KPH)	SITOR			1622	16694	16817.5	24Hr
	(KPH)	SITOR			2238	22303	22395	24Hr
	(KFS)	SITOR			403	4173.5	4211.5	24Hr
	(KFS)	SITOR				6253.5	436.4	24Hr
	(KFS)	SITOR			603	6264	6315.5	24Hr
	(KFS)	SITOR				8323.5	8526.4	24Hr
	(KFS)	SITOR			803	8377.5	8417.5	24Hr
	(KFS)	SITOR			1203	12478	12580.5	24Hr
	(KFS)	SITOR			1247	12500	12602.5	24Hr
	(KFS)	SITOR				16608.5	17211.4	24Hr
	(KFS)	SITOR			1647	16706.5	16829.5	24Hr
	(KFS)	SITOR			2203	22285.5	22377.5	24Hr
Hawaii	(KEJ)	SITOR				4154.5	4300.4	24Hr
	(KEJ)	SITOR			625	6275	6326	24Hr
	(KEJ)	SITOR			830	8391	8431	24Hr
	(KEJ)	SITOR			1265	12509	12611.5	24Hr
	(KEJ)	SITOR			1673	16719.5	16842.5	24Hr
Delaware,	(WCC)	SITOR				6297	6334	24Hr
USA	(WCC)	SITOR			816	8384	8424	24Hr

Continued on Page 59

VOS Program

Continued from Page 58

Location	(CALL)	Mode	SEL CAL	MMSI#	ITU CH#	Freq	Ship Xmit Freq	Ship Rec Watch
	(WCC)	SITOR			1221	12487	12589.5	24Hr
	(WCC)	SITOR			1238	12495.5	12598	24Hr
	(WCC)	SITOR			1621	16693.5	16817	24Hr
Argentina	(LSD836)	SITOR				4160.5	4326	24Hr
	(LSD836)	SITOR				8311.5	8459	24Hr
	(LSD836)	SITOR				12379.5	12736	24Hr
	(LSD836)	SITOR				16560.5	16976	24Hr
	(LSD836)	SITOR				18850.5	19706	24Hr
Guam	(KHF)	SITOR			605	6265	316.5	24Hr
	(KHF)	SITOR			808	8380	8420	24Hr
	(KHF)	SITOR			1301	12527	12629	24Hr
	(KHF)	SITOR			1726	16751	16869	24Hr
	(KHF)	SITOR			1813	18876.5	19687	24Hr
	(KHF)	SITOR			2298	22333	22425	24Hr
Newfoundland,	(VCT)	SITOR			414	4179	4216.5	24Hr
Canada	(VCT)	SITOR			416	4180	4217.5	24Hr
	(VCT)	SITOR			621	6273	6324	24Hr
	(VCT)	SITOR			632	6283.5	6329.5	24Hr
	(VCT)	SITOR			821	8386.5	8426.5	24Hr
	(VCT)	SITOR			838	8395	8435	24Hr
	(VCT)	SITOR			1263	12508	12610.5	24Hr
	(VCT)	SITOR			1638	16702	16825	24Hr
Cape Town,	(ZSC)	SITOR			408	4176	4214	24Hr
South Africa	(ZSC)	SITOR			617	6271	6322	24Hr
	(ZSC)	SITOR			831	8391.5	8431.5	24Hr
	(ZSC)	SITOR			1244	12498.5	12601	24Hr
	(ZSC)	SITOR			1619	16692.5	16816	24Hr
	(ZSC)	SITOR			1824	18882	19692.5	24Hr
Bahrain,	(A9M)	SITOR			419	4181.5	4219	24Hr
Arabian Gulf	(A9M)	SITOR				8302.5	8541	24Hr
	(A9M)	SITOR				12373.5	12668	24Hr
	(A9M)	SITOR				16557.5	17066.5	24Hr
	(A9M)	SITOR				18853.5	19726	24Hr
Gothenburg,	(SAB)	SITOR			228	2155.5	1620.5	24Hr
Sweden	(SAB)	SITOR				4166.5	4259	24Hr
	(SAB)	SITOR			626	6275.5	6326.5	24Hr
	(SAB)	SITOR			837	8394.5	8434.5	24Hr
	(SAB)	SITOR			1291	12522	12624	24Hr
	(SAB)	SITOR			1691	16728.5	16851.5	24Hr
Norway	(LFI)	SITOR				2653	1930	24Hr
	(LFI)	SITOR				4154.5	4339	24Hr
	(LFI)	SITOR				6250.5	6467	24Hr
	(LFI)	SITOR				8326.5	8683.5	24Hr
	(LFI)	SITOR				12415.5	12678	24Hr
	(LFI)	SITOR				16566.5	17204	24Hr
Awanui,	(ZLA)	SITOR			402	4173	4211	24Hr
New Zealand	(ZLA)	SITOR			602	6263.5	6315	24Hr
	(ZLA)	SITOR			802	8377	8417	24Hr
	(ZLA)	SITOR			1202	12477.5	12580	24Hr
	(ZLA)	SITOR			1602	16684	16807.5	24Hr

Continued on Page 60

VOS Program

Continued from Page 59

Location	(CALL)	Mode	SEL CAL	MMSI#	ITU CH#	Freq	Ship Xmit Freq	Ship Rec Watch
	(ZLA)	SITOR				18859.5	19736.4	24Hr
Perth,	(VIP)	SITOR			406	4175	4213	24Hr
Western	(VIP)	SITOR			806	8379	8419	24Hr
Austrailia	(VIP)	SITOR			1206	12479.5	12582	24Hr
	(VIP)	SITOR			1210	12481.5	12584	24Hr
	(VIP)	SITOR			1606	16686	16809.5	24Hr

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

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

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

Mobile Marine Radio Inc.

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

Continued on Page 61

VOS Program

Continued from Page 60

Location	(CALL)	Mode	SEL CAL	MMSI#	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
	(WLO)	SITOR	1090	003660003	1644	16705	16828	24Hr
	(WLO)	SITOR	1090	003660003	1661	16713.5	16836.5	24Hr
	(WLO)	SITOR	1090	003660003	1810	18875	19685.5	24Hr
	(WLO)	SITOR	1090	003660003	2210	22289	22381	24Hr
	(WLO)	SITOR	1090	003660003	2215	22291.5	22383.5	24Hr
	(WLO)	SITOR	1090	003660003	2254	22311	22403	24Hr
	(WLO)	SITOR	1090	003660003	2256	22312	22404	24Hr
	(WLO)	SITOR	1090	003660003	2260	22314	22406	24Hr
	(WLO)	SITOR	1090	003660003	2262	22315	22407	24Hr
	(WLO)	SITOR	1090	003660003	2272	22320	22412	24Hr
	(WLO)	SITOR	1090	003660003	2284	22326	22418	24Hr
	(WLO)	SITOR	1090	003660003	2510	25177.5	26105.5	24Hr
	(WLO)	SITOR	1090	003660003	2515	25180	26108	24Hr
	(WLO)	DSC		003660003		4208	4219	24Hr
	(WLO)	DSC		003660003		6312.5	6331.0	24Hr
	(WLO)	DSC		003660003		8415	8436.5	24Hr
	(WLO)	DSC		003660003		12577.5	12657	24Hr
	(WLO)	DSC		003660003		16805	16903	24Hr
	(WLO)	Voice		003660003	405	4077	4369	24Hr
	(WLO)	Voice			414	4104	4396	24Hr
	(WLO)	Voice			419	4119	4411	24Hr
	(WLO)	Voice		003660003	607	6218	6519	24Hr
	(WLO)	Voice		003660003	824	8264	8788	24Hr
	(WLO)	Voice			829	8279	8803	24Hr
	(WLO)	Voice			830	8282	8806	24Hr
	(WLO)	Voice		003660003	1212	12263	13110	24Hr
	(WLO)	Voice			1226	12305	13152	24Hr
	(WLO)	Voice			1607	16378	17260	24Hr
	(WLO)	Voice			1641	16480	17362	24Hr
	(WLO)	VHF Voice			CH 25,84			24Hr
	(WLO)	DSC Call		003660003	CH 70			24Hr
	(WLO)	DSC Work		003660003	CH 84			24Hr
	(WLO)	CW				434	434	Day
	(WLO)	CW				4250	4250	Day
	(WLO)	CW				6446.5	6446.5	Day
	(WLO)	CW				8445	8445	Day
	(WLO)	CW				8472	8472	Day
	(WLO)	CW				8534	8534	Day
	(WLO)	CW				8658	8658	Day
	(WLO)	CW				12660	12660	Day
	(WLO)	CW				12704.5	12704.5	Day
	(WLO)	CW				13024.9	13024.9	Day
	(WLO)	CW				16969	16969	Day
	(WLO)	CW				17173.5	17173.5	Day
	(WLO)	CW				22686.5	22686.5	Day
Tuckerton,	(WSC)	SITOR	1108		419	4181.5	4219	24Hr
NJ	(WSC)	SITOR	1108		832	8392	8432	24Hr
	(WSC)	SITOR	1108		1283	12518	12620.5	24Hr
	(WSC)	SITOR	1108		1688	16727	16850	24Hr
	(WSC)	SITOR	1108		1805	18872.5	19683	24Hr

Continued on Page 62

VOS Program

Continued from Page 61

Location	(CALL)	Mode	SEL CAL	MMSI#	ITU CH#	Ship Xmit Freq	Ship Rec Freq	Watch
	(WSC)	SITOR	1108		2295	22331.5	22423.5	24Hr
	(WSC)	CW				482	482	24Hr
	(WSC)	CW				4316	4316	24Hr
	(WSC)	CW				6484.5	6484.5	24Hr
	(WSC)	CW				8680	8680	24Hr
	(WSC)	CW				12789.5	12789.5	24Hr
	(WSC)	CW				16916.5	16916.5	24Hr
Seattle, WA	(KLB)	SITOR	1113		408	4176	4214	24Hr
	(KLB)	SITOR	1113		608	6266.5	6318	24Hr
	(KLB)	SITOR	1113		818	8385	8425	24Hr
	(KLB)	SITOR	1113		1223	12488	12590.5	24Hr
	(KLB)	SITOR	1113		1604	16685	16808.5	24Hr
	(KLB)	SITOR	1113		2240	22304	22396	24Hr
	(KLB)	CW				488	488	24Hr
	(KLB)	CW				4348.5	4348.5	24Hr
	(KLB)	CW				8582.5	8582.5	24Hr
	(KLB)	CW				12917	12917	24Hr
	(KLB)	CW				17007.7	17007.7	24Hr
	(KLB)	CW				22539	22539	24Hr

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

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

CW Calling Frequencies: 4184.0, 6276.0, 8368.0, 12552.0, 16736.0, 22280.5, 25172.0 4184.5, 6276.5, 8369.0, 12553.5, 16738.0, 22281.0

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

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

Continued on Page 63

VOS Program

Continued from Page 62

8) MSG+?

9) SEND MESSAGE
10) KKKK (End of Message Indicator,
WAIT for System Response
DO NOT DISCONNECT)

11) RTTY CHANNEL

12) SHIP'S ANSWERBACK

13) SYSTEM REFERENCE, INFORMATION,
TIME, DURATION
14) GA+?

15) GO TO STEP 6, or
16) BRK+? Clear Radio Circuit)

Stations listed as being 24-hr may not be operational during periods of poor propagation.

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

MARITEL STATIONS

INSTRUCTIONS FOR MARITEL

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

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

STATIONS	VHF CHANNEL(S)
WEST COAST	
Bellingham, WA	28,85
Port Angeles, WA	25
Camano Island, WA	24
Seattle, WA	26
Tacoma, WA	28
Tumwater, WA	85
Astoria, OR	24,26
Rainer, OR	28
Portland, OR	26
Newport, OR	28
Coos Bay, OR	25
Santa Cruz, CA	27
Santa Barbara, CA	86
Redondo Bch, CA	27,85,87
HAWAII	
Haleakala,HI (Maui)	26
Palehua, HI (Oahu)	27
GREAT LAKES	
Duluth, MN (Superior)	84
Ontonagon, MI (Superior)	86
Copper Harbor (Superior)	87
Grand Marias (Superior)	84
Sault Ste Marie (Superior)	86
Port Washington, WI (Mich)	85
Charlevoix (Michican)	84
Chicago, IL (Michican)	27
Roger City (Huron)	28
Alpena, MI (Huron)	84
Tawas City, MI (Huron)	87
Port Huron, MI (Huron)	25
Detroit, MI (Erie)	28
Cleveland, OH (Erie)	86
Buffalo, NY (Erie)	28
NORTH EAST COAST	
Portland, ME	24,28,87
Gloucester, MA	25
Boston, MA	26
Hyannisport, MA	28
Nantucket, MA	85
New Bedford, MA	24,26
Providence, RI	27
Narragansett, RI	84
New London, CT	26,86
Bridgeport, CT	27
Staten Island, NY	28
Sandy Hook, NJ	24
Toms River, NJ	27
Ship Bottom, NJ	28

Continued on Page 64

VOS Program

Continued from Page 63

Beach Haven, NJ	25
Atlantic City, NJ	26
Cape May, NJ	24
Philadelphia, PA	26
Delaware WW Odessa, DE	28
Delaware WW Lewes, DE	27
Bethany Beach, DE	86
Ocean City, MD	26
North Bay, MD	24
Virginia Bch, VA	26,27

CHESAPEAKE BAY

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

SOUTH EAST COAST

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

GULF COAST

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

Military Communications Circuits

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

SHIP OBS NWS SILVER SPRING MD

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

New Recruits — May through August 1998

During the four-month period ending August 31, 1998, PMOs recruited 33 vessels as weather observers/ reporters in the National Weather Service (NWS) Voluntary Observing Ship (VOS) Program. Thank you for joining the program.

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

Continued on Page 65

VOS Program

Continued from Page 64

PMOs attend SEAS/AMVER Training

National Weather Service PMOs attended one of two SEAS/AMVER training sessions held at COMSAT headquarters in Bethesda, Maryland, near Washington, D.C., September 15-16, 1998, and November 3-4, 1998. The purpose of the training was for the PMOs to become familiar with the software and help them provide training to ship's officers. Also present at the meetings were Vince Zegowitz (Marine Observations Program Leader), Martin Baron (Assistant Program Leader, Marine Observations), Tim Rulon (GMDSS Program Manager), Bill Woodward (head of the SEAS Program Office, who led the effort to develop the software), and SEAS Field Representatives Jim Farrington (Norfolk) and Warren Krug (Miami).

The SEAS/AMVER software has been developed to simplify preparation of weather and Automated Mutual Assistance Vessel Rescue (AMVER) messages. When COMSAT receives your weather message as formatted by this software, your call sign and position is forwarded to the AMVER center (other INMARSAT stations do not currently perform this service). Please contact any United States PMO to obtain this free software.⚓

National Weather Service Voluntary Observing Ship Program

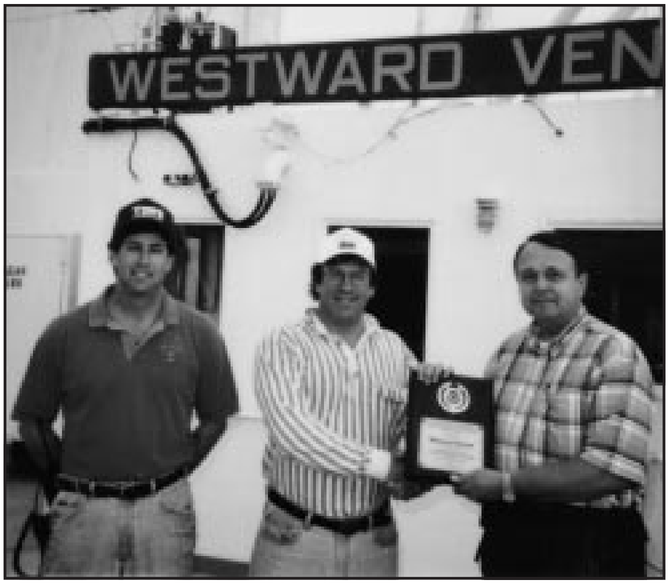
New Recruits from May 1 to August 31, 1998

NAME OF SHIP	CALL	AGENT NAME	RECRUITING PMO
ALEGRIA	ZCCK5	MAX FONVIELLE	MIAMI, FL
APOLLOGRACHT	PCSV	C.V. SCHEEPVAARTONDERNEMING APOLLOGRACHT	BALTIMORE, MD
ATLANTIC NOVA	3FWT4	BARBER INTERNATIONAL LTD	SEATTLE, WA
BUNGA SAGA EMPAT	9MBM9	MAYAYSIAN INTERNATIONAL SHIPPING CO., INC	SEATTLE, WA
CAMARINA	MVGY5	DENHOLM SHIP MGMT. LTD.	NEW ORLEANS, LA
CAPE JACOB	WJBA	CAPE JACOB @ AMERICAN OVERSEAS MARINE CORP	NEW ORLEANS, LA
CHARLOTTE SCHULTE	P3WE4	TRANSCO AGENCIES	NORFOLK, VA
EASTERN BRIDGE	C6JY9	ROPNER SHIP MANAGEMENT LIMITED	BALTIMORE, MD
ENDEAVOR	WCE5063	FARRELL LINES	NORFOLK, VA
ETERNAL WIND	3FIX7	WORLD MARINE COMPANY, LTD	BALTIMORE, MD
EVER APEX	3FCX7	THE WORLD TRADE CENTER	BALTIMORE, MD
EVER DIADEM	3FOF8	EVERGREEN AMERICA CORP	NEW YORK CITY, NY
GULF STAR	3FQY7	STAR MARITIME	NEW ORLEANS, LA
HYUNDAI EXPLORER	3FTG4	HYUNDAI AMERICA SHIPPING AGENCY, INC	SEATTLE, WA
KANIN	ELEO2	SPLOSNA PLOVBA	NEW ORLEANS, LA
KENNICOTT	WCY2920	ALASKA MARINE HIGHWAY SYSTEM D.O.T.	SEATTLE, WA
LEISE MAERSK	OXGR2	MAERSK LINE	SAN FRANCISCO, CA
LIBRA SANTOS	V2AF1	INCHAPE SHIPPING SERVICES	NORFOLK, VA
MAERSK GENOA	DGUC	MAERSK INC, GIELADA FARMS	NEW YORK CITY, NY
MAERSK TAIKI	9VIG	A. P. MOLLER SINGAPORE PTE. LTD.	BALTIMORE, MD
MEKHANIK KALYUZHNIY	UFLO	FESCO AGENCIES N.A., INC	SEATTLE, WA
NOAAS GORDON GUNTER	WTEO	NMFS FACILITY	NEW ORLEANS, LA
OCEAN PALM	3FDO7	FUYOKAIUN SHIPMANAGEMENT CORP.	SEATTLE, WA
ORIENTAL ROAD	3FXT6	PORT METEOROLOGICAL OFFICER	HOUSTON, TX
PRESIDENT HOOVER	WCY2883	AMERICAN SHIP MANAGEMENT	SAN FRANCISCO, CA
REGINA MAERSK	OZIN2	MAERSK INC., GIRALDA FARMS	NEW YORK CITY, NY
RUBIN PHOENIX	3FFT7	INCHAPE SHIPPING SERVICES	NORFOLK, VA
STAR TRONDANGER	LAQQ2	WESTFAL-LARSEN MANAGEMENT A/S	BALTIMORE, MD
SUCO DO BRASIL	ELAQ5	MARITIME SERVICES ALEUROPA GMBH	BALTIMORE, MD
TASCO	LAON2	WILHELMSEN LINES, REFLECTIONS II, SUITE 480	NORFOLK, VA
USCGC HEALY WAGB-20	NZZZ	USCGC HEALY WAGB-20	SEATTLE, WA
VISAYAS VICTORY	DZVP	STAR SHIPPING (NY) INC	BALTIMORE, MD
WESTERN BRIDGE	C6JQ9	ROPNER SHIP MANAGEMENT LIMITED	BALTIMORE, MD

VOS Program Awards and Presentations Gallery

*PMO Jim Saunders of Baltimore presenting award to Captain Scribner of the **ITB JACKSONVILLE**.*

*PMO Jim Saunders of Baltimore presenting award to Second Officer Peter Q. Merka of the **M/V AGULHAS**.*



A 1997 VOS Plaque was awarded to the ***WESTWARD VENTURE*** *for the high quality of surface weather observations. Pictured with PMO Pat Brandow of Seattle from the left are Second Mate Mick Richie and Captain Don Charland.*

The ***WESTWOOD HALLA*** *was one of the ships recognized in 1997 by PMO Pat Brandow. Pictured is Captain Hans Joachim Kruschka.*

OCEAN CLIPPER *receiving 1997 outstanding VOS Program support award from PMO Jack Warrelman. Standing rear: L - Mark Buyes R - Jody Elfert; Standing L-R Ch. Mate Marshall Perez, DPOs David Fazioli, Don Vandelinder, Mike Billings, Ch. Mate Jonathon Samual; Sitting: DPO Michelle Gorman; Kneeling: DPO Fred Blackden; Not Shown: DPOs Ted Agon, Darin Hilton, Chris Serrano.*

The **GOLDEN GATE BRIDGE** comes through once again with one of the top honors for 1997 in the VOS awards program. Pictured form left to right are Third Mate Arjun Ravikant, Chief Mate C.S. Batibrolu, Seattle PMO Pat Brandow, Captain T. Yamamoto, and Radio Officer S. Sarkar.

PMO Bob Drummond of Miami presents a 1997 VOS award to Captain James V. Sieler of the ***R/V SEWARD JOHNSON***

PMO George Smith of Cleveland presents a 1997 award to Captain James Van Dongen of the ***INDIANA HARBOR****. The vessel is 1000 feet long and 150 feet wide.*

VOS Coop Ship Reports — May through August 1998

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

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
1ST LT ALEX BONNYMAN	WMFZ	New York City	0	8	0	120	128
1ST LT BALDOMERO LOPEZ	WJKV	Jacksonville	0	0	43	0	43
A. V. KASTNER	ZCAM9	Jacksonville	0	41	74	65	180
AALSMEERGRACHT	PCAM	Long Beach	42	30	35	40	147
ACADIA FOREST	D5DI	New Orleans	0	87	55	56	198
ACT 7	GWAN	Newark	17	57	65	73	212
ACT I	GYXG	Newark	87	57	45	63	252
ADAM E. CORNELIUS	WCF7451	Chicago	38	78	18	0	134
ADVANTAGE	WPPO	Norfolk	1	52	80	0	133
AGDLEK	OUGV	Miami	33	28	42	43	146
AGULHAS	3ELE9	Baltimore	59	101	56	48	264
AL AWDAH	9KWA	Houston	127	63	356	65	611
AL FUNTAS	9KKX	Miami	34	12	21	3	70
AL SAMIDOON	9KKF	Houston	61	0	9	27	97
AL SHUHADAA	9KKH	Houston	15	11	51	3	80
ALBEMARLE ISLAND	C6LU3	Newark	73	16	72	103	264
ALBERNI DAWN	ELAC5	Houston	58	496	73	10	637
ALDEN W. CLAUSEN	ELBM4	Norfolk	25	0	53	36	114
ALEXANDER VON HUMBOLD	Y3CW	Miami	728	656	293	242	1919
ALKMAN	C6OG4	Houston	56	43	23	54	176
ALLEGIANCE	WSKD	Norfolk	7	52	49	34	142
ALLIGATOR AMERICA	JPAL	Seattle	48	33	63	31	175
ALLIGATOR BRAVERY	3FXX4	Oakland	51	54	104	44	253
ALLIGATOR COLUMBUS	3ETV8	Seattle	32	10	20	77	139
ALLIGATOR FORTUNE	ELFK7	Seattle	35	0	0	0	35
ALLIGATOR GLORY	ELJP2	Seattle	14	6	14	12	46
ALLIGATOR HOPE	ELFN8	Seattle	1	0	0	0	1
ALLIGATOR LIBERTY	JFUG	Seattle	48	28	67	18	161
ALLIGATOR STRENGTH	3FAK5	Oakland	41	47	48	58	194
ALMERIA LYKES	WGMJ	Houston	36	24	30	48	138
ALPENA	WAV4647	Cleveland	87	72	28	58	245
ALTAIR	DBBI	Miami	593	685	576	671	2525
AMAZON	S6BJ	Norfolk	35	43	49	21	148
AMBASSADOR BRIDGE	3ETH9	Oakland	62	129	57	61	309
AMERICA STAR	C6JZ2	Houston	23	64	100	52	239
AMERICAN CONDOR	WJRG	Newark	0	105	70	93	268
AMERICAN CORMORANT	KGOP	Jacksonville	5	0	99	0	104
AMERICAN FALCON	KMJA	Jacksonville	0	0	72	24	96
AMERICAN MERLIN	WRGY	Norfolk	3	0	55	0	58
AMERICANA	LADX2	New Orleans	0	24	15	12	51
AMERIGO VESPUCCI	ICBA	Norfolk	8	19	22	0	49
ANAHUAC	ELFV3	Long Beach	5	26	17	22	70
ANASTASIS	9HOZ	Miami	0	15	3	1	19
ANATOLIY KOLESNICHENKO	UINM	Seattle	19	8	12	17	56
ANDERS MAERSK	OXIT2	Long Beach	62	70	72	37	241
ANKERGRACHT	PCQL	Baltimore	31	48	20	15	114
ANNA MAERSK	OYKS2	Long Beach	5	45	35	55	140
APL CHINA	V7AL5	Seattle	18	52	38	55	163
APL JAPAN	V7AL7	Seattle	35	29	171	71	306
APL KOREA	WCX8883	Seattle	29	0	0	0	29
APL SINGAPORE	WCX8812	Seattle	101	0	0	0	101
APL THAILAND	WCX8882	Seattle	83	0	0	0	83
APOLLOGRACHT	PCSV	Baltimore	34	3	0	1	38
ARABIAN SEA	C6QS	Miami	0	12	15	21	48
ARCO ALASKA	KSBK	Long Beach	6	34	10	0	50
ARCO ANCHORAGE	WCIO	Long Beach	0	12	3	0	15

Continued on Page 70

Continued from Page 69

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
ARCO CALIFORNIA	WMCV	Long Beach	1	0	9	24	34
ARCO FAIRBANKS	WGWB	Long Beach	12	12	8	14	46
ARCO INDEPENDENCE	KLHV	Long Beach	17	24	19	6	66
ARCO JUNEAU	KSBG	Long Beach	0	12	10	3	25
ARCO PRUDHOE BAY	KPFD	Long Beach	1	0	4	0	5
ARCO SAG RIVER	WLDF	Long Beach	8	18	11	4	41
ARCO SPIRIT	KHLD	Long Beach	19	14	14	2	49
ARCO TEXAS	KNFD	Long Beach	12	0	7	19	38
ARCTIC SUN	ELQB8	Long Beach	14	14	57	36	121
ARCTIC UNIVERSAL	4QUL	Baltimore	75	63	46	61	245
ARGONAUT	KFDV	Newark	15	26	54	44	139
ARIES	KGBD	New York City	0	0	94	37	131
ARINA ARCTICA	OVYA2	Miami	137	42	77	84	340
ARKTIS LIGHT	OZBL2	Miami	0	73	18	108	199
ARKTIS SPRING	OWVD2	Miami	0	59	42	48	149
ARMCO	WE6279	Cleveland	53	50	74	72	249
ARTHUR M. ANDERSON	WE4805	Chicago	67	58	75	76	276
ARTHUR MAERSK	OXRS2	Long Beach	40	59	49	6	154
ASPHALT COMMANDER	WFJN	New Orleans	0	18	19	2	39
ATLANTIC	3FYT	Miami	230	219	207	226	882
ATLANTIC BULKER	3FSQ4	Miami	4	44	0	58	106
ATLANTIC CARTIER	C6MS4	Norfolk	24	0	18	10	52
ATLANTIC COMPANION	SKPE	Newark	22	17	25	32	96
ATLANTIC COMPASS	SKUN	Norfolk	37	16	37	16	106
ATLANTIC CONCERT	SKOZ	Norfolk	17	40	9	0	66
ATLANTIC CONVEYOR	C6NI3	Norfolk	5	9	7	3	24
ATLANTIC ERIE	VCQM	Baltimore	12	11	19	16	58
ATLANTIC NOVA	3FWT4	Seattle	13	0	0	0	13
ATLANTIC OCEAN	C6T2064	Newark	15	0	0	51	66
ATLANTIC SUPERIOR	C6BT8	Baltimore	0	32	23	22	77
ATLANTIS	KAQP	New Orleans	30	0	15	11	56
AUCKLAND STAR	C6KV2	Baltimore	39	54	52	58	203
AUSTRAL RAINBOW	WEZP	New Orleans	6	12	64	27	109
AUTHOR	GBSA	Houston	35	54	27	39	155
AXEL MAERSK	OXSF2	Oakland	0	26	52	83	161
B. T. ALASKA	WFQE	Long Beach	8	104	20	31	163
BARBARA ANDRIE	WTC9407	Chicago	10	23	12	32	77
BARBICAN SPIRIT	DVFS	Miami	44	102	29	42	217
BARRINGTON ISLAND	C6QK	Miami	68	38	84	71	261
BAY BRIDGE	ELES7	Seattle	31	17	25	14	87
BELGRANO	P3HR2	Houston	0	45	51	88	184
BELLONA	3FEA4	Jacksonville	3	0	0	0	3
BERING SEA	C6YY	Miami	39	94	0	0	133
BERNARDO QUINTANA A	C6KJ5	New Orleans	43	41	2	24	110
BLEST FUTURE	DUHE	Seattle	1	0	0	0	1
BLOSSOM FOREVER	DZSL	Seattle	0	30	64	119	213
BLUE GEMINI	3FPA6	Seattle	79	34	24	8	145
BLUE HAWK	D5HZ	Norfolk	32	0	0	0	32
BLUE NOVA	3FDV6	Seattle	21	66	56	10	153
BLUE RIDGE	KNJD	Oakland	3	0	0	0	3
BONN EXPRESS	DGNB	Houston	666	676	138	178	1658
BOSPORUS BRIDGE	3FMV3	Oakland	72	73	72	48	265
BOW TRIGGER	3FOT3	New York City	0	42	65	34	141
BP ADMIRAL	ZCAK2	Houston	0	17	8	1	26
BREMEN EXPRESS	9VUM	Norfolk	0	308	659	613	1580
BRIGHT PHOENIX	DXNG	Seattle	80	56	77	51	264
BRIGHT STATE	DXAC	Seattle	44	0	0	0	44
BRIGIT MAERSK	OXVW4	Oakland	28	53	58	45	184
BRISBANE STAR	C6LY4	Seattle	64	31	9	24	128
BRITISH ADVENTURE	ZCAK3	Seattle	16	2	19	56	93
BRITISH RANGER	ZCAS6	Houston	90	65	55	94	304
BROOKLYN BRIDGE	3EZJ9	Oakland	55	61	64	54	234
BRUCE SMART	ELOF4	Oakland	63	25	61	0	149
BT NAVIGATOR	VRIU	New Orleans	0	21	0	10	31
BT NESTOR	ZCBL4	New York City	0	0	0	4	4
BUCKEYE	WAQ3520	Cleveland	0	105	46	58	209
BUNGA ORKID DUA	9MBQ4	Seattle	21	0	47	18	86
BUNGA ORKID SATU	9MBQ3	Seattle	24	0	0	0	24
BUNGA SAGA TIGA	9MBM8	Seattle	0	49	104	83	236
BURNS HARBOR	WQZ7049	Chicago	170	120	178	150	618
CABO TAMAR	ELMV3	Oakland	0	22	5	46	73
CALCITE II	WB4520	Chicago	9	41	74	113	237

Continued on Page 71

Continued from Page 70

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
CALIFORNIA CURRENT	ELMG2	New Orleans	40	30	67	18	155
CALIFORNIA HIGHWAY	3FHQ4	Seattle	7	0	0	0	7
CALIFORNIA JUPITER	ELKU8	Long Beach	44	58	25	49	176
CALIFORNIA LUNA	3EYX5	Seattle	0	31	31	27	89
CALIFORNIA MERCURY	JGPN	Seattle	41	0	37	1	79
CALIFORNIA PEGASUS	3EPB6	Oakland	18	19	12	17	66
CALIFORNIA SATURN	ELKU9	Norfolk	0	8	15	6	29
CALIFORNIA TRITON	S6DB	Long Beach	0	8	0	0	8
CALIFORNIA ZEUS	ELJP8	Oakland	0	24	35	151	210
CANBERRA	GBVC	Miami	0	8	6	9	23
CAPE BREEZE	DUGK	Seattle	0	12	2	15	29
CAPE CHARLES	3EFX5	Seattle	16	15	12	15	58
CAPE HENRY	3ENQ9	Norfolk	16	21	16	22	75
CAPE HENRY	KNJH	Norfolk	16	0	0	0	16
CAPE MAY	JBCN	Norfolk	30	10	11	10	61
CAPE RISE	KAFG	Norfolk	0	1	0	0	1
CAPE WASHINGTON	WRGH	Baltimore	0	48	0	0	48
CAPT STEVEN L BENNETT	KAXO	New Orleans	24	0	0	0	24
CARDIGAN BAY	ZCBF5	New York City	61	45	58	50	214
CARIBBEAN BULKER	C6PL3	New Orleans	52	0	0	0	52
CARLA A. HILLS	ELBG9	Oakland	80	31	103	27	241
CAROLINA	WYBI	Jacksonville	24	0	0	0	24
CASON J. CALLAWAY	WE4879	Chicago	29	96	63	112	300
CELEBRATION	ELFT8	Miami	2	0	25	43	70
CENTURY	ELQX6	Miami	4	14	15	7	40
CENTURY HIGHWAY #2	3EJB9	Long Beach	20	11	5	19	55
CENTURY HIGHWAY NO. 1	3FFJ4	Houston	9	3	22	0	34
CENTURY HIGHWAY_NO. 3	8JNP	Houston	11	16	13	20	60
CENTURY LEADER NO. 1	3FBI6	Houston	24	36	15	40	115
CGM PROVENCE	DEGM	Houston	0	20	10	12	42
CHARLES E. WILSON	WZE4539	Cleveland	0	58	30	22	110
CHARLES ISLAND	C6JT	Miami	64	62	12	42	180
CHARLES LYKES	3EJT9	Baltimore	33	12	60	37	142
CHARLES M. BEEGHLEY	WL3108	Cleveland	5	120	106	37	268
CHARLES PIGOTT	5LPA	Oakland	0	0	84	32	116
CHASTINE MAERSK	OWNJ2	New York City	0	44	27	34	105
CHELSEA	KNCX	New York City	0	25	75	44	144
CHEMBULK FORTITUDE	3ESF7	Norfolk	0	0	33	55	88
CHEMICAL PIONEER	KAFO	Houston	24	20	58	142	244
CHESAPEAKE TRADER	WGZK	Houston	43	9	77	54	183
CHEVRON ARIZONA	KGBE	Miami	23	20	2	0	45
CHEVRON ATLANTIC	C6KY3	New Orleans	66	89	47	0	202
CHEVRON COLORADO	KLHZ	Oakland	0	40	100	35	175
CHEVRON EDINBURGH	VSBZ5	Oakland	105	38	3	166	312
CHEVRON EMPLOYEE PRIDE	C6MC5	Baltimore	54	47	14	0	115
CHEVRON FELUY	ELIN	Houston	0	0	77	0	77
CHEVRON MARINER	ELRC4	New Orleans	0	0	0	17	17
CHEVRON MISSISSIPPI	WXBR	Oakland	42	26	41	32	141
CHEVRON NAGASAKI	A8BK	Oakland	91	0	74	50	215
CHEVRON PERTH	C6KQ8	Oakland	63	0	0	0	63
CHEVRON SOUTH AMERICA	ZCAA2	New Orleans	73	101	20	46	240
CHIEF GADAO	WEZD	Oakland	37	10	78	66	191
CHILEAN EXPRESS	3EME7	Norfolk	0	1	0	5	6
CHINA HOPE	ELQF5	Seattle	0	0	0	2	2
CHIQUITA BARU	ZCAY7	Jacksonville	44	44	31	56	175
CHIQUITA BELGIE	C6KD7	Baltimore	50	36	47	34	167
CHIQUITA BREMEN	ZCBC5	Miami	36	30	33	38	137
CHIQUITA BRENDA	ZCBE9	Miami	58	47	72	78	255
CHIQUITA DEUTSCHLAND	C6KD8	Baltimore	40	62	56	27	185
CHIQUITA ELKESCHLAND	ZCBB9	Miami	22	72	67	55	216
CHIQUITA FRANCES	ZCBD9	Miami	60	52	51	60	223
CHIQUITA ITALIA	C6KD5	Baltimore	38	36	27	19	120
CHIQUITA JEAN	ZCBB7	Jacksonville	50	41	20	30	141
CHIQUITA JOY	ZCBC2	Miami	56	58	26	19	159
CHIQUITA NEDERLAND	C6KD6	Baltimore	51	8	19	12	90
CHIQUITA ROSTOCK	ZCBD2	Miami	65	43	53	41	202
CHIQUITA SCANDINAVIA	C6KD4	Baltimore	62	32	28	23	145
CHIQUITA SCHWEIZ	C6KD9	Baltimore	39	76	38	48	201
CHITTINAD TRADITION	VTRX	New Orleans	5	0	0	0	5
CHO YANG ATLAS	DQVH	Seattle	48	0	0	0	48
CHOYANG VISION	9VOQ	Seattle	21	23	82	80	206
CIELO DI FIRENZE	V2SM	Long Beach	0	158	24	48	230

Continued on Page 72

Continued from Page 71

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
CITY OF DURBAN	GXIC	Long Beach	88	62	84	53	287
CLEVELAND	KGXA	Houston	17	64	40	97	218
CLIFFORD MAERSK	OXME2	Newark	0	0	0	11	11
CMS ISLAND EXPRESS	J8NX	Miami	10	12	17	9	48
COASTAL EAGLE POINT	WHMK	Houston	0	1	0	0	1
COLUMBIA BAY	WRB4008	Houston	7	0	0	0	7
COLUMBIA STAR	WSB2018	Cleveland	133	163	90	63	449
COLUMBIA STAR	C6HL8	Long Beach	79	63	52	72	266
COLUMBINE	3ELQ9	Baltimore	24	6	51	96	177
COLUMBUS AMERICA	ELSX2	Norfolk	56	3	30	54	143
COLUMBUS AUSTRALIA	ELSX3	Houston	48	38	48	37	171
COLUMBUS CALIFORNIA	ELUB7	Long Beach	48	29	43	45	165
COLUMBUS CANADA	ELQN3	Seattle	0	34	83	75	192
COLUMBUS NEW ZEALAND	ELSX4	Newark	0	23	20	11	54
COLUMBUS QUEENSLAND	ELUB9	Norfolk	7	13	23	20	63
COLUMBUS VICTORIA	ELUB6	Long Beach	101	46	50	57	254
CONDOLEEZZA RICE	C6OK	Baltimore	57	0	0	0	57
CONTSHIP AMERICA	3EIP3	Houston	66	13	11	21	111
COPACABANA	PPXI	Norfolk	22	0	34	23	79
CORAL HIGHWAY	3FEB5	Jacksonville	0	16	0	1	17
CORDELIA	3ESJ3	Long Beach	8	20	38	10	76
CORMORANT ARROW	C6IO9	Seattle	5	7	3	2	17
CORNELIA MAERSK	OXIF2	Norfolk	0	29	0	0	29
CORNUCOPIA	KPJC	Oakland	13	1	2	9	25
CORPUS CHRISTI	WMRU	Houston	0	13	180	3	196
CORWITH CRAMER	WTF3319	Norfolk	39	0	71	0	110
COSMOWAY	3EVO3	Seattle	12	0	0	5	17
COURIER	KCBK	Houston	0	20	32	15	67
COURTNEY BURTON	WE6970	Cleveland	111	169	83	77	440
COURTNEY L	ZCAQ8	Baltimore	53	8	36	0	97
CRISTOFORO COLOMBO	ICYS	Norfolk	0	8	0	6	14
CROATIA EXPRESS	9HZC3	New York City	0	1	2	3	6
CROWN OF SCANDINAVIA	OXRA6	Miami	85	87	100	98	370
CROWN PRINCESS	ELGH5	Miami	0	188	36	3	227
CSK UNITY	9VPU	Seattle	0	62	13	24	99
CSL ATLAS	C6IL3	Baltimore	13	0	0	0	13
CSL CABO	D5XH	Seattle	1	20	4	11	36
CSS HUDSON	CGDG	Norfolk	49	49	49	42	189
DAGMAR MAERSK	DHAF	New York City	53	9	0	0	62
DAISHIN MARU	3FPS6	Seattle	82	0	0	22	104
DANIA PORTLAND	OXEH2	Miami	58	50	2	33	143
DARYA PREETH	VRUX8	Long Beach	0	25	0	0	25
DAWN PRINCESS	ELTO4	Miami	11	0	0	0	11
DELAWARE TRADER	WXWL	Long Beach	73	22	0	55	150
DENALI	WSVR	Long Beach	27	90	67	40	224
DESTINY	3FKZ3	Miami	92	46	128	161	427
DG COLUMBIA	PPSL	Norfolk	43	78	156	64	341
DIAMOND STAR	VCBW	New Orleans	0	2	0	5	7
DIRCH MAERSK	OXQP2	Long Beach	34	51	40	32	157
DIRECT CONDOR	DQEB	Long Beach	0	51	58	43	152
DIRECT EAGLE	C6BJ9	Long Beach	0	57	18	29	104
DIRECT FALCON	C6MP7	Long Beach	0	48	67	41	156
DIRECT KEA	C6MP8	Long Beach	46	57	30	52	185
DIRECT KIWI	C6MP9	Long Beach	29	69	48	26	172
DIRECT KOOKABURRA	C6MQ2	Long Beach	41	19	25	34	119
DOCK EXPRESS 10	PJRO	Baltimore	55	32	29	1	117
DOCK EXPRESS 20	PJRF	Baltimore	1	61	0	40	102
DOCTOR LYKES	3ELF9	Baltimore	25	29	87	25	166
DORTHE MAERSK	DHPD	New York City	0	37	28	18	83
DORTHE OLDENDORFF	ELQJ6	Seattle	8	24	92	8	132
DRAGOR MAERSK	OXPW2	Long Beach	7	0	0	0	7
DUBROVNIK EXPRESS	9HOO3	Norfolk	0	29	21	24	74
DUCHESS	KRCJ	Newark	0	6	1	0	7
DUHALLOW	ZCBH9	Baltimore	70	72	95	58	295
DUNCAN ISLAND	C6JS	Miami	47	108	79	46	280
DUSSELDORF EXPRESS	S6IG	Long Beach	381	667	209	8	1265
E.P. LE QUEBECOIS	CG3130	Norfolk	40	220	231	236	727
EAGLE BEAUMONT	S6JO	New York City	2	0	0	0	2
EARL W. OGLEBAY	WZE7718	Cleveland	0	5	0	0	5
EASTERN BRIDGE	C6JY9	Baltimore	0	0	0	84	84
ECSTASY	ELNC5	Miami	0	39	20	82	141
EDELWIESS	VRUM3	Seattle	39	0	22	47	108

Continued on Page 73

Continued from Page 72

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
EDGAR B. SPEER	WQZ9670	Chicago	147	69	93	76	385
EDWARD L. RYERSON	WM5464	Chicago	16	0	0	0	16
EDWIN H. GOTT	WXQ4511	Chicago	90	142	0	305	537
EDYTH L	C6YC	Baltimore	23	11	12	8	54
EIDELWEISS	3FGE2	Seattle	5	0	0	0	5
ELATION	3FOC5	Miami	31	0	0	0	31
ELISE SHULTE	P3NP4	Miami	0	23	58	2	83
ELLEN KNUDSEN	LAKZ4	Norfolk	0	0	1	0	1
ELLIOTT BAY	DZFF	Seattle	53	64	130	50	297
ELSBERG	J8PG	Miami	8	0	0	0	8
ELTON HOYT II	WE3993	Cleveland	0	58	41	2	101
EMPIRE STATE	KKFW	New York City	11	63	44	0	118
ENCHANTMENT OF THE SEAS	LAXA4	Miami	2	0	0	0	2
ENDEAVOR	WAUW	New York City	8	0	0	0	8
ENDURANCE	WAUU	New York City	16	0	0	0	16
ENERGY ENTERPRISE	WBJF	Baltimore	1	0	0	0	1
ENGLISH STAR	C6KU7	Long Beach	66	79	83	71	299
EQUINOX	DPSC	Baltimore	0	37	36	19	92
EUROPA	DLAL	Miami	0	0	4	8	12
EVER DELUXE	3FBE8	Norfolk	14	0	0	0	14
EVER GAINING	BKJO	Norfolk	0	0	0	5	5
EVER GARDEN	BKHB	Norfolk	0	0	0	7	7
EVER GATHER	BKHA	Newark	0	0	11	6	17
EVER GENERAL	BKHY	Baltimore	7	4	0	0	11
EVER GIVEN	BKJJ	Long Beach	0	1	0	0	1
EVER GLEEFUL	BKJY	Long Beach	0	12	0	0	12
EVER GUARD	3ESL2	Seattle	0	2	0	0	2
EVER GUEST	BKJH	Norfolk	2	2	0	8	12
EVER LAUREL	BKHH	Long Beach	4	0	0	0	4
EVER LEVEL	BKHJ	Miami	0	15	25	1	41
EVER RACER	3FJL4	Norfolk	0	0	6	11	17
EVER REPUTE	3FRZ4	New York City	0	0	0	4	4
EVER RESULT	3FSA4	Norfolk	0	9	15	0	24
EVER RIGHT	3FML3	Long Beach	0	4	0	0	4
EVER ROUND	3FQN3	Long Beach	4	1	0	0	5
EVER ULTRA	3FEJ6	Seattle	0	36	43	42	121
EVER UNION	3FFG7	Seattle	6	0	35	27	68
EVER UNIQUE	3FXQ6	Seattle	3	0	0	8	11
EVER UNISON	3FTL6	Long Beach	0	1	62	43	106
EVER UNITED	3FMQ6	Seattle	0	1	0	2	3
EXCELSIOR	V7AZ2	Baltimore	32	107	20	44	203
EXEMPLAR	V7AZ3	Baltimore	0	48	62	60	170
EXPORT PATRIOT	WCJY	Newark	0	10	72	88	170
FAIRLIFT	PEBM	Norfolk	35	54	39	43	171
FAIRMAST	PJLC	Norfolk	31	0	2	0	33
FANAL TRADER	VRUY4	Seattle	64	25	92	84	265
FANTASY	ELKI6	Miami	19	22	18	9	68
FARALLON ISLAND	FARIS	Oakland	109	88	54	549	800
FASCINATION	3EWK9	Miami	8	30	33	25	96
FAUST	WRYX	Jacksonville	45	26	58	36	165
FERNCROFT	LLEJ3	Long Beach	0	10	40	8	58
FIDELIO	WQVY	Jacksonville	31	55	106	34	226
FLAMENGO	PPXU	Norfolk	0	0	118	77	195
FLORAL LAKE	3FFA5	Seattle	0	3	0	0	3
FOREST CHAMPION	3FSH3	Seattle	0	37	0	0	37
FOREST TRADER	A8GJ	Seattle	0	0	12	22	34
FRANCES HAMMER	KRGC	Jacksonville	0	23	47	42	112
FRANCES L	C6YE	Baltimore	1	216	37	17	271
FRANKFURT EXPRESS	9VPP	New York City	21	25	22	5	73
FRED R. WHITE JR	WAR7324	Cleveland	35	37	0	0	72
FREEPORT EXPRESS	V2AJ5	New York City	0	24	49	32	105
G AND C PARANA	LADC2	Long Beach	17	0	0	0	17
GALAXY ACE	VRUI2	Jacksonville	0	0	0	19	19
GALVESTON BAY	WPKD	Houston	51	20	119	71	261
GEETA	VRUL7	New Orleans	0	0	0	1	1
GEORGE A. SLOAN	WA5307	Chicago	73	81	64	87	305
GEORGE A. STINSON	WCX2417	Cleveland	119	142	38	36	335
GEORGE H. WEYERHAEUSER	C6FA7	Oakland	50	114	59	26	249
GEORGE SCHULTZ	ELPG9	Baltimore	47	53	49	47	196
GEORGE WASHINGTON BRIDGE	JKCF	Long Beach	80	46	101	57	284
GEORGIA RAINBOW II	3ERJ8	Jacksonville	49	8	37	0	94
GERMAN SENATOR	P3ZZ6	Norfolk	0	0	2	2	4

Continued on Page 74

Continued from Page 73

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
GINGA MARU	JFKC	Long Beach	0	0	98	88	186
GLOBAL MARINER	WWXA	Baltimore	24	7	33	0	64
GLOBAL NEXTAGE	XYLV	Seattle	0	1	0	0	1
GLORIOUS SUCCESS	DUHN	Seattle	10	46	28	18	102
GLORIOUS SUN	DVTR	Seattle	0	0	71	61	132
GOLDEN BEAR	NMRY	Oakland	65	170	0	0	235
GOLDEN GATE	KIOH	Long Beach	82	52	5	184	323
GOLDEN GATE BRIDGE	3FWM4	Seattle	51	51	55	55	212
GOPHER STATE	WCJV	Norfolk	0	0	0	1	1
GRANDEUR OF THE SEAS	ELTQ9	Miami	24	0	0	0	24
GREAT LAND	WFDP	Seattle	64	31	25	61	181
GREEN BAY	KGTH	Long Beach	0	91	24	9	124
GREEN ISLAND	KIBK	New Orleans	0	34	33	9	76
GREEN LAKE	KGTI	Baltimore	74	158	65	86	383
GREEN MAYA	3ETA5	Seattle	0	13	15	12	40
GREEN RAINIER	3ENI3	Seattle	1	8	3	7	19
GREEN RIDGE	WRYL	Seattle	10	0	13	79	102
GREEN SASEBO	3EUT5	Seattle	1	24	47	31	103
GRETKE OLDENDORFF	ELQJ7	Seattle	0	166	0	36	202
GROTON	KMJL	Newark	42	37	62	12	153
GROWTH RING	3ECN7	Seattle	0	67	0	0	67
GUANAJUATO	ELMH8	Jacksonville	12	33	134	35	214
GUAYAMA	WZJG	Jacksonville	25	43	148	142	358
GULF CURRENT	ELMF9	New Orleans	0	191	17	0	208
GULF SPIRIT	ELIH8	Houston	0	0	0	16	16
GULL ARROW	C6KB4	Baltimore	0	1	10	0	11
GYPSUM BARON	ZCAN3	Norfolk	0	31	44	44	119
GYPSUM KING	ZCAN2	Miami	0	49	48	44	141
H. LEE WHITE	WZD2465	Cleveland	0	37	0	0	37
HADERA	ELBX4	Baltimore	0	2	0	2	4
HANJIN BARCELONA	3EXX9	Long Beach	0	11	12	0	23
HANJIN BREMEN	D7YG	Seattle	10	0	1	3	14
HANJIN FELIXSTOWE	D9TJ	Seattle	11	2	0	3	16
HANJIN HAMBURG	D9TP	Long Beach	0	4	0	0	4
HANJIN KAOHSIUNG	D9TW	Seattle	9	5	5	0	19
HANJIN LE HAVRE	D9SY	Seattle	0	5	8	7	20
HANJIN OAKLAND	D9SG	Long Beach	0	0	0	7	7
HANJIN PORTLAND	3FSB3	Newark	8	4	6	1	19
HANJIN SEATTLE	D9SF	Seattle	9	0	0	0	9
HANJIN SHANGHAI	3FGI5	Newark	0	11	5	12	28
HANJIN SINGAPORE	D9TX	Long Beach	0	0	0	3	3
HANJIN TOKYO	3FZJ3	New York City	1	5	4	0	10
HANJIN VANCOUVER	D9TK	Long Beach	13	0	0	0	13
HANSA CARRIER	ELTY7	Norfolk	0	22	22	0	44
HARBOUR BRIDGE	ELJH9	Seattle	43	19	20	24	106
HEICON	P3TA4	Norfolk	3	37	11	0	51
HEIDELBERG EXPRESS	DEDI	Houston	690	475	360	677	2202
HEKABE	C6OU2	New Orleans	0	11	30	33	74
HELVETIA	OXRO2	Jacksonville	0	26	52	7	85
HENRY HUDSON BRIDGE	JKLS	Long Beach	0	60	46	85	191
HERBERT C. JACKSON	WL3972	Cleveland	0	41	26	29	96
HOEGH CLIPPER	C6IM8	Seattle	0	3	1	0	4
HOEGH DRAKE	ZHEN7	Norfolk	0	31	0	0	31
HOEGH DYKE	C6OX2	Long Beach	26	11	9	19	65
HOEGH MERIT	C6IN3	Seattle	0	12	6	0	18
HOEGH MINERVA	C6IM6	Seattle	0	54	18	0	72
HOLCK LARSEN	VTFJ	Cleveland	2	2	2	0	6
HONSHU SILVIA	3EST7	Seattle	63	92	30	43	228
HOOD ISLAND	C6LU4	Newark	45	12	21	30	108
HOUSTON	FNXB	Houston	14	42	44	49	149
HOUSTON EXPRESS	DLBB	Houston	40	29	32	63	164
HUAL INGRITA	LAUX2	Jacksonville	0	6	2	0	8
HUAL ROLITA	LAVG4	Jacksonville	0	0	14	0	14
HUMACAO	WZJB	Norfolk	33	29	141	78	281
HUMBERGRACHT	PEUQ	Houston	30	33	36	18	117
HUME HIGHWAY	3EJO6	Jacksonville	4	25	27	19	75
HYUNDAI DISCOVERY	3FFR6	Seattle	35	39	45	48	167
HYUNDAI DYNASTY	P3BA7	Long Beach	0	54	48	40	142
HYUNDAI FIDELITY	DNAG	Long Beach	0	59	29	97	185
HYUNDAI FORTUNE	3FLG6	Seattle	11	11	31	23	76
HYUNDAI FREEDOM	3FFS6	Seattle	5	60	11	13	89
HYUNDAI INDEPENDENCE	3FDY6	Seattle	31	90	39	38	198

Continued on Page 75

Continued from Page 74

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
HYUNDAI LIBERTY	3FFT6	Seattle	14	6	23	0	43
IMAGINATION	3EWJ9	Miami	21	19	26	36	102
INDIAN OCEAN	C6T2063	New York City	31	0	0	0	31
INDIANA HARBOR	WXN3191	Cleveland	185	123	95	100	503
INLAND SEAS	WCJ6214	Chicago	2	13	10	7	32
INSPIRATION	3FOA5	Miami	19	111	46	29	205
IOWA TRADER	KNDM	Houston	0	3	0	17	20
IRENA ARCTICA	OXTS2	Miami	57	98	97	127	379
ISLA DE CEDROS	3FOA6	Seattle	76	6	10	9	101
ISLA GRAN MALVINA	LQOK	Newark	0	18	2	0	20
ISLAND BREEZE	C6KP	Miami	4	32	29	0	65
ISLAND PRINCESS	GBBM	Long Beach	4	1	3	26	34
ITB BALTIMORE	WXKM	Baltimore	41	13	39	13	106
ITB MOBILE	KXDB	New York City	8	36	9	48	101
ITB NEW YORK	WVDG	Newark	0	17	24	6	47
IVER EXPLORER	PEXV	Houston	22	0	4	7	33
IVER EXPRESS	PEXX	Houston	23	10	8	17	58
IWANUMA MARU	3ESU8	Seattle	121	83	19	211	434
J. DENNIS BONNEY	ELLE2	Baltimore	0	28	15	93	136
J.A.W. IGLEHART	WTP4966	Cleveland	65	19	0	0	84
JACKLYN M.	WCV7620	Chicago	127	61	19	18	225
JACKSONVILLE	WNDG	Baltimore	51	122	29	65	267
JADE ORIENT	ELRY6	Seattle	12	10	4	0	26
JADE PACIFIC	ELRY5	Seattle	0	8	15	0	23
JAHRE SPIRIT	LAWS2	Houston	5	0	0	0	5
JAMES	ELRR6	New Orleans	15	36	46	40	137
JAMES N. SULLIVAN	ELPG8	Baltimore	0	19	6	0	25
JAMES R. BARKER	WYP8657	Cleveland	126	168	48	88	430
JAPAN SENATOR	DNJS	Norfolk	0	65	67	52	184
JEAN LYKES	WUBV	Houston	0	58	0	0	58
JEB STUART	WRGQ	Oakland	0	117	6	5	128
JO CLIPPER	PFEZ	Baltimore	26	35	21	26	108
JO ELM	PFFD	Baltimore	0	32	20	18	70
JOHN G. MUNSON	WE3806	Chicago	58	124	114	113	409
JOHN J. BOLAND	WF2560	Cleveland	0	69	21	61	151
JOHN PURVES	WCB5820	Chicago	25	0	0	0	25
JOHN YOUNG	ELNG9	Oakland	71	0	84	0	155
JOIDES RESOLUTION	D5BC	Norfolk	1	225	81	58	365
JOSEPH H. FRANTZ	WA6575	Cleveland	0	78	24	28	130
JOSEPH L. BLOCK	WXY6216	Chicago	37	51	37	68	193
JOSEPH LYKES	ELRZ8	Houston	0	1	0	0	1
JUBILANT	ELKA7	Jacksonville	1	0	0	11	12
JUBILEE	3FPM5	Long Beach	8	10	0	0	18
JULIUS HAMMER	KRGJ	Jacksonville	24	32	68	23	147
JUNO ISLAND	3FRF7	Seattle	35	0	0	0	35
KAHO	WZ2043	Chicago	0	11	0	0	11
KAIJIN	3FWI3	Seattle	123	6	0	0	129
KANSAS TRADER	KSDF	Houston	0	23	48	141	212
KAPITAN BYANKIN	UAGK	Seattle	33	115	42	42	232
KAPITAN GNEZPILOV	UQMF	Seattle	0	15	15	3	33
KAPITAN KONEV	UAHV	Seattle	30	49	117	66	262
KAPITAN MAN	UJCQ	Seattle	9	1	9	13	32
KAPITAN SERYKH	UGOZ	Seattle	0	42	55	45	142
KAREN ANDRIE	WBS5272	Chicago	18	0	42	24	84
KAUAI	WSRH	Long Beach	20	55	57	61	193
KAYE E. BARKER	WCF3012	Cleveland	162	198	58	72	490
KAZIMAH	9KKL	Houston	88	54	79	57	278
KELLIE CHOUEST	KUS1038	Norfolk	0	0	0	2	2
KEN KOKU	3FMN6	Seattle	38	0	0	26	64
KEN SHIN	YJQS2	Seattle	23	57	50	47	177
KENAI	WSNB	Houston	36	19	8	35	98
KENNETH E. HILL	C6FA6	Newark	43	26	47	60	176
KENNETH T. DERR	C6FA3	Newark	47	7	81	18	153
KENTUCKY HIGHWAY	JKPP	Norfolk	0	0	0	7	7
KHALEEJ BAY	DHSB	Houston	0	0	0	1	1
KINSMAN INDEPENDENT	WUZ7811	Cleveland	141	189	96	119	545
KNOCK ALLAN	ELOI6	Houston	71	0	5	7	83
KOELN EXPRESS	9VBL	New York City	206	665	697	168	1736
KOMET	V2SA	Miami	31	37	37	37	142
KOMSOMOLETS PRIMORYA	EMEK	Seattle	0	37	52	35	124
KURAMA	3EOF7	Newark	0	3	6	2	11
KURE	3FGN3	Seattle	15	0	74	35	124

Continued on Page 76

Continued from Page 75

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
LA ESPERANZA	3EQV8	Baltimore	3	0	34	26	63
LAKE CHARLES	KPTB	New Orleans	0	9	91	17	117
LAWRENCE H. GIANELLA	WLBX	Norfolk	26	31	15	12	84
LEE A. TREGURTHA	WUR8857	Cleveland	33	62	16	11	122
LEGEND OF THE SEAS	ELRR5	New Orleans	17	0	0	0	17
LEONARD J. COWLEY	CG2959	Norfolk	0	16	0	0	16
LEOPARDI	V7AV8	Baltimore	0	3	0	24	27
LIBERTY SEA	KPZH	New Orleans	41	0	0	0	41
LIBERTY STAR	WCBP	New Orleans	54	16	50	108	228
LIBERTY SUN	WCOB	Houston	0	15	3	40	58
LIBERTY WAVE	KRHZ	Norfolk	2	0	0	1	3
LIHUE	WTST	Seattle	14	46	105	30	195
LILAC ACE	3FDL4	Long Beach	0	134	19	13	166
LINDA OLDENDORF	ELRR2	Baltimore	12	50	45	9	116
LIRCAY	ELEV8	Houston	3	10	9	3	25
LNG AQUARIUS	WSKJ	Oakland	118	35	76	86	315
LNG CAPRICORN	KHLN	New York City	64	11	22	0	97
LNG LEO	WDZB	New York City	13	20	47	28	108
LNG LIBRA	WDZG	New York City	0	0	0	36	36
LNG TAURUS	WDZW	New York City	63	13	51	84	211
LNG VIRGO	WDZX	New York City	0	0	36	112	148
LOA	ELOF7	Long Beach	2	0	0	0	2
LONDON SPIRIT	GCCC	Baltimore	0	36	2	44	82
LONDON VICTORY	GCCB	New York City	0	62	42	62	166
LONG BEACH	3FOU3	Seattle	4	26	5	144	179
LONG LINES	WATF	Baltimore	57	0	0	0	57
LOOTSGRACHT	PFPT	Houston	8	1	19	10	38
LOUIS MAERSK	OXMA2	Baltimore	2	0	0	22	24
LT ARGOSY	VTKG	Cleveland	5	0	0	0	5
LT PRAGATI	VVDX	Seattle	206	0	0	0	206
LT. ODYSSEY	VTKB	Cleveland	0	0	0	3	3
LTC CALVIN P. TITUS	KAKG	Baltimore	0	41	0	0	41
LUCY OLDENDORFF	ELPA2	Long Beach	15	20	0	2	37
LUISE OLDENDORFF	3FOW4	Seattle	67	22	47	94	230
LUTJENBURG	DGLU	Long Beach	0	43	74	70	187
LUTJENBURG	ELVF6	Long Beach	56	0	0	0	56
LYKES EXPLORER	WGLA	Houston	4	10	113	41	168
M/V FRANCOIS L.D.	FNEQ	Norfolk	17	0	0	0	17
MACKINAC BRIDGE	JKES	Long Beach	62	54	91	48	255
MADISON MAERSK	OVJB2	Oakland	24	20	57	5	106
MAERSK CALIFORNIA	WCX5083	Houston	0	0	0	107	107
MAERSK CONSTELLATION	WRYJ	Oakland	33	0	37	284	354
MAERSK ENDEAVOUR	XP4210	Miami	0	195	194	186	575
MAERSK EXPLORER	XP3344	Miami	1	129	172	162	464
MAERSK GANNET	GJLK	Miami	0	21	7	58	86
MAERSK GIANT	OU2465	Miami	235	219	233	235	922
MAERSK QUITO	OXWF2	Norfolk	0	0	1	0	1
MAERSK SHETLAND	MSQK3	Miami	0	20	50	49	119
MAERSK SOMERSET	MQVF8	New Orleans	68	37	79	28	212
MAERSK STAFFORD	MRSS9	Miami	0	19	8	36	63
MAERSK SUN	S6ES	Seattle	71	88	36	0	195
MAERSK SURREY	MRSG8	Houston	0	0	15	16	31
MAERSK TEXAS	WCX3249	Houston	7	0	0	0	7
MAGLEBY MAERSK	OUSH2	Newark	26	14	14	20	74
MAHARASHTRA	VTSQ	Seattle	0	86	0	15	101
MAHIMAHI	WHRN	Oakland	48	53	67	60	228
MAIRANGI BAY	GXEW	Long Beach	67	70	80	59	276
MAJ STEPHEN W PLESS MPS1	WHAU	Norfolk	0	26	92	11	129
MAJESTIC MAERSK	OUJH2	Newark	11	46	49	43	149
MANGAL DESAI	VTJS	Cleveland	21	7	7	1	36
MANHATTAN BRIDGE	3FWL4	Long Beach	30	25	68	42	165
MANOA	KDBG	Oakland	41	71	66	81	259
MANUKAI	KNLO	Oakland	19	58	53	67	197
MANULANI	KNIJ	Oakland	0	44	30	61	135
MARCARRIER	V2VM	Newark	243	0	0	1	244
MARCHEN MAERSK	OWDQ2	Long Beach	22	11	54	30	117
MAREN MAERSK	OWZU2	Long Beach	1	5	51	1	58
MARGARET LYKES	WGXO	Houston	51	19	79	28	177
MARGRETHE MAERSK	OYSN2	Long Beach	12	35	30	47	124
MARI BETH ANDRIE	WUY3362	Chicago	0	0	15	37	52
MARIE MAERSK	OULL2	Newark	30	46	26	106	208
MARIT MAERSK	OZFC2	Oakland	31	26	35	47	139

Continued on Page 77

Continued from Page 76

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
MARK HANNAH	WYZ5243	Chicago	7	47	48	15	117
MARLIN	6ZXG	New Orleans	0	0	0	67	67
MARSTA MAERSK	OUNO5	Norfolk	5	11	22	49	87
MATHILDE MAERSK	OUUU2	Long Beach	19	17	69	34	139
MATSONIA	KHRC	Oakland	90	73	52	90	305
MAUI	WSLH	Long Beach	43	30	109	90	272
MAURICE EWING	WLDZ	Newark	28	26	20	47	121
MAYAGUEZ	WZJE	Jacksonville	0	35	201	87	323
MAYVIEW MAERSK	OWEB2	Oakland	18	102	40	19	179
MC-KINNEY MAERSK	OUZW2	Newark	19	17	48	31	115
MEDALLION	OYEK2	Jacksonville	0	0	4	14	18
MEDUSA CHALLENGER	WA4659	Cleveland	92	108	132	117	449
MEKHANIK MOLDOVANOV	UIKI	Seattle	22	0	0	0	22
MELBOURNE HIGHWAY	3ERW2	Long Beach	0	0	0	4	4
MELBOURNE STAR	C6JY6	Newark	39	81	200	35	355
MELVILLE	WECB	Long Beach	98	230	19	0	347
MERCHANT PREMIER	VROP	Houston	31	30	10	38	109
MERCHANT PRINCE	C6HQ8	Houston	30	16	12	69	127
MERIDIAN	C6IP3	Miami	0	14	34	18	66
MERLION ACE	9VHJ	Long Beach	0	16	15	16	47
MESABI MINER	WYQ4356	Cleveland	164	0	0	197	361
METEOR	DBBH	Houston	210	207	200	214	831
METTE MAERSK	OXKT2	Long Beach	15	21	19	85	140
MICHIGAN	WRB4141	Chicago	11	89	197	0	297
MIDDLETOWN	WR3225	Cleveland	44	51	24	38	157
MING ASIA	BDEA	New York City	11	0	0	6	17
MING PLEASURE	BLII	Long Beach	0	38	17	39	94
MOANA PACIFIC	P3EK7	Long Beach	0	4	2	0	6
MOKIHANA	WNRD	Oakland	56	61	46	73	236
MOKU PAHU	WBWK	Oakland	74	54	18	5	151
MORELOS	PGBB	Houston	47	52	58	172	329
MORMACSKY	WMBQ	New York City	0	0	3	11	14
MORMACSTAR	KGDF	Houston	0	30	217	42	289
MORMACSUN	WMBK	Norfolk	28	10	8	9	55
MOSEL ORE	ELRE5	Norfolk	66	61	251	59	437
MSC BOSTON	9HGP4	New York City	8	0	0	0	8
MSC JESSICA	C6BK6	Newark	78	12	34	0	124
MSC NEW YORK	9HIG4	New York City	3	0	0	0	3
MUNKEBO MAERSK	OUNI5	New York City	17	14	138	25	194
MV MIRANDA	3FRO4	Norfolk	44	0	0	0	44
MYRON C. TAYLOR	WA8463	Chicago	27	84	104	105	320
MYSTIC	PCCQ	Long Beach	0	9	37	45	91
NADA II	ELAV2	Seattle	16	0	0	0	16
NAJA ARCTICA	OXVH2	Miami	77	62	120	102	361
NATIONAL DIGNITY	DZRG	Long Beach	8	7	14	9	38
NATIONAL HONOR	DZDI	Long Beach	9	16	3	3	31
NATIONAL PRIDE	DZPK	Long Beach	0	18	9	11	38
NAUTICAS MEXICO	XCMM	Houston	0	0	0	21	21
NEDLLOYD ABIDJAN	S6BP	Long Beach	18	52	136	12	218
NEDLLOYD DELFT	PGDD	Houston	56	57	51	64	228
NEDLLOYD HOLLAND	KRHX	Houston	32	148	52	121	353
NEDLLOYD MONTEVIDEO	PGAF	Long Beach	32	22	1	44	99
NEDLLOYD RALEIGH BAY	PHKG	Houston	21	34	36	38	129
NEDLLOYD ROTTERDAM	PGEI	Newark	1	0	0	0	1
NEDLLOYD VAN DAJIMA	PGDB	Houston	43	64	50	68	225
NEDLLOYD VAN DIEMEN	PGFE	Houston	39	47	46	45	177
NEGO LOMBOK	DXQC	Seattle	0	62	31	21	114
NELVANA	YJWZ7	Baltimore	16	67	70	22	175
NEPTUNE ACE	JFLX	Long Beach	15	66	13	55	149
NEPTUNE JADE	9VNQ	Norfolk	0	9	6	4	19
NEPTUNE RHODONITE	ELJP4	Long Beach	19	39	32	21	111
NEW CARISSA	3ELY7	Seattle	243	33	24	43	343
NEW HORIZON	WKWB	Long Beach	52	29	0	6	87
NEW NIKKI	3FHG5	Seattle	81	39	47	74	241
NEWARK BAY	WPKS	Houston	26	56	35	144	261
NEWPORT BRIDGE	3FGH3	Oakland	17	13	18	17	65
NOAA DAVID STARR JORDAN	WTDK	Seattle	42	7	8	26	83
NOAA SHIP ALBATROSS IV	WMVF	Norfolk	91	97	304	73	565
NOAA SHIP CHAPMAN	WTED	New Orleans	175	147	169	106	597
NOAA SHIP DELAWARE II	KNBD	New York City	142	69	205	55	471
NOAA SHIP FERREL	WTEZ	Norfolk	54	66	125	255	500
NOAA SHIP KA’IMIMOANA	WTEU	Seattle	141	472	106	224	943

Continued on Page 78

Continued from Page 77

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
NOAA SHIP MCARTHUR	WTEJ	Seattle	36	99	105	33	273
NOAA SHIP MILLER FREEMAN	WTDM	Seattle	197	381	136	229	943
NOAA SHIP OREGON II	WTDO	New Orleans	0	190	160	162	512
NOAA SHIP RAINIER	WTEF	Seattle	60	97	78	81	316
NOAA SHIP T. CROMWELL	WTDF	Seattle	82	413	177	130	802
NOAA SHIP WHITING	WTEW	Baltimore	148	65	212	197	622
NOBEL STAR	KRPP	Houston	0	8	21	6	35
NOL AMBER	S6CY	Seattle	0	2	11	0	13
NOL DELPHI	ZCBF6	Houston	63	0	48	58	169
NOL DIAMOND	9VYT	Long Beach	0	0	2	5	7
NOL LAGENO	ZCBF2	New York City	0	58	59	46	163
NOL RISSO	ZCBE6	New York City	32	50	35	24	141
NOL RUBY	9VOP	Seattle	0	6	0	0	6
NOL STENO	ZCBD4	New York City	14	13	23	29	79
NOL STENO	ZCBF4	New York City	16	44	38	57	155
NOL TOPAZ	9VOW	Seattle	0	7	9	8	24
NOL ZIRCON	9VOS	Long Beach	0	29	17	13	59
NOLIZWE	MQLN7	New York City	241	45	72	128	486
NOMZI	MTQU3	Baltimore	131	105	239	81	556
NOORDAM	PGHT	Miami	1	0	0	0	1
NORASIA SHANGHAI	DNHS	New York City	26	4	29	29	88
NORD JAHRE TRANSPORTER	LACF4	Baltimore	0	15	8	0	23
NORD PARTNER	P3XC5	New York City	0	39	35	61	135
NORDMAX	P3YS5	Seattle	64	11	335	82	492
NORDMORITZ	P3YR5	Seattle	93	33	79	54	259
NORDSTRAND	P3NV5	Norfolk	6	0	0	0	6
NORTHERN LIGHTS	WFJK	New Orleans	56	116	154	54	380
NORTHERN LION	A8IE	Long Beach	0	142	67	0	209
NORWAY	C6CM7	Miami	0	10	3	3	16
NTABENI	3EGR6	Houston	45	56	68	80	249
NUERNBERG EXPRESS	9VBK	Houston	730	689	729	718	2866
NUEVO LEON	XCKX	Houston	47	62	35	31	175
NUEVO SAN JUAN	KEOD	Norfolk	32	77	74	70	253
NYK SEABREEZE	ELNJ3	Seattle	6	32	24	18	80
NYK SPRINGTIDE	S6CZ	Houston	7	6	12	15	40
NYK STARLIGHT	3FUX6	Long Beach	10	31	41	52	134
NYK SUNRISE	3FYZ6	Seattle	58	26	27	34	145
NYK SURFWIND	ELOT3	Seattle	4	1	0	0	5
OCEAN BELUGA	3FEI6	Jacksonville	56	8	2	6	72
OCEAN CAMELLIA	3FTR6	Seattle	68	51	188	58	365
OCEAN CITY	WCYR	Houston	0	11	18	105	134
OCEAN CLIPPER	3EXI7	New Orleans	65	0	63	119	247
OCEAN HARMONY	3FRX6	Seattle	0	40	30	15	85
OCEAN LAUREL	3FLX4	Seattle	6	1	4	32	43
OCEAN LILY	3EQS7	Seattle	8	0	0	0	8
OCEAN ORCHID	3ECQ9	Seattle	0	11	9	0	20
OCEAN SERENE	DURY	Seattle	71	78	51	11	211
OGLEBAY NORTON	WAQ3521	Cleveland	83	21	8	11	123
OLEANDER	PJJU	Newark	5	46	39	136	226
OLIVEBANK	3ETQ5	Baltimore	17	4	27	37	85
OLYMPIAN HIGHWAY	3FSH4	Seattle	0	0	0	11	11
OMI COLUMBIA	KLKZ	Oakland	63	11	10	15	99
OOCL AMERICA	ELSM7	Oakland	20	12	44	53	129
OOCL CALIFORNIA	ELSA4	Seattle	28	13	12	23	76
OOCL CHINA	ELSU8	Long Beach	54	121	56	47	278
OOCL ENVOY	ELNV7	Seattle	31	27	22	17	97
OOCL FAIR	ELFV2	Long Beach	29	19	34	33	115
OOCL FAME	ELRO3	Seattle	0	42	14	12	68
OOCL FIDELITY	ELFV8	Long Beach	32	219	25	25	301
OOCL FORTUNE	ELFU8	Norfolk	105	31	20	47	203
OOCL FREEDOM	VRCV	Norfolk	22	39	54	45	160
OOCL FRONTIER	VRUC6	Seattle	0	22	17	14	53
OOCL HONG KONG	VRVA5	Oakland	11	40	39	31	121
OOCL INNOVATION	WPWH	Houston	130	54	40	266	490
OOCL INSPIRATION	KRPB	Houston	38	146	51	140	375
OOCL JAPAN	ELSU6	Long Beach	64	70	57	46	237
ORANGE BLOSSOM	ELEI6	Newark	5	0	0	0	5
ORANGE WAVE	ELPX7	Newark	0	0	8	3	11
ORIANA	GVSN	Miami	43	34	22	37	136
ORIENTE GRACE	3FHT4	Seattle	33	21	19	14	87
ORIENTE HOPE	3ETH4	Seattle	53	33	67	46	199
ORIENTE NOBLE	3FVF5	Seattle	26	18	5	22	71

Continued on Page 79

Continued from Page 78

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
ORIENTE PRIME	3FOU4	Seattle	0	20	23	17	60
OURO DO BRASIL	ELPP9	Baltimore	15	26	42	41	124
OVERSEAS ALASKA	WEHV	Seattle	0	12	7	19	38
OVERSEAS ARCTIC	KLEZ	New Orleans	0	14	23	36	73
OVERSEAS CHICAGO	KBCF	Oakland	5	11	131	7	154
OVERSEAS HARRIET	WRFJ	Houston	0	23	12	30	65
OVERSEAS JOYCE	WUQL	Jacksonville	60	24	46	33	163
OVERSEAS JUNEAU	WWND	Seattle	10	46	0	11	67
OVERSEAS MARILYN	WFQB	Houston	0	21	33	12	66
OVERSEAS NEW ORLEANS	WFKW	Houston	26	5	18	68	117
OVERSEAS NEW YORK	WMCK	Houston	16	1	11	17	45
OVERSEAS OHIO	WJBG	Oakland	47	62	74	53	236
OVERSEAS VIVIAN	KAAZ	Norfolk	0	0	1	1	2
OVERSEAS WASHINGTON	WFGV	Houston	0	3	44	79	126
P&O NEDLLOYD CHILE	DVRA	New York City	20	0	3	0	23
PACASIA	ELKM7	Seattle	0	27	18	27	72
PACDUKE	A8SL	Seattle	8	24	33	8	73
PACIFIC ARIES	ELJQ2	Seattle	7	23	0	0	30
PACIFIC HIRO	3FOY5	Seattle	0	0	0	42	42
PACIFIC HOPE	3EOK8	Seattle	0	21	36	0	57
PACIFIC RAINBOW II	3FCY5	Seattle	0	14	5	7	26
PACIFIC SANDPIPER	GDRJ	Miami	63	83	53	29	228
PACIFIC SELESA	DVCK	Seattle	27	0	0	0	27
PACIFIC SENATOR	ELTY6	Long Beach	0	47	20	37	104
PACIFIC WAVE	3EXQ9	Long Beach	0	1	17	18	36
PACMERCHANT	5MCB	Seattle	0	10	11	6	27
PACOCEAN	XYLA	Seattle	2	2	0	0	4
PACROSE	YJQK2	Seattle	2	14	10	92	118
PACSEA	XYKX	Seattle	8	15	0	17	40
PACSTAR	XYLB	Seattle	23	50	77	20	170
PARIS	ELTY4	Houston	1	0	0	0	1
PAUL BUCK	KDGR	Houston	0	0	0	103	103
PAUL H. TOWNSEND	WF9016	Cleveland	0	35	0	0	35
PAUL R. TREGURTHA	WYR4481	Cleveland	69	99	172	75	415
PEGASUS HIGHWAY	3FMA4	New York City	13	18	15	22	68
PEGGY DOW	PJOY	Long Beach	70	46	30	63	209
PFC EUGENE A. OBREGON	WHAQ	Norfolk	0	0	5	80	85
PFC JAMES ANDERSON JR	WJXG	Newark	24	0	0	23	47
PHILADELPHIA	KSYP	Baltimore	26	47	47	54	174
PHILIP R. CLARKE	WE3592	Chicago	38	104	92	39	273
PHOENIX DIAMOND	3EGS6	Norfolk	0	10	34	33	77
PIERRE FORTIN	CG2678	Norfolk	223	226	225	235	909
PINO GLORIA	3EZW7	Seattle	15	14	34	41	104
PISCES EXPLORER	MWQD5	Long Beach	21	21	34	28	104
PISCES PIONEER	MWQE5	Long Beach	40	61	20	30	151
POLAR EAGLE	ELPT3	Long Beach	51	36	53	53	193
POLYNESIA	D5NZ	Long Beach	92	192	104	93	481
POROS	P3DX6	New Orleans	0	0	2	0	2
POTOMAC TRADER	WXBZ	Houston	43	12	17	48	120
POYANG	ELAX2	Long Beach	3	43	55	60	161
PRESIDENT ADAMS	WRYW	Oakland	55	58	69	72	254
PRESIDENT EISENHOWER	KRJG	Long Beach	2	50	98	56	206
PRESIDENT F. ROOSEVELT	KRJF	Long Beach	0	77	73	39	189
PRESIDENT HOOVER	WCY2883	Oakland	54	0	0	0	54
PRESIDENT JACKSON	WRYC	Oakland	71	20	82	28	201
PRESIDENT KENNEDY	WRYE	Oakland	33	32	17	46	128
PRESIDENT POLK	WRYD	Oakland	62	58	49	60	229
PRESIDENT TRUMAN	WNDP	Oakland	18	44	24	39	125
PRESQUE ISLE	WZE4928	Chicago	144	203	81	89	517
PRIDE OF BALTIMORE II	WUW2120	Baltimore	74	0	0	168	242
PRINCE OF OCEAN	3ECO9	Seattle	62	0	58	57	177
PRINCE OF TOKYO 2	3EUU6	Seattle	0	43	283	35	361
PRINCE WILLIAM SOUND	WSDX	Long Beach	18	64	13	54	149
PRINCESS CLIPPER	VRUC4	Norfolk	27	0	0	0	27
PRINCESS OF SCANDINAVIA	OWEN2	Miami	129	49	64	104	346
PROJECT ARABIA	PJKP	Miami	20	26	48	57	151
PROJECT ORIENT	PJAG	Baltimore	15	32	10	9	66
PUDONG SENATOR	DQVI	Seattle	55	0	0	58	113
PUERTO CORTES	C6IM2	Jacksonville	0	0	1	23	24
PUSAN SENATOR	DQVG	Seattle	25	22	7	0	54
QUEEN ELIZABETH 2	GBTT	New York City	50	20	49	55	174
QUEEN OF SCANDINAVIA	OUSE6	Miami	52	78	58	48	236

Continued on Page 80

Continued from Page 79

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
QUEENSLAND STAR	C6JZ3	Houston	122	73	203	77	475
R. HAL DEAN	C6JN	Long Beach	0	0	7	0	7
R.J. PFEIFFER	WRJP	Long Beach	65	23	52	22	162
RANI PADMINI	ATSR	Norfolk	0	15	5	15	35
RAYMOND E. GALVIN	ELCO5	Oakland	0	41	9	9	59
REBECCA LYNN	WCW7977	Chicago	3	0	0	60	63
REGINA J	V2AC3	Miami	0	29	10	0	39
REPULSE BAY	MQYA3	Houston	0	59	46	47	152
RESERVE	WE7207	Cleveland	50	144	85	75	354
RESOLUTE	KFDZ	Norfolk	53	11	38	57	159
RHAPSODY OF THE SEAS	LAZK4	Miami	4	0	0	0	4
RHINE FOREST	ELFO3	New Orleans	0	82	39	47	168
RICHARD G MATTHIESEN	WLBV	Jacksonville	0	0	3	4	7
RICHARD REISS	WBF2376	Cleveland	6	17	0	0	23
RIO ENCO	CBRE	New York City	4	0	0	0	4
ROGER BLOUGH	WZP8164	Chicago	103	103	79	89	374
ROGER REVELLE	KAOU	New Orleans	55	0	0	46	101
RONALD H. BROWN	WTEC	New Orleans	83	0	48	251	382
ROSITA	LATL2	Miami	0	35	0	4	39
ROSSEL CURRENT	J8FI6	Houston	11	210	188	44	453
ROVER	KCBH	Houston	0	0	4	0	4
ROYAL ETERNITY	DUXW	Norfolk	56	0	0	0	56
ROYAL MAJESTY	3ETG9	Miami	0	7	13	2	22
ROYAL PRINCESS	GBRP	Long Beach	27	17	29	11	84
RUBIN BONANZA	3FNV5	Seattle	10	0	28	27	65
RUBIN KOBE	DYZM	Seattle	52	59	55	63	229
RUBIN PEARL	YJQA8	Seattle	0	53	13	9	75
RUBIN STAR	3FIA5	Seattle	0	12	2	0	14
RUBIN STELLA	3FAP5	Seattle	25	159	14	24	222
SAGA CREST	LATH4	Miami	0	16	7	0	23
SALOME	S6CL	Newark	0	5	85	29	119
SAM HOUSTON	KDGA	Houston	28	0	23	145	196
SAMUEL GINN	C6OB	Oakland	49	0	0	0	49
SAMUEL H. ARMACOST	C6FA2	Oakland	10	7	5	32	54
SAMUEL L. COBB	KCDJ	Oakland	0	0	24	0	24
SAMUEL RISLEY	CG2960	Norfolk	151	86	14	76	327
SAN ANTONIO	LATN4	New Orleans	44	62	50	56	212
SAN FELIPE	DNEN	Houston	15	3	0	0	18
SAN FERNANDO	DGGD	Houston	37	7	15	24	83
SAN FRANCISCO	DIGF	New York City	33	17	22	40	112
SAN ISIDRO	ELVG8	Norfolk	24	0	0	0	24
SAN MARCOS	ELND4	Jacksonville	48	19	289	0	356
SAN VINCENTE	DNGV	Norfolk	0	29	31	60	120
SANKO LAUREL	3EXQ3	Seattle	0	0	52	60	112
SANKO MOON	3FKE2	Seattle	0	13	5	9	27
SANTA CHRISTINA	3FAE6	Seattle	80	148	55	34	317
SANTA ISABELLALOON	DPSI	Long Beach	0	0	0	5	5
SANTORIN 2	P3ZL4	Seattle	0	112	46	263	421
SARAMATI	9VIW	Baltimore	3	0	1	21	25
SC HORIZON	ELOC8	New York City	76	174	64	67	381
SCHACKENBORG	OYUY4	Houston	0	2	5	19	26
SEA COMMERCE	ELGH7	Miami	0	29	33	31	93
SEA FLORIDA	3EKI3	New Orleans	0	41	61	41	143
SEA FOX	KBGK	Jacksonville	32	40	191	74	337
SEA INITIATIVE	DEBB	Houston	4	3	7	49	63
SEA ISLE CITY	WCYQ	Houston	0	15	28	30	73
SEA LION	KJLV	Jacksonville	150	0	62	110	322
SEA LYNX	DGOO	Jacksonville	49	0	0	59	108
SEA MAJESTY	DYAA	Seattle	0	50	91	45	186
SEA MARINER	J8FF9	Miami	68	0	1	0	69
SEA NOVIA	ELRV2	Miami	0	13	15	0	28
SEA PRINCESS	KRCP	New Orleans	6	50	26	15	97
SEA RACER	ELQI8	Jacksonville	21	15	13	7	56
SEA SPRAY	WRXN	Newark	0	4	9	8	21
SEA TRADE	ELGH4	Norfolk	0	14	0	0	14
SEA VIGOR	P3ZH4	Miami	13	0	0	0	13
SEA WISDOM	3FUO6	Seattle	35	14	0	45	94
SEA WOLF	KNFG	Jacksonville	4	52	147	92	295
SEA-LAND CHARGER	V7AY2	Long Beach	0	42	64	51	157
SEA-LAND EAGLE	V7AZ8	Long Beach	58	0	34	30	122
SEA/LAND VICTORY	DIDY	New York City	3	38	32	25	98
SEABOARD SUN	ELRV6	Jacksonville	4	35	17	18	74

Continued on Page 81

Continued from Page 80

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
SEABOARD UNIVERSE	ELRU3	Miami	15	25	65	29	134
SEABREEZE I	3FGV2	Miami	11	14	13	9	47
SEALAND ANCHORAGE	KGTX	Seattle	50	44	47	44	185
SEALAND ARGENTINA	DGVN	Jacksonville	9	0	0	0	9
SEALAND ATLANTIC	KRLZ	Norfolk	24	12	1	33	70
SEALAND CHALLENGER	WZJC	Newark	74	56	63	35	228
SEALAND CHAMPION	V7AM9	Oakland	37	23	75	51	186
SEALAND COMET	V7AP3	Oakland	12	16	7	86	121
SEALAND CONSUMER	WCHF	Long Beach	47	7	40	18	112
SEALAND CRUSADER	WZJF	Jacksonville	81	89	120	29	319
SEALAND DEFENDER	KGJB	Oakland	41	34	29	105	209
SEALAND DEVELOPER	KHRH	Long Beach	29	58	48	52	187
SEALAND DISCOVERY	WZJD	Jacksonville	72	63	50	62	247
SEALAND ENDURANCE	KGJX	Long Beach	21	60	8	35	124
SEALAND ENTERPRISE	KRGB	Oakland	74	103	162	68	407
SEALAND EXPEDITION	WPGJ	Jacksonville	64	5	175	25	269
SEALAND EXPLORER	WGJF	Long Beach	46	21	47	106	220
SEALAND EXPRESS	KGJD	Long Beach	24	377	10	45	456
SEALAND FREEDOM	V7AM3	Seattle	23	80	35	51	189
SEALAND HAWAII	KIRF	Houston	63	42	48	33	186
SEALAND INDEPENDENCE	WGJC	Long Beach	0	25	126	67	218
SEALAND INNOVATOR	WGKF	Oakland	90	41	60	31	222
SEALAND INTEGRITY	WPVD	Houston	111	165	87	148	511
SEALAND INTREPID	V7BA2	Norfolk	33	0	0	0	33
SEALAND KODIAK	KGTZ	Seattle	21	1	19	20	61
SEALAND LIBERATOR	KHRP	Oakland	63	25	19	18	125
SEALAND MARINER	V7AM5	Seattle	0	72	57	5	134
SEALAND MERCURY	V7AP6	Oakland	31	25	87	65	208
SEALAND METEOR	V7AP7	Long Beach	8	43	27	80	158
SEALAND NAVIGATOR	WPGK	Long Beach	44	82	93	79	298
SEALAND PACER	KSLB	Newark	18	12	10	15	55
SEALAND PACIFIC	WSRL	Long Beach	68	71	99	54	292
SEALAND PATRIOT	KHRF	Oakland	61	16	95	52	224
SEALAND PERFORMANCE	KRPD	Norfolk	82	229	57	47	415
SEALAND PRODUCER	WJBJ	Long Beach	94	78	98	58	328
SEALAND QUALITY	KRNJ	Jacksonville	9	25	204	22	260
SEALAND RACER	V7AP8	Long Beach	17	43	24	26	110
SEALAND RELIANCE	WFLH	Long Beach	87	61	80	84	312
SEALAND SPIRIT	WFLG	Oakland	36	0	11	50	97
SEALAND TACOMA	KGTY	Seattle	45	63	24	58	190
SEALAND TRADER	KIRH	Oakland	89	47	96	82	314
SEALAND VOYAGER	KHRK	Seattle	57	35	105	59	256
SEARIVER BATON ROUGE	WAFA	Oakland	14	9	0	6	29
SEARIVER BAYTOWN	KFPM	Oakland	0	0	10	5	15
SEARIVER BENICIA	KPKL	Long Beach	1	2	8	20	31
SEARIVER LONG BEACH	WHCA	Long Beach	13	0	0	14	27
SEARIVER NORTH SLOPE	KHLQ	Oakland	8	1	0	0	9
SEARIVER SAN FRANCISCO	KAAC	Oakland	9	10	13	26	58
SEAWIND CROWN	3EIY6	Miami	0	51	57	31	139
SEILLEAN	3FPF6	Long Beach	0	108	112	117	337
SENSATION	3ESE9	Miami	16	48	37	44	145
SETO BRIDGE	JMQY	Oakland	0	43	59	65	167
SEVEN OCEAN	DULR	Seattle	0	1	15	7	23
SEWARD JOHNSON	WST9756	Miami	96	0	0	339	435
SGT WILLIAM A BUTTON	WJLX	Norfolk	0	0	31	19	50
SGT. METEJ KOCAK	WHAC	Norfolk	10	13	12	34	69
SHELLY BAY	3EKH3	Miami	18	73	59	59	209
SHIRAOI MARU	3ECM7	Seattle	82	76	77	52	287
SIBOHELLE	LAQN4	Norfolk	0	10	7	18	35
SIDNEY STAR	C6JY7	Houston	59	64	30	56	209
SIETE OCEANOS	DYBX	Seattle	0	57	0	0	57
SINCERE GEMINI	3FFG3	Seattle	0	5	0	1	6
SINCERE SUCCESS	VRUC5	Seattle	0	2	22	9	33
SKAUBRYN	LAJV4	Seattle	24	21	27	15	87
SKAUGRAN	LADB2	Seattle	61	9	3	2	75
SKOGAFOSS	V2QT	Norfolk	0	44	29	40	113
SKY PRINCESS	GYYP	Miami	0	26	114	24	164
SNOW CRYSTAL	C6ID8	New York City	0	42	43	58	143
SOKOLICA	ELIG5	Baltimore	2	8	28	35	73
SOL DO BRASIL	ELQQ4	Baltimore	0	18	13	5	36
SOLAR WING	ELJS7	Jacksonville	42	37	40	29	148
SONG OF AMERICA	LENA3	Miami	7	20	16	6	49

Continued on Page 82

Continued from Page 81

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
SONORA	XCTJ	Houston	39	309	37	32	417
SOREN TOUBRO	VTFM	Cleveland	1	167	34	7	209
SOUTH FORTUNE	3FJC6	Seattle	61	0	0	0	61
SOUTHERN LION	V7AW8	Long Beach	38	7	19	8	72
SPERO	LAON4	Seattle	80	46	47	74	247
SPRING GANNET	3EVB3	Seattle	92	43	5	22	162
SPRING WAVE	9VXB	Seattle	19	25	23	48	115
ST BLAIZE	J8FO	Norfolk	52	0	44	38	134
ST. CLAIR	WZA4027	Cleveland	0	118	0	0	118
STAR ALABAMA	LAVU4	Long Beach	10	2	7	5	24
STAR AMERICA	LAVV4	Jacksonville	37	30	132	7	206
STAR DOVER	LAEP4	Seattle	6	0	0	0	6
STAR EAGLE	LAWO2	Houston	30	12	14	25	81
STAR EVVIVA	LAHE2	Jacksonville	9	42	29	14	94
STAR FLORIDA	LAVW4	Houston	43	24	32	52	151
STAR FUJI	LAVX4	Seattle	14	35	19	22	90
STAR GRAN	LADR4	Long Beach	33	14	18	0	65
STAR GRINDANGER	ELFT9	Norfolk	4	0	0	0	4
STAR HANSA	LAXP4	Jacksonville	1	0	0	0	1
STAR HARDANGER	LAXD4	Baltimore	5	119	45	79	248
STAR HERDLA	LAVD4	Baltimore	34	16	30	22	102
STAR HOYANGER	LAXG4	Long Beach	0	0	1	0	1
STAR SKARVEN	LAJY2	Miami	36	33	28	41	138
STAR SKOGANGER	LASS2	Houston	12	7	5	12	36
STAR STRONEN	LAHG2	Houston	22	0	4	62	88
STATENDAM	PHSG	Miami	12	0	0	0	12
STELLA LYKES	WGXN	Houston	27	17	14	131	189
STEPAN KRASHENINNIKOV	UYPO	Seattle	5	2	5	8	20
STEPHAN J	V2JN	Miami	95	145	133	131	504
STEWART J. CORT	WYZ3931	Chicago	33	5	23	81	142
STOLT CONDOR	D5VF	Newark	9	0	2	0	11
STOLT HELLULAND	ELJZ7	New York City	0	3	0	0	3
STONEWALL JACKSON	KDDW	New Orleans	68	11	75	33	187
STRONG CAJUN	KALK	Norfolk	25	0	0	0	25
STRONG VIRGINIAN	KSPH	Oakland	0	50	33	15	98
SUGAR ISLANDER	KCKB	Houston	0	1	0	0	1
SUMMER BREEZE	ZCBB4	Miami	2	45	42	22	111
SUMMER MEADOW	ZCAY8	Long Beach	0	10	13	7	30
SUN DANCE	3ETQ8	Seattle	12	14	23	14	63
SUN PRINCESS	ELSJ2	Miami	0	0	4	2	6
SUNBELT DIXIE	D5BU	Baltimore	16	17	15	49	97
SUNDA	ELPB8	Houston	64	43	54	58	219
SUSAN W. HANNAH	WAH9146	Chicago	11	209	0	0	220
SVEN OLTMANN	V2JP	Miami	32	27	22	29	110
SWAN ARROW	C6CN8	Baltimore	4	0	0	0	4
T/V STATE OF MAINE	NTNR	Norfolk	12	44	3	0	59
TADEUSZ OCIOSZYNSKI	SQGI	Houston	0	0	7	0	7
TAI CHUNG	BHFL	Seattle	0	0	29	19	48
TAI HE	BOAB	Long Beach	53	42	34	90	219
TAI SHING	BHFR	Seattle	0	11	37	13	61
TAIHO MARU	3FMP6	Seattle	114	32	27	21	194
TAIKO	LAQT4	New York City	9	2	3	1	15
TAKAYAMA	LACQ5	New York City	5	35	68	120	228
TALABOT	LAQU4	Miami	4	53	3	63	123
TALLAHASSEE BAY	WRA4829	Houston	0	45	0	0	45
TANABATA	LAZO4	Baltimore	18	21	16	0	55
TAPIOLA	LAOQ2	Norfolk	3	0	0	0	3
TARAGO	C6LS7	Long Beach	0	0	18	0	18
TARONGA	LACU5	Jacksonville	0	0	38	0	38
TELLUS	WRYG	Baltimore	56	35	24	34	149
TEPOZTECO II	ZCAZ7	Seattle	0	11	3	24	38
TEQUI	3FDZ5	Seattle	19	32	15	0	66
TEXAS	LMWR3	Baltimore	0	0	21	43	64
TEXAS CLIPPER	KVWA	Houston	0	37	35	0	72
TILLIE LYKES	WMLH	Houston	73	136	42	58	309
TMM MEXICO	XCMG	Houston	15	59	37	306	417
TMM OAXACA	ELUA5	Houston	60	44	19	0	123
TMM VERACRUZ	ELFU9	Norfolk	24	20	30	15	89
TOBIAS MAERSK	MSJY8	Long Beach	22	25	3	0	50
TOKIO EXPRESS	9VUY	Long Beach	357	6	118	603	1084
TOLUCA	3EFY7	Long Beach	0	9	5	4	18
TONSINA	KJDG	Houston	0	0	0	1	1

Continued on Page 83

Continued from Page 82

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
TORBEN	V2TI	Norfolk	0	15	0	12	27
TORM AMERICA	J8FI5	New York City	0	19	0	0	19
TORM FREYA	OXDF3	Norfolk	27	32	30	32	121
TOWER BRIDGE	ELJL3	Seattle	14	14	12	15	55
TRADE APOLLO	VRUN7	New York City	25	51	63	39	178
TRANSWORLD BRIDGE	ELJJ5	Seattle	60	60	55	43	218
TRINITY	WRGL	Houston	55	0	0	0	55
TRITON	WTU2310	Chicago	63	0	0	0	63
TROPIC DAY	J8PC	Miami	0	0	16	0	16
TROPIC FLYER	J8NV	Miami	0	0	15	24	39
TROPIC ISLE	J8PA	Miami	0	18	11	14	43
TROPIC JADE	J8NY	Miami	0	19	19	14	52
TROPIC KEY	J8PE	Miami	13	32	0	0	45
TROPIC LURE	J8PD	Miami	19	11	12	14	56
TROPIC MIST	J8NZ	Miami	16	0	0	0	16
TROPIC SUN	3EZK9	New Orleans	63	45	33	37	178
TROPIC TIDE	3FGQ3	Miami	38	16	35	41	130
TROPICALE	ELBM9	New Orleans	1	40	0	4	45
TRSL ARCTURUS	MSQQ8	Baltimore	0	18	22	0	40
TRUST 38	3EUY3	Baltimore	0	75	59	0	134
TUI PACIFIC	P3GB4	Seattle	53	0	0	0	53
TURMOIL	9VGL	New York City	14	13	3	2	32
TYSON LYKES	WMLG	Houston	31	47	48	20	146
USCGC ACACIA (WLB406)	NODY	Chicago	0	3	16	9	28
USCGC ACTIVE WMEC 618	NRTF	Seattle	91	0	119	20	230
USCGC ACUSHNET WMEC 167	NNHA	Oakland	20	0	43	3	66
USCGC ALERT (WMEC 630)	NZVE	Seattle	0	7	0	0	7
USCGC BOUTWELL WHEC 719	NYCQ	Seattle	0	6	5	0	11
USCGC BRAMBLE (WLB 392)	NODK	Cleveland	0	0	3	1	4
USCGC CHASE (WHEC 718)	NLPM	Long Beach	0	0	1	0	1
USCGC COURAGEOUS	NCRG	Norfolk	0	0	2	1	3
USCGC DAUNTLESS WMEC 624	NDTS	Houston	0	25	19	88	132
USCGC DILIGENCE WMEC 616	NMUD	Norfolk	0	0	7	4	11
USCGC DURABLE (WMEC 628)	NRUN	Houston	0	3	0	12	15
USCGC EAGLE (WIX 327)	NRCB	Miami	0	4	0	1	5
USCGC HAMILTON WHEC 715	NMAG	Long Beach	0	0	0	5	5
USCGC HARRIET LANE	NHNC	Norfolk	31	9	13	16	69
USCGC HORNBEAM	NODM	Norfolk	0	4	0	0	4
USCGC LEGARE	NRPM	Norfolk	0	2	0	25	27
USCGC MELLON (WHEC 717)	NMEL	Seattle	0	28	0	85	113
USCGC MIDGETT (WHEC 726)	NHWR	Seattle	0	2	25	61	88
USCGC PLANETREE	NRPY	Seattle	0	0	34	4	38
USCGC POLAR SEA__(WAGB 1	NRUO	Seattle	140	0	0	6	146
USCGC RELIANCE WMEC 615	NJPJ	Miami	1	2	2	1	6
USCGC SASSAFRAS	NODT	Oakland	0	0	1	1	2
USCGC SEDGE (WLB 402)	NODU	Seattle	0	0	3	8	11
USCGC SENECA	NFMK	Norfolk	31	0	30	26	87
USCGC SPENCER	NWHE	Norfolk	5	0	0	0	5
USCGC STEADFAST (WMEC 62	NSTF	Seattle	0	3	84	0	87
USCGC STORIS (WMEC 38)	NRUC	Seattle	12	10	20	6	48
USCGC SUNDEW (WLB 404)	NODW	Chicago	1	2	0	6	9
USCGC SWEETBRIER WLB 405	NODX	Seattle	7	6	17	6	36
USCGC TAHOMA	NCBE	Norfolk	29	13	13	96	151
USCGC TAMPA WMEC 902	NIKL	Norfolk	0	0	0	97	97
USCGC THETIS	NYWL	Jacksonville	23	0	0	39	62
USCGC VALIANT (WMEC 621)	NVAI	Miami	0	38	0	23	61
USCGC VENTUROUS WMEC 625	NVES	Oakland	13	9	78	0	100
USCGC WOODRUSH (WLB 407)	NODZ	Seattle	0	5	3	1	9
USNS ALGOL	NAMW	Jacksonville	0	0	0	1	1
USNS APACHE (T-ATF 172)	NIGP	Norfolk	40	20	14	39	113
USNS BOWDITCH	NWSW	New Orleans	0	0	51	53	104
USNS CAPELLA	NBXO	Jacksonville	0	0	23	0	23
USNS DENEBOLA	NDSP	Newark	0	0	8	0	8
USNS GUS W. DARNELL	KCDK	Houston	13	4	6	46	69
USNS HAYES	NRLW	Jacksonville	0	0	109	0	109
USNS HENSON	NENB	New Orleans	48	0	0	0	48
USNS JOHN MCDONNELL (T-A	NJMD	New Orleans	0	93	20	0	113
USNS LARAMIE T-AO 203	NLAR	New Orleans	0	2	0	0	2
USNS PATHFINDER T-AGS 60	NGKK	New Orleans	0	0	86	57	143
USNS PATUXENT	NPCZ	New Orleans	63	120	72	48	303
USNS PECOS	NPEC	Oakland	0	504	11	0	515

Continued on Page 84

Continued from Page 83

SHIP NAME	CALL	PORT	MAY	JUN	JUL	AUG	TOTAL
USNS SATURN T-AFS-10	NADH	Norfolk	48	34	43	60	185
USNS SIOUX	NJOV	Oakland	202	0	0	0	202
USNS SIRIUS (T-AFS 8)	NPGA	Norfolk	0	24	48	48	120
USNS SUMNER	NZAU	New Orleans	72	69	50	33	224
USNS TIPPECANOE (TAO-199	NTIP	New Orleans	0	0	0	263	263
USNS VANGUARD TAG 194	NIDR	Newark	0	10	247	45	302
USNS YUKON (T-AO 202)	NYUK	New Orleans	27	0	0	0	27
VASILTY BURKHANOV	UZHC	Seattle	12	15	31	12	70
VEGA	9VJS	Houston	39	42	36	32	149
VENUS DIAMOND	9VRR	Houston	0	0	13	0	13
VERA ACORDE	3EAG4	Seattle	8	285	0	11	304
VICTORIA	GBBA	Miami	7	22	16	5	50
VIRGINIA	3EBW4	Seattle	114	102	74	162	452
VISAYAN GLORY	3EHJ7	Seattle	0	28	135	0	163
VIVA	LACU2	Norfolk	0	63	61	110	234
WALTER J. MCCARTHY	WXU3434	Cleveland	0	21	33	22	76
WASHINGTON HIGHWAY	JKHH	Seattle	38	15	45	61	159
WASHINGTON SENATOR	DEAZ	Long Beach	0	0	36	55	91
WAVELET	DVDJ	Seattle	0	0	0	13	13
WECOMA	WSD7079	Seattle	90	84	89	62	325
WESTERN BRIDGE	C6JQ9	Baltimore	0	0	0	75	75
WESTERN LION	A8BN	Long Beach	0	63	0	24	87
WESTWARD	WZL8190	Miami	28	0	0	24	52
WESTWARD VENTURE	KHJB	Seattle	95	141	144	86	466
WESTWOOD ANETTE	DVDM	Seattle	74	52	29	48	203
WESTWOOD BELINDA	C6CE7	Seattle	44	48	55	61	208
WESTWOOD CLEO	C6OQ8	Seattle	60	26	15	5	106
WESTWOOD FUJI	S6BR	Seattle	63	35	58	53	209
WESTWOOD HALLA	S6BO	Seattle	42	127	61	55	285
WESTWOOD JAGO	C6CW9	Seattle	64	21	16	32	133
WESTWOOD MARIANNE	DVPV	Seattle	0	6	23	22	51
WILFRED SYKES	WC5932	Chicago	3	38	46	52	139
WILLIAM E. CRAIN	ELOR2	Oakland	0	32	0	0	32
WILLIAM E. MUSSMAN	D5OE	Seattle	66	42	57	46	211
WOLVERINE	WZC4518	Cleveland	0	68	11	21	100
YUCATAN	XCUY	Houston	39	130	20	28	217
YURIY OSTROVSKIY	UAGJ	Seattle	79	189	81	82	431
ZAGREB EXPRESS	9HPL3	Norfolk	9	0	0	0	9
ZENITH	ELOU5	Miami	0	11	3	7	21
ZIM ADRIATIC	4XIO	Long Beach	0	36	23	5	64
ZIM AMERICA	4XGR	Newark	17	5	22	38	82
ZIM ASIA	4XFB	New Orleans	52	68	48	22	190
ZIM ATLANTIC	4XFD	New York City	26	33	20	55	134
ZIM CANADA	4XGS	Norfolk	55	33	29	41	158
ZIM CHINA	4XFQ	New York City	48	0	0	0	48
ZIM EUROPA	4XFN	New York City	31	26	9	22	88
ZIM IBERIA	4XFP	New York City	21	0	0	0	21
ZIM ISRAEL	4XGX	New Orleans	23	21	31	42	117
ZIM ITALIA	4XGT	New Orleans	69	22	39	16	146
ZIM JAMAICA	4XFE	New York City	21	19	52	30	122
ZIM JAPAN	4XGV	Baltimore	63	56	33	11	163
ZIM KEELUNG	4XII	Newark	0	7	3	27	37
ZIM KOREA	4XGU	Miami	21	12	39	24	96
ZIM MONTEVIDEO	V2AG7	Norfolk	22	9	11	9	51
ZIM SANTOS	ELRJ6	Baltimore	39	50	53	32	174
ZIM SAVANNAH	4XIL	Long Beach	0	19	17	2	38
ZIM U.S.A.	4XFO	New York City	0	0	0	5	5

Totals	May	35,031
	Jun	44,390
	Jul	43,822
	Aug	43,383
Period Total		166,626

Buoy Climatological Data Summary —

April through August 1998

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

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
April 1998													
41001	34.7N	072.6W	0718	18.0	20.0								1014.4
41004	32.5N	079.1W	0692	18.3		1.3	3.2	09/15	12.1	SW	30.7	30/21	1014.8
41008	31.4N	080.9W	0708	18.9	19.0	1.0	2.3	28/20	11.7	S	25.3	10/08	1015.3
41009	28.5N	080.2W	1426	21.9	22.1	1.3	3.2	11/19	12.5	S	29.3	11/19	1016.0
41010	28.9N	078.6W	1373	22.5	24.8	1.8	4.0	12/06	14.4	SE	26.8	09/12	1016.0
42001	25.9N	089.7W	0719	23.1	24.1	1.5	3.5	14/12	16.0	SE	29.0	27/10	1014.7
42002	25.9N	093.6W	0716	22.3	23.1	1.4	3.5	13/19	12.6	SE	27.4	13/04	1013.4
42003	25.9N	085.9W	0715		25.5	1.3	2.9	11/15	15.6	SE	33.8	30/10	1014.8
42007	30.1N	088.8W	0714	20.0	20.7	0.8	2.9	29/22	12.5	SE	34.4	29/22	1014.5
42019	27.9N	095.4W	0718	20.4	20.7	1.3	3.0	17/15	11.2	SE	26.8	17/13	1013.2
42020	26.9N	096.7W	0714	21.3	21.3	1.4	2.9	18/18	11.8	SE	24.9	17/13	1012.7
42035	29.3N	094.4W	0714	19.8	20.3	0.9	2.3	25/15	11.7	SE	26.4	29/11	1013.5
42036	28.5N	084.5W	0713	20.2	20.3	1.0	3.3	11/08	11.2	SE	27.8	30/08	1016.3
42039	28.8N	086.0W	0573	20.9	21.7	1.2	2.8	11/07	12.6	SE	35.9	30/03	1017.0
42040	29.2N	088.3W	0711	20.2	21.0	1.2	3.0	30/03	12.2	SE	28.0	29/23	1015.7
44004	38.5N	070.7W	0690	9.6	9.5	2.0	5.8	23/13	13.4	W	36.5	23/11	1013.1
44005	42.9N	068.9W	0713	5.5	4.6	1.4	4.7	24/03	10.7	SW	32.4	10/10	1011.7
44007	43.5N	070.2W	0718	6.5	5.6	0.9	4.1	24/04	9.9	N	31.7	24/02	1012.2
44008	40.5N	069.4W	0718	6.7	5.7	1.7	5.9	10/11	12.6	SW	35.4	10/11	1012.2
44009	38.5N	074.7W	0712	10.4	9.9	1.2	3.5	04/22	12.3	S	29.1	04/16	1013.1
44011	41.1N	066.6W	0712	5.9	4.6	2.0	7.1	10/20	13.4	SW	35.9	10/18	1011.9
44013	42.4N	070.7W	0717	7.2	5.9	0.9	4.1	24/00	9.2	SE	32.3	10/09	1011.5
44014	36.6N	074.8W	0531	10.9	9.4	1.5	3.3	23/07	10.9	S	27.0	09/21	1015.0
44025	40.3N	073.2W	0683	8.3	7.4	1.2	3.9	10/02	11.3	SW	34.6	10/00	1013.2
45001	48.1N	087.8W	0655	3.3	2.5	0.7	2.8	13/00	10.0	SW	26.0	13/00	1016.4
45002	45.3N	086.4W	0710	4.8	3.5	0.7	2.4	01/04	9.9	NE	28.0	01/02	1014.5
45003	45.3N	082.8W	0296	4.5	3.3	0.4	1.4	26/12	7.0	W	17.9	26/11	1019.1
45004	47.6N	086.6W	0647	3.4	2.9	0.7	3.4	17/18	10.0	SE	29.9	17/15	1016.9
45005	41.7N	082.4W	0717	7.5	6.8	0.7	3.9	10/00	9.9	NE	33.0	10/00	1013.9
45006	47.3N	089.9W	0676	3.8	2.2	0.8	2.7	07/21	9.0	NE	27.4	07/21	1016.4
45007	42.7N	087.0W	0713	5.5	4.1	0.7	2.7	09/21	9.6	N	27.6	26/14	1014.1
45008	44.3N	082.4W	0378	4.8	3.3	0.6	1.7	17/11	8.0	NE	23.5	17/11	1016.9

Continued on Page 86

Continued from Page 85

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
46001	56.3N	148.2W	0712	4.4	5.4	3.1	7.0	01/10	15.8	S	33.6	01/10	1004.5
46002	42.5N	130.3W	0709	9.5	10.7	2.9	6.0	10/19	13.0	NW	31.9	10/10	1018.6
46003	51.9N	155.9W	0164	4.2	4.6	2.3	3.5	29/09	13.8	NW	25.1	28/17	1007.7
46005	46.1N	131.0W	0714	8.4	9.6	2.9	6.9	07/06	13.2	S	26.8	20/14	1018.7
46011	34.9N	120.9W	0718	12.0	13.0	2.3	5.0	08/02	11.8	NW	27.8	25/04	1016.4
46013	38.2N	123.3W	0683	11.0	11.9	2.6	5.2	02/00	13.7	NW	30.1	11/21	1017.3
46014	39.2N	124.0W	0718	10.7	11.5	2.6	5.2	01/11	12.8	NW	28.6	30/23	1016.7
46023	34.7N	121.0W	0710	12.2	13.3	2.4	4.7	01/20	14.4	NW	32.3	25/04	1017.4
46045	33.8N	118.5W	0710	13.7	15.3	1.0	2.8	12/12	7.6	W	22.3	13/00	1015.7
46050	44.6N	124.5W	0055	12.2	12.3	1.7	2.5	28/21	9.9	N	19.6	29/03	1012.5
46054	34.3N	120.5W	0700	12.1	12.7	2.1	4.5	01/21	14.8	NW	31.9	25/06	1016.2
46063	34.3N	120.7W	0056	11.7	12.3	1.7	2.2	29/08	10.1	NW	18.3	29/06	1014.1
51001	23.4N	162.3W	0708	22.1	23.2	2.6	4.7	11/03	14.9	NE	24.1	12/14	1023.2
51002	17.2N	157.8W	0715	23.7	24.7	2.8	4.7	11/16	17.7	NE	26.7	10/19	1019.0
91328	8.6N	149.7E	0463	28.0					8.7	NE	15.5	02/05	1011.5
91343	7.6N	155.2E	0714	28.2									1011.0
91352	6.2N	160.7E	0434	28.1									1013.3
91377	6.1N	172.1E	0468	27.9									1014.6
91411	8.3N	137.5E	0173	28.9									1011.6
91442	4.6N	168.7E	0713	27.9					13.6	NE	26.2	15/02	1012.1
ABAN6	44.3N	075.9W	0716	7.6	5.1				4.6	N	19.3	09/20	1014.3
ALSN6	40.5N	073.8W	0713	9.9		0.9	2.9	10/03	15.5	S	41.7	10/00	1013.2
BLIA2	60.8N	146.9W	1422	4.1					9.5	NE	30.3	28/07	1009.0
BURL1	28.9N	089.4W	0716	19.7					13.7	SE	47.2	29/01	1014.5
CARO3	43.3N	124.4W	0712	9.4					8.5	N	26.7	01/02	1018.0
CDRF1	29.1N	083.0W	0713	20.6					9.7	S	22.9	09/11	1016.1
CHLV2	36.9N	075.7W	0714	13.1	12.1	1.0	3.9	04/21	15.6	S	44.5	04/16	1014.3
CLKN7	34.6N	076.5W	0713	16.3					13.4	SW	29.8	04/21	1016.4
CSBF1	29.7N	085.4W	0713	19.7					9.7	SE	29.2	22/23	1016.3
DBLN6	42.5N	079.4W	0714	7.9					10.2	SW	33.1	09/22	1014.7
DESW1	47.7N	124.5W	0710	8.9					8.6	NW	31.1	10/23	1017.2
DPIA1	30.3N	088.1W	0711	19.5	20.8				13.2	SE	38.9	29/23	1015.4
DRYF1	24.6N	082.9W	0712	23.3	23.0				11.0	SE	24.5	11/14	1014.9
DSLN7	35.2N	075.3W	0714	14.8		1.8	4.4	05/05	18.3	SW	43.5	04/22	1014.1
DUCN7	36.2N	075.8W	0705	14.8		0.9	2.9	05/00	13.3	S	41.1	04/20	1015.9
FFIA2	57.3N	133.6W	0716	6.3					8.5	SE	24.9	05/17	
FPSN7	33.5N	077.6W	0710	17.7		1.4	4.1	09/19	15.9	SW	41.4	09/03	1014.2
FWYF1	25.6N	080.1W	0713	23.7	24.6				16.0	SE	30.3	11/06	1017.2
GDIL1	29.3N	090.0W	0713	20.5	22.8				11.5	SE	32.4	29/04	1015.0
GLLN6	43.9N	076.5W	0707	6.2					10.6	SW	31.7	17/23	1014.3
IOSN3	43.0N	070.6W	0712	7.3					12.5	NW	36.1	24/00	1011.9
KTNF1	29.8N	083.6W	0714	19.5					10.7	S	27.6	10/00	1015.6
LKWF1	26.6N	080.0W	0709	23.0	24.1				12.6	SE	25.7	11/22	1016.5
LONF1	24.9N	080.9W	0718	24.1	25.0				13.7	SE	24.6	12/04	1015.9
LPOI1	48.1N	116.5W	0713	7.8	6.1				4.5	S	33.6	24/01	
MDRM1	44.0N	068.1W	0712	5.3									1011.5
MISM1	43.8N	068.9W	0714	5.4					14.2	N	40.0	24/04	1011.4
MLRF1	25.0N	080.4W	0714	23.9	24.7				14.2	SE	26.6	11/03	1016.3
MRKA2	61.1N	146.7W	1428	3.6					6.1	NE	20.3	28/08	1010.3
NWPO3	44.6N	124.1W	0714	8.9					8.2	E	28.5	11/06	1018.1
PILM4	48.2N	088.4W	0711	3.8					11.7	NE	36.8	01/04	1017.0
POTA2	61.1N	146.7W	1422	3.5					10.2	NE	22.4	17/14	1008.9
PTAC1	39.0N	123.7W	0715	10.1					10.6	N	27.3	12/01	1016.7
PTAT2	27.8N	097.1W	0710	20.8	21.7				12.9	SE	28.9	17/12	1013.4
PTGC1	34.6N	120.7W	0710	11.7					14.8	N	39.2	12/05	1017.7
ROAM4	47.9N	089.3W	0561	4.9	2.6				12.1	NE	33.8	01/04	1015.6
SANF1	24.5N	081.9W	0715	23.9	24.3				13.6	SE	25.8	11/06	1015.9
SAUF1	29.9N	081.3W	0717	20.3	19.2				10.0	S	23.0	28/23	1016.2
SBIO1	41.6N	082.8W	0710	9.0					9.7	NE	25.4	17/08	1013.8
SGNW3	43.8N	087.7W	0714	6.4	8.0				10.9	N	32.6	09/17	
SISW1	48.3N	122.9W	0719	9.3					8.5	W	30.6	24/11	1017.6
SMKF1	24.6N	081.1W	0715	24.3	25.0				15.5	SE	28.1	11/09	1016.3
SPGF1	26.7N	079.0W	0708	23.1					11.0	SE	27.6	12/00	1016.1
SRST2	29.7N	094.1W	0716	19.1					11.0	S	26.4	27/04	1015.2
STDM4	47.2N	087.2W	0713	4.6					13.2	NE	40.9	01/04	1015.6
SUPN6	44.5N	075.8W	0709	7.7	5.8				9.0	N	27.5	17/18	1013.5
THIN6	44.3N	076.0W	0544	8.2									
TPLM2	38.9N	076.4W	0698	13.3	12.8				10.7	S	35.9	27/00	1014.5
TTIW1	48.4N	124.7W	0715	8.5					9.4	SW	28.5	29/18	1017.9

Continued on Page 87

Continued from Page 86

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)
VENF1	27.1N	082.5W	0712	21.3	23.3				10.9	S	27.3	19/14	1017.3
WPOW1	47.7N	122.4W	0318	8.3					8.4	S	22.8	11/21	1014.1

May 1998

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
41001	34.7N	072.6W	0745	21.5	22.4								1011.4
41002	32.3N	075.2W	0576	23.4	24.2	1.7	4.9	13/23	12.5	SW	31.9	08/09	1012.7
41004	32.5N	079.1W	0730	23.0		0.9	2.5	01/00	9.1	SW	21.8	03/22	1012.2
41008	31.4N	080.9W	0736	23.8	23.6	0.7	1.6	01/00	9.4	S	22.3	11/02	1013.1
41009	28.5N	080.2W	1472	24.7	24.6	0.8	2.5	14/19	8.9	S	26.6	04/20	1014.3
41010	28.9N	078.6W	1451	25.1	25.8	1.2	4.0	14/16	10.9	S	31.3	04/23	1014.2
42001	25.9N	089.7W	0731	25.5		0.8	3.1	09/16	10.1	SE	35.2	09/15	1014.1
42002	25.9N	093.6W	0741	25.2	25.5	0.8	2.6	09/12	10.6	SE	27.6	09/07	1012.8
42003	25.9N	085.9W	0737	26.1	26.4	0.7	1.7	08/15	9.0	SE	23.9	27/09	1014.2
42007	30.1N	088.8W	0735	25.3	25.9	0.4	1.3	10/03	9.5	SW	20.4	10/03	1013.3
42019	27.9N	095.4W	0739	24.3	24.3	0.9	1.9	10/01	9.4	SE	20.0	15/01	1011.8
42020	26.9N	096.7W	0740	24.8	24.6	1.0	2.2	15/01	11.1	SE	22.9	15/08	1011.0
42035	29.3N	094.4W	0741	24.6	24.8	0.8	1.6	22/10	10.7	SE	21.6	09/06	1012.1
42036	28.5N	084.5W	0735	24.8	25.0	0.5	1.9	10/17	6.9	SW	17.5	01/14	1015.1
42039	28.8N	086.0W	0742	24.9	25.3	0.6	2.2	10/09	7.7	SW	19.2	08/08	1015.6
42040	29.2N	088.3W	0735	25.0	25.6	0.6	2.1	10/06	8.8	SW	19.2	11/02	1014.8
44004	38.5N	070.7W	0571	16.6	16.6	1.4	5.9	13/07	10.4	SE	29.0	12/23	1011.1
44005	42.9N	068.9W	0741	8.9	7.4	1.3	4.4	13/05	10.0	S	23.9	11/10	1012.2
44007	43.5N	070.2W	0734	10.7	9.0	1.0	3.1	11/16	8.6	S	25.8	12/05	1012.6
44008	40.5N	069.4W	0738	10.0	8.3	1.5	4.8	12/20	10.4	SW	27.8	12/00	1012.1
44009	38.5N	074.7W	0729	14.1	13.5	1.2	4.2	12/19	10.5	S	29.3	09/20	1011.1
44011	41.1N	066.6W	0738	8.8	7.0	1.6	4.8	13/06					1012.7
44013	42.4N	070.7W	0732	11.9	10.2	0.9	4.0	11/21	9.7	NE	27.0	10/15	1011.4
44014	36.6N	074.8W	0741	14.2	12.7	1.2	4.9	13/18	9.1	S	26.0	01/18	1010.9
44025	40.3N	073.2W	0705	12.2	11.1	1.2	4.0	12/18	11.0	NE	31.3	09/16	1012.0
45001	48.1N	087.8W	0731	5.7	3.4	0.6	2.6	17/00	9.5	NE	25.3	17/01	1012.1
45002	45.3N	086.4W	0732	9.5	7.4	0.5	1.8	16/14	8.6	NE	22.3	16/14	1011.3
45003	45.3N	082.8W	0723	7.5	4.6	0.4	2.1	31/18	8.1	SE	24.9	31/17	1012.2
45004	47.6N	086.6W	0733	5.6	3.5	0.5	2.1	17/06	8.8	SE	25.5	31/19	1012.9
45005	41.7N	082.4W	0736	15.7	14.8	0.4	1.4	08/19	7.8	NE	20.6	31/11	1011.5
45006	47.3N	089.9W	0736	6.1	2.4	0.5	2.0	08/11	9.2	E	24.5	07/16	1006.7
45007	42.7N	087.0W	0736	11.3	9.2	0.5	1.6	08/22	7.8	N	25.6	31/08	1012.2
45008	44.3N	082.4W	0737	9.1	6.3	0.4	2.1	31/13	8.6	N	30.3	31/11	1012.3
46001	56.3N	148.2W	0734	5.9	6.4	2.4	5.5	09/05	14.5	SW	29.1	08/23	1010.1
46002	42.5N	130.3W	0736	10.9	12.0	2.3	5.8	02/06	13.4	NW	28.6	02/01	1017.2
46003	51.9N	155.9W	0717	5.1	5.1	2.7	6.8	06/12	15.6	NE	29.5	08/13	1012.8
46005	46.1N	131.0W	0730	9.7	10.7	2.3	6.0	14/22	11.4	NW	26.8	14/12	1017.8
46006	40.9N	137.5W	0688	10.5	11.3	2.5	5.7	01/21	14.6	N	29.3	01/18	1021.5
46011	34.9N	120.9W	0740	13.0	13.1	1.9	3.9	02/11	12.4	NW	24.3	22/04	1015.5
46013	38.2N	123.3W	0724	12.3	12.4	2.1	5.3	02/03	13.2	NW	28.2	08/23	1016.2
46014	39.2N	124.0W	0741	12.1	12.5	2.0	4.5	28/17	11.4	NW	29.7	01/13	1015.3
46023	34.7N	121.0W	0734	13.2	13.6	2.1	4.4	02/11	15.3	NW	28.0	01/18	1016.6
46025	33.8N	119.1W	0733	15.3	16.6	1.4	3.3	02/15	7.5	W	22.7	26/11	1015.9
46029	46.1N	124.5W	0589	11.5	12.6	1.9	4.4	15/06	11.3	NW	24.3	14/12	1015.6
46035	56.9N	177.8W	0722	0.9	2.8	2.2	6.7	18/07	17.6	N	36.7	17/21	1002.3
46045	33.8N	118.5W	0741	15.5	16.8	1.1	2.4	02/16	6.7	W	18.1	12/22	1015.2
46050	44.6N	124.5W	0741	12.1	12.6	2.0	4.6	15/08	9.9	N	25.3	14/14	1015.5
46053	34.2N	119.9W	0739	13.9	13.9	1.2	2.8	02/13	10.7	W	23.9	26/22	1015.5
46054	34.3N	120.5W	0733	13.0	12.8	1.8	4.2	02/13	15.5	NW	25.8	21/07	1015.4
46059	38.0N	130.0W	0739		13.7	2.3	4.9	01/11	13.5	NW	29.1	12/15	
46060	60.6N	146.8W	1478	6.5	7.4	0.6	3.2	09/22	11.7	E	39.6	09/21	1011.3
46061	60.2N	146.8W	1478	6.7	7.5	1.3	5.0	10/00	11.7	SE	37.9	09/21	1011.4
46062	35.1N	121.0W	0718	13.1	13.1	1.9	5.0	02/11	13.0	NW	24.9	10/04	1015.7
46063	34.3N	120.7W	0734	13.5	13.5	2.1	4.5	02/11	14.7	NW	25.3	20/12	1015.5
51001	23.4N	162.3W	0741	22.4	23.2	2.4	4.3	02/13	15.6	E	22.0	02/02	1021.7
51002	17.2N	157.8W	0738	24.0	24.8	2.4	3.6	22/14	17.1	NE	24.6	21/09	1018.0
51003	19.1N	160.8W	0741	23.8	24.7	2.3	3.4	23/20	13.5	NE	20.8	02/09	1017.8
51004	17.4N	152.5W	0049	24.0	24.6	2.3	2.7	30/08	15.8	E	19.8	30/07	1018.7
51028	0.0N	153.9W	0715	27.4	27.9	2.0	3.3	24/13	8.4	NE	20.8	11/10	1010.5
91328	8.6N	149.7E	0474	28.3					7.9	NE	15.5	17/05	1010.1
91343	7.6N	155.2E	0731	28.4									1009.9
91352	6.2N	160.7E	0426	28.1									1012.0

Continued on Page 88

Continued from Page 87

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)
91374	8.7N	171.2E	0738	27.5					6.5	NE	12.9	30/17	1011.6
91377	6.1N	172.1E	0429	28.1									1013.2
91411	8.3N	137.5E	0243	29.2									1009.9
ABAN6	44.3N	075.9W	0743	15.1	10.1				3.8	N	19.8	31/15	1012.3
ALSN6	40.5N	073.8W	0738	14.6		1.0	2.9	09/19	14.7	S	42.2	31/22	1011.9
BLIA2	60.8N	146.9W	1464	6.1					7.1	NE	27.8	04/03	1012.1
BURL1	28.9N	089.4W	0730	24.7					9.3	SW	22.3	09/21	1013.6
BUZM3	41.4N	071.0W	0733	12.2		0.9	3.3	02/14	14.9	SW	35.1	10/23	1013.0
CARO3	43.3N	124.4W	0734	11.3					8.1	N	25.6	14/17	1016.3
CDRF1	29.1N	083.0W	0739	25.1					7.8	W	20.8	27/14	1014.6
CHLV2	36.9N	075.7W	0740	17.6	16.4	0.8	2.8	14/01	13.3	S	37.7	05/09	1012.0
CLKN7	34.6N	076.5W	0739	20.1					10.4	SW	35.8	05/04	1013.6
CSBF1	29.7N	085.4W	0730	24.4					7.8	SW	22.2	11/02	1014.8
DBLN6	42.5N	079.4W	0734	15.5					8.3	SW	25.6	31/21	1012.3
DESW1	47.7N	124.5W	0725	11.0					6.6	NW	23.6	14/12	1014.6
DISW3	47.1N	090.7W	0734	10.0					10.4	NE	33.2	05/01	1011.5
DPIA1	30.3N	088.1W	0738	25.1	26.3				8.8	SW	23.9	09/22	1014.1
DRYF1	24.6N	082.9W	0737	25.4	24.1				6.1	NE	24.6	05/01	1014.1
DSLN7	35.2N	075.3W	0732	18.9		1.0	1.7	16/02	14.6	SW	42.2	01/13	1011.3
DUCN7	36.2N	075.8W	0735	19.0		0.8	3.1	13/14	11.5	SW	31.2	12/23	1013.4
FBIS1	32.7N	079.9W	0739	23.3					7.6	SW	18.0	18/04	1013.2
FFIA2	57.3N	133.6W	0732	9.1					6.9	S	22.8	06/17	1013.3
FPSN7	33.5N	077.6W	0724	22.0		1.1	3.6	01/06	12.5	SW	47.6	01/05	1011.4
FWYF1	25.6N	080.1W	0726	26.2	26.4				11.0	S	43.9	02/00	1016.0
GDIL1	29.3N	090.0W	0735	25.8	28.6				8.5	SE	20.0	10/06	1014.0
GLLN6	43.9N	076.5W	0739	13.9					9.7	SE	38.8	31/16	1012.1
IOSN3	43.0N	070.6W	0737	12.1					12.7	NE	30.2	11/16	1011.9
KTNF1	29.8N	083.6W	0739	24.4					10.2	SW	27.8	04/15	1013.9
LKWF1	26.6N	080.0W	0734	25.5	25.6				8.0	SE	24.4	05/22	1015.0
LONF1	24.9N	080.9W	0737	26.8	28.6				8.3	SE	31.2	01/23	1014.8
LPOI1	48.1N	116.5W	0735	12.3	10.7				6.0	S	24.7	14/00	
MDRM1	44.0N	068.1W	0732	8.6									1012.5
MISM1	43.8N	068.9W	0736	9.1					13.7	SW	36.0	02/16	1012.1
MLRF1	25.0N	080.4W	0731	26.1	26.3				8.6	SE	26.2	05/02	1015.2
MRKA2	61.1N	146.7W	1449	6.1					6.0	NE	23.9	22/21	1013.1
NWPO3	44.6N	124.1W	0733	11.2					8.0	N	28.8	14/17	1016.1
PILM4	48.2N	088.4W	0735	7.4					11.1	NE	37.5	16/22	1013.4
POTA2	61.1N	146.7W	1470	5.9					7.3	NE	23.7	24/13	1011.8
PTAC1	39.0N	123.7W	0731	11.9					9.7	N	32.6	01/11	1015.4
PTAT2	27.8N	097.1W	0724	24.7	26.2				13.0	SE	24.1	09/09	1011.5
PTGC1	34.6N	120.7W	0734	13.0					15.5	N	29.3	17/13	1016.9
ROAM4	47.9N	089.3W	0615	9.2	4.3				11.9	NE	36.1	16/18	1011.7
SANF1	24.5N	081.9W	0739	26.0	25.9				7.7	E	32.5	05/01	1015.1
SAUF1	29.9N	081.3W	0737	24.6	23.4				7.9	W	22.8	04/18	1014.4
SBIO1	41.6N	082.8W	0733	17.3					8.1	NE	29.0	31/12	1011.2
SGNW3	43.8N	087.7W	0738	13.3					11.0	N	28.1	08/18	
SISW1	48.3N	122.9W	0730	10.9					9.5	SW	32.1	14/17	1014.6
SMKF1	24.6N	081.1W	0737	26.5	27.1				8.4	E	34.3	01/23	1015.3
SPGF1	26.7N	079.0W	0734	25.8					8.4	S	24.7	05/00	1014.6
SRST2	29.7N	094.1W	0730	24.7					11.7	S	21.9	03/13	1013.6
STDM4	47.2N	087.2W	0738	9.4					14.2	SE	33.2	15/03	1012.1
SUPN6	44.5N	075.8W	0734	15.3	11.0				6.9	N	31.9	31/18	1011.5
THIN6	44.3N	076.0W	0735	15.1									
TPLM2	38.9N	076.4W	0730	18.6	17.7				9.4	S	25.5	10/02	1012.5
TTIW1	48.4N	124.7W	0739	10.3					9.0	SW	38.9	02/07	1015.2
VENF1	27.1N	082.5W	0501	23.6	23.9				8.2	NW	23.7	04/20	1015.5
WPOW1	47.7N	122.4W	0711	11.8					9.5	S	26.3	15/12	1014.9

June 1998

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
41001	34.7N	072.6W	0709	24.3	24.9								1013.0
41002	32.3N	075.2W	0711	26.6	26.8	1.1	2.6	16/04	11.0	SW	23.5	30/23	1013.9
41004	32.5N	079.1W	0711	26.7		0.8	2.0	15/18	10.6	SW	28.8	11/00	1013.4
41008	31.4N	080.9W	0709	27.2	27.0	0.6	1.5	10/06	10.4	SW	25.1	19/22	1014.5
41009	28.5N	080.2W	1389	27.7	27.7	0.5	1.3	08/06	9.0	S	18.5	17/04	1016.1
41010	28.9N	078.6W	0683	27.0	27.5	1.0	1.9	06/18	10.6	SW	17.9	14/04	1015.1
42001	25.9N	089.7W	0713	28.0		1.0	3.4	25/14	11.7	SE	32.3	25/10	1015.0
42002	25.9N	093.6W	0715	28.3	28.7	1.2	2.2	27/18	14.6	SE	25.1	27/16	1013.8

Continued on Page 89

Continued from Page 88

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)
42003	25.9N	085.9W	0716	28.5	29.4				8.2	E	22.0	25/02	1016.0
42007	30.1N	088.8W	0710	27.5	28.2	0.4	1.4	25/17	10.1	S	28.2	06/05	1015.3
42019	27.9N	095.4W	0714	27.8	28.0	1.3	2.4	09/09	13.5	SE	24.5	11/07	1012.3
42020	26.9N	096.7W	0713	27.9	27.6	1.3	2.3	11/08	13.5	SE	23.3	11/08	1011.5
42035	29.3N	094.4W	0714	28.0	28.4	1.2	2.1	09/09	14.1	S	26.2	28/23	1013.0
42036	28.5N	084.5W	0711	28.5	29.0	0.6	2.0	09/10	8.1	SW	20.0	06/11	1016.9
42039	28.8N	086.0W	0716	28.5	29.2	0.6	1.6	06/12	8.3	SW	25.6	06/09	1017.6
42040	29.2N	088.3W	0710	28.2	29.2	0.8	2.2	25/13	9.7	SW	30.7	25/11	1016.7
44004	38.5N	070.7W	0718	19.9	20.7	1.3	3.1	14/00	11.1	W	23.3	28/06	1011.5
44005	42.9N	068.9W	0716	12.1	10.4	1.1	4.1	14/22	9.4	S	31.3	27/20	1010.1
44007	43.5N	070.2W	0713	13.2	12.0	0.8	4.3	14/16	8.9	S	32.8	14/16	1010.2
44008	40.5N	069.4W	0719	13.5	11.8	1.2	4.5	14/12	9.4	S	28.4	14/11	1011.3
44009	38.5N	074.7W	0708	19.4	18.7	0.8	2.1	28/13	9.0	S	32.1	16/03	1011.2
44011	41.1N	066.6W	0717	12.8	11.1	1.3	3.9	14/22					1011.8
44013	42.4N	070.7W	0714	14.2	12.4	0.6	2.7	14/14	8.0	SE	25.1	14/12	1009.4
44014	36.6N	074.8W	0715	21.4	20.4	0.8	2.2	16/10	7.9	S	18.8	04/02	1011.5
44025	40.3N	073.2W	0685	17.9	17.3	0.9	2.1	14/10	10.8	S	24.3	03/05	1011.2
45001	48.1N	087.8W	0709	8.3	5.9	0.5	1.5	03/20	8.6	SW	19.2	02/22	1009.9
45002	45.3N	086.4W	0714	14.2	13.1	0.5	3.0	01/23	8.5	S	29.0	01/20	1008.9
45003	45.3N	082.8W	0706	11.9	10.3	0.5	2.1	01/01	8.4	W	24.9	01/01	1009.7
45004	47.6N	086.6W	0714	8.7	6.6	0.4	1.7	12/14	8.4	W	23.7	12/14	1010.6
45005	41.7N	082.4W	0714	19.5	19.7	0.4	1.4	05/08	9.0	S	25.6	26/09	1010.4
45007	42.7N	087.0W	0713	15.4	14.2	0.4	2.1	02/21	7.7	S	27.6	02/17	1011.2
45008	44.3N	082.4W	0563	12.1	10.7	0.5	2.2	02/22	7.6	NW	29.5	02/20	1010.7
46001	56.3N	148.2W	0708	8.3	8.7	2.1	5.2	08/16	13.6	W	27.0	20/21	1017.2
46002	42.5N	130.3W	0711	12.4	13.5	2.1	3.8	12/05	14.6	NW	24.5	11/15	1022.5
46003	51.9N	155.9W	0646	7.1	6.8	2.1	7.9	07/19	14.2	SW	54.6	07/16	1017.5
46005	46.1N	131.0W	0710	11.3	12.2	2.0	3.9	25/10	14.0	NW	23.3	24/14	1023.1
46006	40.9N	137.5W	0524	12.9	13.9	1.6	2.8	25/02	11.4	N	19.2	24/16	1028.5
46011	34.9N	120.9W	0719	14.3	14.3	1.7	3.7	16/23	9.2	NW	24.9	30/21	1015.5
46012	37.4N	122.7W	0310	13.3	14.5	1.7	2.6	26/20	9.7	NW	19.4	30/07	1015.4
46013	38.2N	123.3W	0704	12.7	12.3	1.9	4.4	16/17	11.7	NW	31.1	16/15	1015.4
46014	39.2N	124.0W	0719	12.6	12.4	2.1	4.3	16/22	11.8	NW	30.9	16/17	1015.0
46023	34.7N	121.0W	0701	14.3	14.4	1.7	3.6	17/06	10.9	NW	29.1	30/22	1015.9
46025	33.8N	119.1W	0703	16.5	18.1	1.0	2.0	03/09	7.0	W	22.0	03/05	1015.0
46027	41.9N	124.4W	0019	11.1	10.5	1.0	1.1	30/21	6.1	NW	8.0	30/09	1020.3
46029	46.1N	124.5W	0716	12.9	14.1	1.8	3.7	12/18	9.7	NW	21.2	16/05	1017.6
46035	56.9N	177.8W	0699	4.1	4.5	1.4	4.5	06/01	12.2	N	31.9	05/19	1009.0
46041	47.4N	124.5W	0484	12.5	12.9	1.7	3.4	12/13	8.1	NW	21.0	15/12	1018.1
46042	36.8N	122.4W	0310	13.6	14.4	2.1	3.4	17/23	11.5	NW	22.0	27/02	1015.8
46045	33.8N	118.5W	0719	16.6	17.6	0.8	1.5	03/04	5.8	SW	12.8	03/01	1014.2
46050	44.6N	124.5W	0716	13.6	13.4	1.9	4.2	12/21	10.7	N	22.2	28/06	1018.1
46053	34.2N	119.9W	0716	15.0	15.5	0.9	1.9	29/01	9.9	W	24.3	02/22	1014.6
46054	34.3N	120.5W	0719	14.5	13.9	1.5	3.3	30/23	13.7	NW	30.7	30/09	1014.7
46059	38.0N	130.0W	0717		14.5	2.1	4.1	12/23	15.2	N	25.1	11/14	
46060	60.6N	146.8W	1366	10.5	10.8	0.5	1.3	08/21	7.4	E	22.9	08/03	1017.8
46061	60.2N	146.8W	1429	10.4	10.5	1.0	3.4	21/11	7.6	E	27.2	21/10	1017.7
46062	35.1N	121.0W	0705	14.4	14.7	1.7	4.3	17/00	10.6	NW	27.2	30/20	1015.0
46063	34.3N	120.7W	0709	14.2	14.0	1.8	3.4	17/07	12.4	NW	27.2	30/07	1014.8
51001	23.4N	162.3W	0717	23.8	24.7	1.9	3.5	23/02	14.6	E	22.0	22/19	1019.6
51002	17.2N	157.8W	0717	24.6	25.4	2.1	3.1	25/10	15.5	NE	23.3	24/10	1016.7
51003	19.1N	160.8W	0718	24.9	25.7	2.0	3.0	24/11	11.7	NE	19.2	22/20	1016.3
51004	17.4N	152.5W	0715	24.4	25.0	2.1	3.2	24/15	14.8	E	23.0	22/21	1017.4
51028	0.0N	153.9W	0705	25.0	25.2	1.8	3.5	11/00	10.2	E	16.7	09/09	1011.3
91328	8.6N	149.7E	0452	28.3					7.2	NE	13.6	03/19	1009.6
91343	7.6N	155.2E	0714	28.3									1009.4
91352	6.2N	160.7E	0403	27.8									1011.7
91374	8.7N	171.2E	0714	28.0					6.5	NE	16.4	25/09	1010.7
91377	6.1N	172.1E	0437	28.0									1012.9
91411	8.3N	137.5E	0239	28.2									1009.6
ABAN6	44.3N	075.9W	0710	18.1	16.2				3.6	S	15.9	02/15	1009.7
ALSN6	40.5N	073.8W	0713	18.7		0.7	2.0	15/01	14.3	W	35.2	01/00	1010.9
BLIA2	60.8N	146.9W	1427	10.2					5.9	NW	19.9	21/15	1018.3
BURL1	28.9N	089.4W	0708	28.1					11.8	S	30.7	27/12	1015.6
BUZM3	41.4N	071.0W	0709	15.8		0.4	1.9	01/01	13.6	S	33.7	27/21	1011.5
CARO3	43.3N	124.4W	0711	12.3					8.0	N	21.8	24/20	1018.6
CDRF1	29.1N	083.0W	0711	28.3					8.2	W	22.0	24/01	1016.4
CHLV2	36.9N	075.7W	0712	22.9	21.2	0.6	1.7	28/18	11.4	S	30.2	17/00	1012.3
CLKN7	34.6N	076.5W	0712	25.5					9.7	SW	33.5	14/01	1014.1

Continued on Page 90

Continued from Page 89

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)
CSBF1	29.7N	085.4W	0713	27.3					7.4	W	25.0	06/10	1016.8
DBLN6	42.5N	079.4W	0707	18.4					9.2	SW	29.6	26/20	1010.9
DESW1	47.7N	124.5W	0704	12.5					7.6	NW	25.1	15/14	1017.1
DISW3	47.1N	090.7W	0708	12.9					9.2	SW	42.8	25/11	1009.8
DPIA1	30.3N	088.1W	0712	27.7	29.3				8.7	SW	29.6	06/06	1016.2
DRYF1	24.6N	082.9W	0697	29.1	28.9				5.9	E	16.1	23/03	1015.8
DSLN7	35.2N	075.3W	0715	25.0		0.7	1.3	14/14	12.2	SW	37.4	19/20	1011.9
DUCN7	36.2N	075.8W	0709	24.2		0.4	1.3	28/22	10.0	SW	30.5	16/03	1013.8
FBIS1	32.7N	079.9W	0714	26.9					7.9	SW	25.2	10/18	1014.5
FFIA2	57.3N	133.6W	0717	12.3					6.3	SW	20.8	14/22	1017.3
FPSN7	33.5N	077.6W	0705	26.2		0.9	2.4	15/23	13.1	SW	38.7	20/00	1012.4
FWYF1	25.6N	080.1W	0700	28.9	29.2				9.6	E	27.3	23/09	1017.9
GDIL1	29.3N	090.0W	0712	28.4	30.9				9.7	S	24.7	25/17	1016.0
GLLN6	43.9N	076.5W	0713	17.0					12.4	W	34.0	03/19	1009.7
IOSN3	43.0N	070.6W	0711	14.3					12.0	SE	34.7	05/00	1009.6
KTNF1	29.8N	083.6W	0704	27.4					10.7	SW	28.6	06/11	1015.9
LKWF1	26.6N	080.0W	0709	28.0	28.3				7.7	SE	20.8	30/21	1016.8
LONF1	24.9N	080.9W	0175	29.1	31.6				6.5	NW	13.3	02/01	1015.3
LPOI1	48.1N	116.5W	0410	15.4	13.7				6.7	S	20.8	15/04	1013.3
MDRM1	44.0N	068.1W	0709	11.1									1010.2
MISM1	43.8N	068.9W	0714	11.3					13.7	S	38.9	14/18	1009.7
MLRF1	25.0N	080.4W	0710	28.9	29.4				7.7	SE	21.2	09/05	1017.1
MRKA2	61.1N	146.7W	1418	10.0					7.6	NE	20.9	25/00	1018.6
NWPO3	44.6N	124.1W	0716	12.1					7.4	N	25.6	01/02	1018.7
PILM4	48.2N	088.4W	0697	10.7					11.3	W	31.0	21/23	1011.2
POTA2	61.1N	146.7W	1416	10.1					6.7	NE	20.5	21/16	1017.7
PTAC1	39.0N	123.7W	0712	12.6					9.0	N	28.5	16/10	1015.1
PTAT2	27.8N	097.1W	0702		29.4				16.3	SE	33.0	16/01	1012.0
PTGC1	34.6N	120.7W	0711	13.7					14.3	N	31.7	30/09	1016.3
ROAM4	47.9N	089.3W	0661	12.5	7.9				11.1	NE	32.2	19/06	1009.8
SANF1	24.5N	081.9W	0715	28.9	29.3				7.1	E	21.5	10/05	1016.9
SAUF1	29.9N	081.3W	0711	28.0	25.8				8.7	W	27.7	20/01	1016.0
SBIO1	41.6N	082.8W	0700	20.5					9.6	NW	47.0	12/23	1010.5
SGNW3	43.8N	087.7W	0714	16.6					9.1	S	31.1	02/16	1010.0
SISW1	48.3N	122.9W	0713	12.0					9.4	W	38.0	16/01	1016.7
SMKF1	24.6N	081.1W	0717	29.4	30.3				7.6	E	20.9	23/12	1017.1
SPGF1	26.7N	079.0W	0712	28.4					7.9	SW	20.1	26/22	1016.4
SRST2	29.7N	094.1W	0710	27.9					14.9	S	29.5	16/03	1014.6
STDM4	47.2N	087.2W	0715	12.4					13.2	NW	30.7	12/11	1009.9
SUPN6	44.5N	075.8W	0698	17.9	16.7				7.8	SW	27.3	03/18	1009.0
THIN6	44.3N	076.0W	0706	17.9									
TPLM2	38.9N	076.4W	0711	21.8	21.7				9.5	S	26.3	02/19	1012.4
TTIW1	48.4N	124.7W	0705	11.4					9.8	S	28.9	22/20	1017.6
VENF1	27.1N	082.5W	0580	28.0	28.6				7.1	NW	18.6	25/00	1017.9
WPOW1	47.7N	122.4W	0687	13.7					8.5	S	23.9	24/18	1016.7

July 1998

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
41001	34.7N	072.6W	0714	26.4	26.7	1.6	3.6	18/00	13.0	SW	23.9	17/23	1016.0
41002	32.3N	075.2W	0734	27.7	28.1	1.5	2.9	01/06	12.6	SW	25.5	01/04	1016.3
41004	32.5N	079.1W	0732	27.9		1.1	2.2	01/05	12.7	SW	24.5	01/04	1014.8
41008	31.4N	080.9W	0733	28.0	28.5	0.8	1.8	13/02	12.2	SW	33.0	23/23	1015.4
41009	28.5N	080.2W	1465	27.9	28.2	0.6	1.4	15/01	8.8	SW	21.6	07/22	1016.9
41010	28.9N	078.6W	0778	29.1	29.7	1.0	1.6	15/17	9.0	S	20.0	22/14	1017.6
42001	25.9N	089.7W	0740	29.2		0.6	3.3	02/08	8.1	E	30.1	02/07	1016.4
42002	25.9N	093.6W	0740	29.2	30.0	0.8	3.0	03/09	10.3	SE	34.4	03/08	1016.3
42003	25.9N	085.9W	0731	29.1	30.1	0.6	1.0	24/14	7.3	E	28.4	11/21	1016.8
42007	30.1N	088.8W	0736	28.8	29.5	0.3	0.9	10/12	8.6	SW	25.5	10/21	1016.1
42019	27.9N	095.4W	0735	28.8	29.3	0.8	2.8	03/17					1015.4
42020	26.9N	096.7W	0740	28.8	29.0	1.0	2.3	03/20	12.1	SE	20.8	03/06	1014.7
42035	29.3N	094.4W	0742	29.2	29.6	0.7	2.3	03/14	10.6	S	24.5	03/13	1015.5
42036	28.5N	084.5W	0735	29.0	29.7	0.5	1.8	11/03	7.6	SW	24.5	10/12	1017.4
42039	28.8N	086.0W	0735	29.3	30.4	0.5	1.9	10/22	7.8	W	23.5	12/21	1018.1
42040	29.2N	088.3W	0738	29.0	30.2	0.4	1.7	03/01	7.9	W	27.4	14/18	1017.5
44004	38.5N	070.7W	0740	22.7	22.7	1.1	3.0	01/06	8.8	SW	24.9	31/21	1015.1
44005	42.9N	068.9W	0735	18.2	17.3	1.0	2.4	29/16	9.2	S	22.5	23/20	1012.1
44007	43.5N	070.2W	0738	17.5	15.6	0.7	1.5	28/02	7.5	S	19.2	28/01	1012.2
44008	40.5N	069.4W	0744	17.5	15.9	1.0	2.5	01/01	7.4	S	22.9	31/18	1014.2

Continued on Page 91

Continued from Page 90

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)
44009	38.5N	074.7W	0732	23.2	22.7	0.8	2.4	31/16	7.6	S	24.3	31/15	1014.3
44011	41.1N	066.6W	0731	16.2	14.8	1.1	3.6	01/04	6.7	S	22.0	31/21	1014.3
44013	42.4N	070.7W	0735	19.1	17.2	0.4	0.9	05/21	7.2	S	19.6	01/22	1011.9
44014	36.6N	074.8W	0737	25.1	25.0	0.9	2.1	31/22	9.6	SW	25.6	26/14	1014.2
44025	40.3N	073.2W	0738	22.5	22.1	0.8	1.8	01/09	8.8	S	22.7	31/07	1014.5
45001	48.1N	087.8W	0726	16.3	15.4	0.6	2.4	21/19	9.4	SW	26.4	21/18	1013.1
45002	45.3N	086.4W	0727	19.6	19.4	0.6	2.1	27/06	9.5	S	25.6	27/06	1013.4
45003	45.3N	082.8W	0729	18.6	18.3	0.5	2.0	23/21	9.4	W	25.1	23/20	1013.7
45004	47.6N	086.6W	0742	16.5	15.6	0.6	2.7	21/21	8.9	W	25.8	21/20	1013.9
45005	41.7N	082.4W	0740	22.9	23.7	0.4	1.6	22/13	9.1	SW	28.6	22/04	1014.4
45006	47.3N	089.9W	0741	17.0	18.2	0.5	2.5	15/06	9.2	W	22.7	15/03	1018.5
45007	42.7N	087.0W	0736	21.7	21.9	0.5	1.7	04/18	8.7	N	30.7	21/19	1015.7
45008	44.3N	082.4W	0221	19.7	19.8	0.5	1.9	24/00	9.2	NW	22.5	27/10	1014.4
46001	56.3N	148.2W	0728	11.4	12.1	1.3	2.6	20/09	9.3	SW	24.3	20/07	1013.3
46002	42.5N	130.3W	0728	15.1	15.6	1.7	2.7	03/07	12.6	NE	22.3	14/11	1020.2
46003	51.9N	155.9W	0712	9.4	9.4	1.6	4.0	17/07	12.1	W	28.2	16/06	1014.1
46005	46.1N	131.0W	0727	14.1	14.3	1.7	3.7	16/19	11.9	NW	26.2	14/19	1020.1
46006	40.9N	137.5W	0514	16.5	17.2	1.6	3.3	14/09	11.1	N	24.5	15/23	1021.7
46011	34.9N	120.9W	0737	14.6	15.5	1.7	3.4	02/04	11.2	NW	25.8	01/18	1014.2
46012	37.4N	122.7W	0727	13.4	13.5	1.5	3.1	03/13	8.9	NW	21.4	02/02	1015.0
46013	38.2N	123.3W	0734	12.3	11.3	1.8	3.6	19/09	13.7	NW	30.7	04/01	1015.0
46014	39.2N	124.0W	0741	12.7	12.5	1.7	3.3	03/09	11.4	NW	27.2	04/03	1015.1
46022	40.7N	124.5W	0736	12.7	12.2	1.5	3.1	24/07	8.6	N	24.5	05/10	1017.0
46023	34.7N	121.0W	0730	14.5	15.4	1.8	3.8	02/02	13.3	NW	29.1	27/20	1014.7
46025	33.8N	119.1W	0728	17.8	19.4	1.1	2.0	02/05	5.9	W	15.7	26/02	1013.6
46027	41.9N	124.4W	0735	12.1	11.5	1.5	3.3	03/02	6.6	NW	29.9	05/23	1016.6
46029	46.1N	124.5W	0736	14.7	15.3	1.3	2.7	14/19	9.3	NW	24.3	14/18	1017.5
46030	40.4N	124.5W	0721	11.6	10.3	1.6	3.2	24/10	12.3	N	22.7	02/14	1017.1
46035	56.9N	177.8W	0708	7.1	7.6	1.2	3.9	31/04	11.5	SE	27.8	21/17	1012.5
46041	47.4N	124.5W	0732	13.8	13.8	1.2	2.8	14/22	7.8	NW	24.1	14/18	1017.6
46042	36.8N	122.4W	0736	13.6	13.7	1.7	3.3	03/12	11.9	NW	27.8	16/22	1015.2
46045	33.8N	118.5W	0738	18.6	20.5	0.8	1.6	02/05	5.5	SW	12.8	05/00	1012.8
46050	44.6N	124.5W	0740	15.1	15.1	1.5	3.1	21/02	9.9	N	22.3	20/18	1017.7
46053	34.2N	119.9W	0735	16.9	18.0	1.0	2.2	02/03	8.9	W	22.7	29/05	1013.2
46054	34.3N	120.5W	0736	15.8	16.2	1.8	3.5	02/03	15.7	NW	31.1	02/09	1013.1
46059	38.0N	130.0W	0732		16.6	1.7	2.9	03/12	12.6	NW	22.0	02/16	
46060	60.6N	146.8W	1463	13.0	13.6	0.3	1.0	05/17	7.4	E	22.3	22/15	1015.8
46061	60.2N	146.8W	1472	12.7	13.5	0.8	2.8	22/01	9.0	E	27.0	11/14	1015.2
46062	35.1N	121.0W	0712	14.3	15.3	1.7	3.3	02/01	12.6	NW	29.0	02/02	1013.8
46063	34.3N	120.7W	0730	14.9	15.6	1.9	3.7	02/02	15.1	NW	30.7	01/14	1013.3
51001	23.4N	162.3W	0741	24.4	25.2				14.9	E	24.1	08/14	1020.1
51002	17.2N	157.8W	0739	25.1	25.8	2.1	3.0	06/22	15.8	SE	21.6	14/21	1016.7
51003	19.1N	160.8W	0740	25.4	26.1	1.9	3.1	07/16	13.1	NE	21.2	08/16	1017.3
51004	17.4N	152.5W	0739	24.9	25.7	2.0	2.7	12/17	14.8	NE	21.3	13/04	1017.0
51028	0.0N	153.9W	0719	23.9	23.7	1.7	2.8	10/04	10.2	NE	17.9	12/13	1012.0
91328	8.6N	149.7E	0501	28.3					4.8	NE	11.6	05/18	1009.7
91343	7.6N	155.2E	0622	28.2									1009.7
91352	6.2N	160.7E	0470	27.8									1012.2
91374	8.7N	171.2E	0734	27.4					5.5	NE	15.1	14/02	1010.9
91377	6.1N	172.1E	0441	27.9									1013.4
91411	8.3N	137.5E	0356	28.5									1009.3
ABAN6	44.3N	075.9W	0741	20.8	20.9				3.5	S	13.1	21/19	1013.3
ALSN6	40.5N	073.8W	0737	22.8		0.6	1.8	28/00	13.2	S	30.9	29/00	1014.1
BLIA2	60.8N	146.9W	1463	12.3					6.0	NW	24.0	25/15	1016.4
BURL1	28.9N	089.4W	0723	29.3					8.9	W	24.7	14/18	1016.6
BUZM3	41.4N	071.0W	0727	20.3		0.4	1.2	01/11	11.3	SW	24.8	02/00	1014.4
CARO3	43.3N	124.4W	0729	13.3					6.8	N	28.6	14/21	1018.2
CDRF1	29.1N	083.0W	0740	28.8					7.2	W	16.9	22/00	1016.9
CHLV2	36.9N	075.7W	0739	25.1	24.2	0.7	1.5	26/16	10.0	SW	27.7	31/18	1015.3
CLKN7	34.6N	076.5W	0737	27.1					10.9	SW	24.9	18/02	1016.6
CSBF1	29.7N	085.4W	0724	27.6					6.1	W	22.3	31/14	1017.3
DBLN6	42.5N	079.4W	0730	21.8					8.4	SW	33.1	21/19	1014.8
DESW1	47.7N	124.5W	0717	13.8					9.2	NW	36.4	14/22	1017.3
DISW3	47.1N	090.7W	0736	18.7					9.4	SW	40.7	15/03	1014.3
DPIA1	30.3N	088.1W	0733	28.6	30.3				7.7	SW	30.1	10/03	1016.8
DRYF1	24.6N	082.9W	0618	29.5	30.4				8.0	E	18.7	23/07	1016.7
DSLN7	35.2N	075.3W	0733	26.5		0.9	1.4	14/23	13.7	SW	29.6	09/08	1014.5
DUCN7	36.2N	075.8W	0718	26.0		0.5	1.5	26/17	10.2	SW	25.7	26/15	1016.6
FBIS1	32.7N	079.9W	0737	28.1					9.8	SW	19.9	14/23	1015.8

Continued on Page 92

Continued from Page 91

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)
FFIA2	57.3N	133.6W	0551	13.1					6.5	S	30.2	16/05	1016.8
FPSN7	33.5N	077.6W	0722	27.8		1.2	2.7	01/08	14.1	SW	34.0	01/07	1014.4
FWYF1	25.6N	080.1W	0732	29.2	30.2				10.1	E	31.5	22/07	1018.4
GDIL1	29.3N	090.0W	0733	29.5	32.0				7.7	SW	25.2	14/17	1017.0
GLLN6	43.9N	076.5W	0734	21.0					11.2	SW	28.8	29/06	1013.3
IOSN3	43.0N	070.6W	0736	19.8					11.5	S	24.9	29/11	1011.8
KTNF1	29.8N	083.6W	0737	27.9					8.8	SW	27.9	04/02	1016.3
LKWF1	26.6N	080.0W	0738	28.3	29.0				7.1	SE	19.7	07/20	1017.6
LONF1	24.9N	080.9W	0627	29.5	31.1				8.1	E	24.7	04/21	1016.8
MDRM1	44.0N	068.1W	0722	14.8									1012.1
MISM1	43.8N	068.9W	0732	15.7					12.7	S	30.0	10/22	1011.5
MLRF1	25.0N	080.4W	0727	29.2	30.4				9.1	SE	28.6	21/05	1017.6
MRKA2	61.1N	146.7W	1460	11.6					7.7	NE	24.9	06/09	1016.0
NWPO3	44.6N	124.1W	0726	13.5					7.5	N	23.1	21/03	1018.3
PILM4	48.2N	088.4W	0729	16.7					11.7	W	32.4	21/19	1014.5
POTA2	61.1N	146.7W	1459	11.8					6.5	NE	22.0	31/11	1015.6
PTAC1	39.0N	123.7W	0725	12.3					10.5	N	21.3	19/06	1015.1
PTAT2	27.8N	097.1W	0717		29.9				13.0	SE	22.8	03/23	1015.1
PTGC1	34.6N	120.7W	0734	14.1					16.7	N	32.0	01/14	1015.0
ROAM4	47.9N	089.3W	0664	17.0	14.0				7.4	SW	28.1	29/20	1013.9
SANF1	24.5N	081.9W	0739	29.2	30.2				9.6	E	28.5	12/21	1017.3
SAUF1	29.9N	081.3W	0731	27.9	27.8				7.4	SW	25.5	12/17	1016.9
SBIO1	41.6N	082.8W	0730	23.4					8.5	SW	30.8	21/13	1014.4
SGNW3	43.8N	087.7W	0739	20.7					9.0	S	21.5	04/07	1015.1
SISW1	48.3N	122.9W	0728	13.1					8.7	W	28.7	11/01	1017.1
SMKF1	24.6N	081.1W	0656	29.5	30.8				10.2	E	27.8	04/22	1017.5
SPGF1	26.7N	079.0W	0733	29.0					6.8	SE	19.7	14/21	1017.2
SRST2	29.7N	094.1W	0727	29.1					12.0	S	25.6	03/14	1016.9
STDM4	47.2N	087.2W	0737	18.3					11.7	W	32.0	21/21	1013.7
SUPN6	44.5N	075.8W	0730	20.7	21.3				7.1	S	17.1	01/18	1012.4
THIN6	44.3N	076.0W	0723	20.5									
TPLM2	38.9N	076.4W	0726	25.1	25.4				9.1	S	24.5	01/00	1015.5
TTIW1	48.4N	124.7W	0730	13.0					9.6	S	27.5	15/02	1017.9
VENF1	27.1N	082.5W	0538	27.7	30.2				7.2	W	22.0	11/20	1018.0
WPOW1	47.7N	122.4W	0723	16.2					7.6	NE	17.3	13/04	1017.0

August 1998

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
41001	34.7N	072.6W	0558	27.0	27.8	1.5	5.3	26/20	9.4	E	31.9	27/04	1017.5
41002	32.3N	075.2W	0737	27.6	28.6	1.7	9.7	26/02	10.8	SW	41.2	26/03	1015.7
41004	32.5N	079.1W	0710	26.9		1.3	6.2	26/04	10.4	NE	38.5	26/12	1015.3
41008	31.4N	080.9W	0731	27.6	27.6	0.9	2.7	02/00	10.6	NE	24.5	02/08	1015.8
41009	28.5N	080.2W	1448	28.4	28.9	1.0	4.0	25/15	8.4	SE	27.4	20/17	1016.1
41010	28.9N	078.6W	1472	29.0	30.0	1.5	6.0	24/20	9.4	NE	26.8	25/18	1016.1
42001	25.9N	089.7W	0738	29.3		0.6	2.8	31/22	9.4	E	31.7	20/14	1014.5
42002	25.9N	093.6W	0743	29.5	30.5	0.7	3.1	31/22	9.2	E	27.2	20/19	1014.7
42003	25.9N	085.9W	0738	29.0	30.2	0.5	1.6	20/08	8.0	E	24.5	05/19	1014.9
42007	30.1N	088.8W	0734	28.9	30.1	0.5	1.9	21/16	8.3	E	29.0	14/17	1015.3
42019	27.9N	095.4W	0741	28.8	29.8	0.7	4.4	22/04	9.1	SE	29.7	22/02	1014.3
42020	26.9N	096.7W	0742	28.9	29.2	0.7	2.9	22/05	9.9	SE	26.6	21/13	1014.0
42035	29.3N	094.4W	0736	29.3	30.7	0.6	3.0	21/23	8.8	S	27.8	22/01	1014.9
42036	28.5N	084.5W	0738	28.9	29.9	0.5	2.0	21/03	7.3	E	26.6	20/16	1016.5
42039	28.8N	086.0W	0737	28.9	30.2	0.5	2.1	21/11	7.6	E	31.3	19/12	1017.0
42040	29.2N	088.3W	0734	29.0	30.3	0.6	3.0	21/18	7.9	E	26.6	19/16	1016.3
44004	38.5N	070.7W	0742	23.4	23.4	1.6	6.8	29/01	11.4	NE	34.4	29/00	1017.8
44005	42.9N	068.9W	0739	19.0	18.4	1.0	3.5	29/18	8.6	S	26.2	26/09	1016.9
44007	43.5N	070.2W	0739	17.4	17.3	0.6	1.8	29/22	7.4	S	17.9	10/21	1017.3
44008	40.5N	069.4W	0736	20.1	19.4	1.2	5.4	29/10	8.1	NE	23.9	29/13	1018.1
44009	38.5N	074.7W	0738	23.8	24.4	1.1	3.6	28/17	10.9	NE	30.5	28/16	1017.1
44011	41.1N	066.6W	0737	18.8	18.0	1.2	5.9	29/17	7.4	N	35.0	29/16	1018.4
44013	42.4N	070.7W	0741	18.2	16.4	0.4	1.6	29/17	6.5	S	20.6	29/11	1016.7
44014	36.6N	074.8W	0742	24.9	24.9	1.5	6.1	27/23	11.1	NE	37.3	28/01	1015.9
44025	40.3N	073.2W	0737	22.5	22.7	1.0	3.1	29/01	8.8	S	28.0	19/06	1017.7
45001	48.1N	087.8W	0733	18.8	18.9	0.6	1.7	16/20	10.3	SW	25.1	17/11	1016.0
45002	45.3N	086.4W	0711	21.1	21.7	0.5	1.7	20/08	10.1	S	26.8	14/23	1015.9
45003	45.3N	082.8W	0732	20.0	20.4	0.5	1.5	20/15	9.2	S	22.2	23/11	1017.0

Continued on Page 93

Continued from Page 92

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)
45004	47.6N	086.6W	0740	18.6	18.5	0.6	1.9	17/16	9.8	S	22.7	17/16	1016.9
45005	41.7N	082.4W	0739	23.0	23.8	0.4	1.4	19/02	8.6	SW	24.1	25/14	1017.0
45006	47.3N	089.9W	0742	19.5	19.3	0.5	1.6	24/01	9.8	NE	29.1	29/07	1016.1
45007	42.7N	087.0W	0736	22.6	23.2	0.5	2.0	16/00	9.0	S	19.6	15/23	1017.4
45008	44.3N	082.4W	0740	21.0	21.1	0.5	1.9	18/08	8.9	N	24.1	18/07	1017.3
46001	56.3N	148.2W	0735	12.4	13.2	2.0	8.2	31/22	12.4	W	29.3	31/04	1011.7
46002	42.5N	130.3W	0741	17.3	18.1	1.5	2.6	30/19	10.5	N	20.4	23/07	1022.7
46003	51.9N	155.9W	0741	11.1	11.6	2.1	5.6	31/16	15.0	W	31.7	31/14	1016.5
46005	46.1N	131.0W	0735	16.2	16.9	1.4	2.5	09/07	9.6	NW	20.4	05/11	1022.8
46006	40.9N	137.5W	0514	18.6	19.2	1.4	2.2	09/02	9.5	N	18.1	02/12	1024.1
46011	34.9N	120.9W	0744	15.6	17.1	1.8	3.3	08/00	11.2	NW	23.5	23/23	1014.0
46012	37.4N	122.7W	0735	13.6	14.5	1.7	3.2	07/14	9.4	NW	20.0	23/02	1014.8
46013	38.2N	123.3W	0733	12.4	12.5	2.0	3.6	06/22	15.4	NW	29.3	07/01	1014.7
46014	39.2N	124.0W	0738	12.4	11.9	2.0	3.6	07/03	13.6	NW	27.2	17/00	1014.8
46022	40.7N	124.5W	0738	13.0	12.4	1.7	3.2	08/04	9.3	N	20.8	08/10	1017.2
46023	34.7N	121.0W	0738	15.4	17.1	1.8	3.0	07/22	13.8	NW	26.2	23/23	1014.6
46025	33.8N	119.1W	0729	19.2	20.6	1.1	1.9	04/21	5.9	W	15.2	05/00	1013.5
46026	37.8N	122.8W	0287	12.7	13.7	1.4	2.3	23/04	11.8	NW	23.7	23/04	1014.5
46027	41.9N	124.4W	0360	12.2	11.9	1.6	3.4	08/00	6.8	NW	32.6	07/22	1016.8
46028	35.7N	121.9W	0413	14.5	15.4	2.1	3.4	29/06	16.9	NW	28.0	23/04	1013.4
46029	46.1N	124.5W	0743	15.8	16.0	1.2	2.3	30/23	9.0	N	21.0	31/06	1019.5
46030	40.4N	124.5W	0733	12.2	10.9	1.8	3.0	15/04	14.4	N	25.1	05/13	1017.1
46035	56.9N	177.8W	0718	8.3	8.6	1.9	5.5	16/11	14.9	SW	35.8	25/02	1012.0
46041	47.4N	124.5W	0740	14.4	14.0	1.1	2.2	24/02	7.2	NW	20.0	13/02	1019.8
46042	36.8N	122.4W	0741	14.2	15.2	1.9	3.2	17/06	12.9	NW	25.6	29/00	1014.9
46045	33.8N	118.5W	0741	19.5	20.6	0.7	1.4	19/05	4.8	SW	11.9	18/22	1012.6
46050	44.6N	124.5W	0743	15.6	14.4	1.5	2.7	31/06	11.7	N	21.4	30/07	1019.3
46053	34.2N	119.9W	0687	17.6	19.4	0.9	1.8	24/03	9.6	W	20.8	18/03	1013.4
46054	34.3N	120.5W	0735	16.3	17.3	1.7	2.7	07/23	17.3	NW	31.1	18/01	1012.7
46059	38.0N	130.0W	0739		18.4	1.7	2.7	31/22	12.1	N	20.8	24/15	
46060	60.6N	146.8W	1479	12.6	14.0	0.4	1.9	31/21	9.8	E	31.3	31/20	1012.7
46061	60.2N	146.8W	1472	12.6	13.6	1.0	4.5	31/23	10.2	E	37.1	31/22	1012.0
46062	35.1N	121.0W	0724	15.3	16.8	1.8	3.0	07/18	12.4	NW	24.9	23/19	1013.6
46063	34.3N	120.7W	0739	15.8	16.8	1.9	3.1	23/16	16.0	NW	25.6	29/05	1013.0
51001	23.4N	162.3W	0740	25.2	26.1	2.0	3.1	23/22	14.5	E	21.8	23/00	1018.4
51002	17.2N	157.8W	0737	25.9	26.5	2.2	3.4	19/18	14.2	NE	22.2	21/02	1015.6
51003	19.1N	160.8W	0574	26.0	26.7	1.8	2.8	24/02	11.4	NE	20.3	24/20	1016.3
51004	17.4N	152.5W	0741	25.7	26.3	2.1	3.6	23/23	14.3	NE	20.9	24/20	1016.0
51028	0.0N	153.9W	0713	23.2	23.0	2.0	3.0	04/16	10.7	E	19.4	18/10	1012.3
91204	9.9N	139.7E	0512	49.5					5.6	NE	27.2	10/04	1010.0
91328	8.6N	149.7E	0511	28.1					4.4	NE	21.3	27/06	1009.5
91343	7.6N	155.2E	0503	28.2									1009.1
91352	6.2N	160.7E	0464	27.9									1011.9
91374	8.7N	171.2E	0737	27.4					4.4	NE	15.3	01/02	1010.5
91377	6.1N	172.1E	0447	28.0									1013.1
91411	8.3N	137.5E	0383	28.5									1009.6
ABAN6	44.3N	075.9W	0741	20.7	21.4				3.6	S	14.1	18/19	1017.8
ALSN6	40.5N	073.8W	0738	23.3		0.8	2.1	28/22	11.5	S	33.1	19/05	1018.0
BLIA2	60.8N	146.9W	1478	11.4					8.3	N	31.3	31/16	1013.4
BURL1	28.9N	089.4W	0735	29.4					8.8	E	29.9	15/21	1015.3
BUZM3	41.4N	071.0W	0735	20.8		0.5	2.1	26/08	10.3	S	30.0	19/07	1018.8
CARO3	43.3N	124.4W	0736	13.1					6.5	NE	20.3	28/20	1019.3
CDRF1	29.1N	083.0W	0741	28.0					7.4	NE	27.7	08/00	1016.4
CHLV2	36.9N	075.7W	0742	24.6	24.4	1.0	3.5	28/15	13.4	NE	71.8	28/06	1017.4
CLKN7	34.6N	076.5W	0713	26.2					13.0	NE	58.6	27/05	1017.3
CSBF1	29.7N	085.4W	0734	28.3					6.0	NE	21.5	07/21	1016.7
DBLN6	42.5N	079.4W	0741	22.0					7.2	SW	30.2	25/17	1018.0
DESW1	47.7N	124.5W	0730	14.3					9.3	NW	31.9	13/01	1019.5
DISW3	47.1N	090.7W	0732	19.8					9.9	SW	23.3	17/12	1016.3
DPIA1	30.3N	088.1W	0737	28.7	30.8				8.2	E	22.1	21/15	1016.2
DRYF1	24.6N	082.9W	0735	29.5	30.8				7.1	E	23.3	19/20	1014.6
DSLN7	35.2N	075.3W	0737	25.8		1.0	3.5	26/01	14.5	NE	63.0	27/19	1015.8
DUCN7	36.2N	075.8W	0726	25.4		0.9	2.9	27/20	12.3	NE	44.9	27/20	1018.5
FBIS1	32.7N	079.9W	0738	27.1					8.4	SW	23.6	20/11	1016.8

Meteorological Services—Observations

U.S. Port Meteorological Officers

Headquarters

Vincent Zegowitz
Voluntary Observing Ships Program Leader
National Weather Service, NOAA
1325 East-West Hwy., Room 14112
Silver Spring, MD 20910
Tel: 301-713-1677 Ext. 129
Fax: 301-713-1598

Martin S. Baron
VOS Assistant Program Leader
National Weather Service, NOAA
1325 East-West Hwy., Room 14108
Silver Spring, MD 20910
Tel: 301-713-1677 Ext. 134
Fax: 301-713-1598

CDR. Tim Rulon
GMDSS Program Manager
National Weather Service, NOAA
1325 East-West Hwy., Room 14114
Silver Spring, MD 20910
Tel: 301-713-1677 Ext. 128
Fax: 301-713-1598
E-Mail: Timothy.Rulon@noaa.gov

Mary Ann Burke, Editor
Mariners Weather Log
3030 70th Avenue
Wilson, WI 54027
Tel and Fax: 715-772-3487
E-Mail: wvrs@discover-net.net

Atlantic Ports

Robert Drummond, PMO
National Weather Service, NOAA
2550 Eisenhower Blvd, No. 312
P.O. Box 165504
Port Everglades, FL 33316
Tel: 954-463-4271
Fax/Tel: 954-462-8963

Lawrence Cain, PMO
National Weather Service, NOAA
13701 Fang Rd.
Jacksonville, FL 32218
Tel: 904-741-5186

Peter Gibino, PMO, Norfolk
NWS-NOAA
200 World Trade Center
Norfolk, VA 23510
Tel: 757-441-3415
Fax: 757-441-6051

James Saunders, PMO
National Weather Service, NOAA
Maritime Center I, Suite 287
2200 Broening Hwy.
Baltimore, MD 21224-6623
Tel: 410-633-4709
Fax: 410-633-4713
E-mail: pmojim@erols.com

PMO, New Jersey
National Weather Service, NOAA
110 Lower Main Street, Suite 201
South Amboy, NJ 08879-1367
Tel: 732-316-5409
Fax: 732-316-6543

Tim Kenefick, PMO, New York
National Weather Service, NOAA
110 Lower Main Street, Suite 201
South Amboy, NJ 08879-1367
Tel: 732-316-5409
Fax: 732-316-6543

Great Lakes Ports

Amy Seeley, PMO
National Weather Service, NOAA
333 West University Dr.
Romeoville, IL 60441
Tel: 815-834-0600 Ext. 269
Fax: 815-834-0645

George Smith, PMO
National Weather Service, NOAA
Hopkins International Airport
Federal Facilities Bldg.
Cleveland, OH 44135
Tel: 216-265-2374
Fax: 216-265-2371
E-Mail: George.E.Smith@noaa.gov

Gulf of Mexico Ports

John Warrelmann, PMO
National Weather Service, NOAA
Int’l Airport, Moisant Field
Box 20026
New Orleans, LA 70141
Tel: 504-589-4839

James Nelson, PMO
National Weather Service, NOAA
Houston Area Weather Office
1620 Gill Road
Dickinson, TX 77539
Tel: 281-534-2640 x.277
Fax: 281-337-3798
E-mail: jim.nelson@noaa.gov

Pacific Ports

Derek Lee Loy
Ocean Services Program Coordinator
NWS Pacific Region HQ
Grosvenor Center, Mauka Tower
737 Bishop Street, Suite 2200
Honolulu, HI 96813-3213
Tel: 808-532-6439
Fax: 808-532-5569

Robert Webster, PMO
National Weather Service, NOAA
501 West Ocean Blvd., Room 4480
Long Beach, CA 90802-4213
Tel: 562-980-4090
Fax: 562-980-4089
Telex: 7402731/BOBW UC
E-mail: bob.webster@noaa.gov

Robert Novak, PMO
National Weather Service, NOAA
1301 Clay St., Suite 1190N
Oakland, CA 94612-5217
Tel: 510-637-2960
Fax: 510-637-2961
Telex: 7402795/WPMO UC
E-mail: w-wr-oak@noaa.gov

Patrick Brandow, PMO
National Weather Service, NOAA
7600 Sand Point Way, N.E.
Seattle, WA 98115-0070
Tel: 206-526-6100
Fax: 206-526-4571 or 6094
Telex: 7608403/SEA UC
E-Mail: pat.brandow@noaa.gov

Gary Ennen
National Weather Service, NOAA
600 Sandy Hook St., Suite 1
Kodiak, AK 99615
Tel: 907-487-2102
Fax: 907-487-9730

Lynn Chrystal, OIC
National Weather Service, NOAA
Box 427

Continued on Page 95

Meteorological Services

Continued from Page 94

Valdez, AK 99686
Tel: 907-835-4505
Fax: 907-835-4598

Greg Matzen, Marine Program Mgr.
W/AR1x2 Alaska Region
National Weather Service
222 West 7th Avenue #23
Anchorage, AK 99513-7575
Tel: 907-271-3507

SEAS Field Representatives

Mr. Robert Decker
Seas Logistics/ PMC
7600 Sand Point Way N.E.
Seattle, WA 98115
Tel: 206-526-4280
Fax: 206-526-6365
Telex: 7408535
E-Mail: bob.decker@noaa.gov

Mr. Steven Cook
NOAA-AOML
United States GOOS Center
4301 Rickenbacker Causeway
Miami, FL 33149
Tel: 305-361-4501
Fax: 305-361-4366
E-Mail: cook@aoml.noaa.gov

Mr. Robert Benway
National Marine Fisheries Service
28 Tarzwell Dr.
Narragansett, RI 02882
Tel: 401-782-3295
Fax: 401-782-3201

Mr. Jim Farrington
SEAS Logistics/ A.M.C.
439 WestWork St.
Norfolk, VA 23510
Tel: 757-441-3062
Fax: 757-441-6495

Mr. Warren Krug
Atlantic Oceanographic & Met. Lab.
4301 Rickenbacker Causeway
Miami, FL 33149
Tel: 305-361-4433
Fax: 305-361-4582
Telex: 744 7600 MCI

NIMA Fleet Liaison

Tom Hunter, Fleet Liaison Officer
ATTN: GIMM (MS D-44)
4600 Sangamore Road
Bethesda, MD 20816-5003
Tel: 301-227-3120
Fax: 301-227-4211

U.S. Coast Guard AMVER Center

Richard T. Kenney
AMVER Maritime Relations Officer
United States Coast Guard
Battery Park Building
New York, NY 10004
Tel: 212-668-7764
Fax: 212-668-7684
Telex: 127594 AMVERNYK

Other Port Meteorological Officers

Australia

Headquarters
Tony Baxter
Bureau of Meteorology
150 Lonsdale Street, 7th Floor
Melbourne, VIC 3000
Tel: +613 96694651
Fax: +613 96694168

Melbourne
Michael T. Hills, PMA
Victoria Regional Office
Bureau of Meteorology, 26th Floor
150 Lonsdale Street
Melbourne, VIC 3000
Tel: +613 66694982
Fax: +613 96632059

Fremantle
Captain Alan H. Pickles, PMA
WA Regional Office
1100 Hay Street, 5th Floor
West Perth WA 6005
Tel: +619 3356670
Fax: +619 2632297

Sydney
Captain E.E. (Taffy) Rowlands, PMA
NSW Regional Office
Bureau of Meteorology, Level 15
300 Elizabeth Street
Sydney NSW 2000
Tel:+612 92961547
Fax: +612 92961589
Telex: AA24640

Canada

Randy Sheppard, PMO
Environment Canada
1496 Bedford Highway, Bedford
(Halifax) Nova Scotia B4A 1E5
902-426-6703

Denis Blanchard
Environment Canada
100 Alexis Nihon Blvd., 3rd Floor
Ville St. Laurent, (Montreal) Quebec
H4M 2N6
Tel: 514-283-6325

D. Miller, PMO
Environment Canada
Bldg. 303, Pleasantville
P.O. Box 21130, Postal Station "B"
St. John's, Newfoundland A1A 5B2
Tel: 709-772-4798

Michael Riley, PMO
Environment Canada
Pacific and Yukon Region
Suite 700, 1200 W. 73rd Avenue
Vancouver, British Columbia V6P 6H9
Tel: 604-664-9136
Fax: 604-664-9195
E-Mail: Mike.Riley@ec.gc.ca

Ron Fordyce, Supt. Marine Data Unit
Rick Shukster, PMO
Environment Canada
Port Meteorological Office
100 East Port Blvd.
Hamilton, Ontario L8H 7S4
Tel: 905-312-0900
Fax: 905-312-0730

China

YU Zhaoguo
Shanghai Meteorological Bureau
166 Puxi Road
Shanghai, China

Denmark

Commander Lutz O. R. Niegsch
PMO, Danish Meteorological Inst.
Lyngbyvej 100, DK-2100
Copenhagen, Denmark
Tel: +45 39157500
Fax: +45 39157300

United Kingdom

Headquarters
Capt. Stuart M. Norwell,
Marine Superintendent, BD (OM)
Meteorological Office, Met O (OM)
Scott Building, Eastern Road
Bracknell, Berks RG12 2PW

Continued on Page 96

Meteorological Services

Continued from Page 95

Tel: +44-1344 855654
Fax: +44-1344 855921
Telex: 849801 WEABKA G

Bristol Channel
Captain Austin P. Maytham, PMO
P.O. Box 278, Companies House
CrownWay, Cardiff CF4 3UZ
Tel: + 44 1222 221423
Fax: +44 1222 225295

East England
Captain John Steel, PMO
Customs Bldg., Albert Dock
Hull HU1 2DP
Tel: +44 1482 320158
Fax: +44 1482 328957

Northeast England
Captain Gordon Young, PMO
Able House, Billingham Reach
Industrial Estate, Cleveland TS23 lPX
Tel: +44 1642 560993
Fax:+44 1642 562170

Northwest England
Captain Jim Williamson, PMO
Room 313, Royal Liver Building
Liverpool L3 1JH
Tel:+44 151 2366565
Fax: +44 151 2274762

Scotland and Northern Ireland
Captain Peter J. Barratt, PMO
Navy Buildings, Eldon St.
Greenock, Strathclyde PA16 7SL
Tel: +44 1475 724700
Fax: +44 1475 892879

Southeast England
Captain Harry Gale, PMO
Trident House, 21 Berth, Tilbury Dock
Tilbury, Essex RM18 7HL
Tel: +44 1375 859970
Fax: +44 1375 859972

Southwest England
Captain Douglas R. McWhan, PMO
8 Viceroy House, Mountbatten Centre
Millbrook Rd. East
Southampton SO15 lHY
Tel: +44 1703 220632
Fax: +44 1703 337341

France

Yann Prigent, PMO
Station Mét., Noveau Semaphore
Quai des Abeilles, Le Havre
Tel: +33 35422106
Fax: +33 35413119

P. Coulon
Station Météorologique
de Marseille-Port
12 rue Sainte Cassien
13002 Marseille
Tel: +33 91914651 Ext. 336

Germany

Henning Hesse, PMO
Wetterwarte, An der neuen Schleuse
Bremerhaven
Tel: +49 47172220
Fax: +49 47176647

Jurgen Guhne, PMO
Deutscher Wetterdienst
Seewetteramt
Bernhard Nocht-Strasse 76
20359 Hamburg
Tel: 040 3190 8826

Greece

George E. Kassimidis, PMO
Port Office, Piraeus
Tel: +301 921116
Fax: +3019628952

Hong Kong

C. F. Wong, PMO
Hong Kong Observatory
Unit 2613, 26/F, Miramar Tower
14/F Ocean Centre
1 Kimberly Road
Kowloon, Hong Kong
Tel: +852 2926 3100
Fax: +852 2375 7555

Israel

Hani Arbel, PMO
Haifa Port
Tel: 972 4 8664427

Aharon Ofir, PMO
Marine Department
Ashdod Port
Tel: 972 8 8524956

Japan

Headquarters
Marine Met. Div., Marine Dept.
Japan Meteorological Agency
1-34 Otemachi, Chiyoda-ku
Tokyo, 100 Japan
Fax: 03-3211-6908

Port Meteorological Officer
Kobe Marine Observatory
14-1, Nakayamatedori-7-chome
Chuo-ku, Kobe, 650 Japan
Fax: 078-361-4472

Port Meteorological Officer
Nagoya Local Meteorological Obs.
2-18, Hiyori-cho, Chikusa-ku
Nagoya, 464 Japan
Fax: 052-762-1242

Port Meteorological Officer
Yokohama Local Met. Observatory
99 Yamate-cho, Naka-ku,
Yokohama, 231 Japan
Fax: 045-622-3520

Kenya

Ali J. Mafimbo, PMO
PO Box 98512
Mombasa, Kenya
Tel: +254 1125685
Fax: +254 11433440

Malaysia

NG Kim Lai
Assistant Meteorological Officer
Malaysian Meteorological Service
Jalan Sultan, 46667 Petaling
Selangor, Malaysia

Mauritius

Mr. S Ragoonaden
Meteorological Services
St. Paul Road, Vacoas, Mauritius
Tel: +230 6861031
Fax: +230 6861033

Netherlands

John W. Schaap, PMO
KNMI/PMO-Office
Wilhelminalaan 10, PO Box 201
3730 AE De Bilt, Netherlands
Tel: +3130 2206391
Fax: +3130 210849
E-Mail: schaap@knmi.nl

New Zealand

Julie Fletcher, MMO
MetService New Zealand Ltd.

Continued on Page 97

Meteorological Services
Continued from Page 96

P.O. Box 722
Wellington, New Zealand
Tel: +644 4700789
Fax: +644 4700772

Norway

Tor Inge Mathiesen, PMO
Norwegian Meteorological Institute
Allegaten 70, N-5007
Bergen, Norway
Tel: +475 55236600
Fax: +475 55236703

Poland

Jozef Kowalewski,PMO
Institute of Meteorology and Water Mgt.
Maritime Branch
ul.Waszyngtona 42, 81-342 Gdynia Poland
Tel: +4858 6205221
Fax: +4858 6207101
E-mail: kowalews@stratus/imgw.gdynia.pl

Saudi Arabia

Mahmud Rajkhan, PMO
National Met. Environment Centre
Eddah
Tel:+ 9662 6834444 Ext. 325

Singapore

Edmund Lee Mun San, PMO
Meteorological Service, PO Box 8
Singapore Changi Airport
Singapore 9181
Tel: +65 5457198
Fax: +65 5457192

South Africa

C. Sydney Marais, PMO
c/o Weather Office
Capt Town International Airport 7525
Tel: + 27219340450 Ext. 213
Fax: +27219343296

Gus McKay, PMO
Meteorological Office
Durban International Airpot 4029
Tel: +2731422960
Fax: +2731426830

Sweden

Morgan Zinderland
SMHI
S-601 76 Norrköping, Sweden

Meteorological Services - Forecasts

Headquarters

Laura Cook
Marine Weather Services Program Manager
National Weather Service
1325 East-West Highway, Room 14126
Silver Spring, MD 20910
Tel: 301-713-1677 x. 126
Fax: 301-713-1598

Richard May
Assistant Marine Weather Services Program Manager
National Weather Service
1325 East-West Highway, Room 14124
Silver Spring, MD 20910
Tel: 301-713-1677 x. 127
Fax: 301-713-1598
E-Mail: richard.may@noaa.gov

U.S. NWS Offices

Atlantic & Eastern Pacific Offshore & High Seas

David Feit
National Centers for Environmental Prediction
Marine Prediction Center
Washington, DC 20233
Tel: 301-763-8442
Fax: 301-763-8085

Tropics

Chris Burr
National Centers for Environmental Prediction
Tropical Prediction Center
11691 Southwest 17th Street
Miami, FL 33165
Tel: 305-229-4433
Fax: 305-553-1264
E-Mail: burr@nhc.noaa.gov

Central Pacific High Seas

Hans Rosendal
National Weather Service Forecast Office
2525 Correa Road, Suite 250
Honolulu, HI 96822-2219
Tel: 808-973-5280
Fax: 808-973-5281

Alaska High Seas

Dave Percy
National Weather Service
6930 Sand Lake Road
Anchorage, AK 99502-1845
Tel: 907-266-5106
Fax: 907-266-5188

Coastal Atlantic

Robert Marine
National Weather Service Forecast Office
P.O. Box 1208
Gray, ME 04039
Tel: 207-688-3216

Tom Fair
National Weather Service Forecast Office
445 Myles Standish Blvd.
Taunton, MA 02780
Tel: 508-823-1900

Ingrid Amberger
National Weather Service Forecast Office
175 Brookhaven Avenue
Building NWS #1
Upton, NY 11973
Tel: 516-924-0499 (0227)

James A. Eberwine
National Weather Service Forecast Office
Philadelphia

Continued on Page 98

Meteorological Services

Continued from Page 97

732 Woodlane Road
Mount Holly, NJ 08060
Tel: 609-261-6600 ext. 238

Dewey Walston
National Weather Service Forecast Office
44087 Weather Service Road
Sterling, VA 20166
Tel: 703-260-0107

Neil Stuart
National Weather Service Office
10009 General Mahone Hwy.
Wakefield, VA 23888-2742
Tel: 804-899-4200 ext. 231

John Elardo
National Weather Service Office
53 Roberts Road
Newport, NC 28570
Tel: 919-223-5737

Doug Hoehler
National Weather Service Forecast Office
2015 Gardner Road
Wilmington, NC 28405
Tel: 910-762-4289

John F. Townsend
National Weather Service Office
5777 South Aviation Avenue
Charleston, SC 29406-6162
Tel: 803-744-0303 ext. 6 (forecaster)
803-744-0303 ext. 2 (marine weather recording)

Andrew Shashy
National Weather Service Forecast Office
13701 Fang Road
Jacksonville, FL 32218
Tel: 904-741-5186

Randy Lascody
National Weather Service Office
421 Croton Road
Melbourne, FL 32935
Tel: 407-254-6083

Michael O'Brien
National Weather Service Forecast Office
11691 Southwest 17 Street
Miami, FL 33165-2149
Tel: 305-229-4525

Great Lakes

Daron Boyce, Senior Marine Forecaster
National Weather Service Forecast Office
Hopkins International Airport
Cleveland, OH 44135
Tel: 216-265-2370
Fax: 216-265-2371

Tom Paone
National Weather Service Forecast Office
587 Aero Drive
Buffalo, NY 14225
Tel: 716-565-0204 (M-F 7am-5pm)

Tracy Packingham
National Weather Service Office
5027 Miller Trunk Hwy.
Duluth, MN 55811-1442
Tel: 218-729-0651

Dave Guenther
National Weather Service Office
112 Airport Drive S.
Negaunee, MI 49866
Tel: 906-475-5782

Jim Skowronski and Jill Last
National Weather Service Office
2485 S. Pointe Road
Green Bay, WI 54313-5522
Tel: 414-494-5845

Thomas Zajdel
National Weather Service Forecast Office
Milwaukee
N3533 Hardscrabble Road
Dousman, WI 53118-9409
Tel: 414-297-3243
Fax: 414-965-4296

Amy Seely
National Weather Service Forecast Office
333 West University Drive
Romeoville, IL 60446
Tel: 815-834-0673

Peter Chan
National Weather Service Office
4899 S. Complex Drive, S.E.
Grand Rapids, MI 49512-4034
Tel: 616-956-7180 or 949-0643

Scott Rozanski
National Weather Service Office
8800 Passenheim Hill Road
Gaylord, MI 49735-9454
Tel: 517-731-3384

Bill Hosman
National Weather Service Forecast Office
9200 White Lake Road
White Lake, MI 48386-1126
Tel: 248-625-3309
Fax: 248-625-4834

Coastal Gulf of Mexico

Constantine Pashos
National Weather Service Forecast Office
2090 Airport Road
New Braunfels, TX 78130
Tel: 210-606-3600

Len Bucklin
National Weather Service Forecast Office
62300 Airport Road
Slidell, LA 70460-5243
Tel: 504-522-7330

Steve Pfaff, Marine Focal Point
National Weather Service Forecast Office
300 Pinson Drive
Corpus Christi, TX 78406
Tel: 512-289-0959
Fax: 512-289-7823

Jim Bafnall
National Weather Service Office
500 Airport Blvd., #115
Lake Charles, LA 70607
Tel: 318-477-3422
Fax: 318-474-8705

Eric Esbensen
National Weather Service Office
8400 Airport Blvd., Building 11
Mobile, AL 36608
Tel: 334-633-6443
Fax: 334-607-9773

Paul Yura/Mark Jackson
National Weather Service Office
20 South Vermillion
Brownsville, TX 78521

Robert Van Hoven
National Weather Service Office
Houston
1620 Gill Road
Dickenson, TX 77539
Tel: 281-337-5074
Fax: 281-337-3798

Greg Mollere, Marine Focal Point
National Weather Service Forecast Office
3300 Capital Circle SW, Suite 227
Tallahassee, FL 32310
Tel: 904-942-8999
Fax: 904-942-9396

Dan Sobien
National Weather Service Office
Tampa Bay
2525 14th Avenue SE
Ruskin, FL 33570

Continued on Page 99

Meteorological Services

Continued from Page 98

Tel: 813-645-2323
Fax: 813-641-2619

Scott Stripling, Marine Focal Point
National Weather Service Office
Carr. 190 #4000
Carolina, Puerto Rico 00979
Tel: 787-253-4586
Fax: 787-253-7802
Scott.Stripling@noaa.gov

Coastal Pacific

William D. Burton
National Weather Service Forecast Office
Bin C15700
7600 Sand Point Way NE
Seattle, WA 98115
Tel: 206-526-6095 ext. 231
Fax: 206-526-6094

Stephen R. Starmer
National Weather Service Forecast Office
5241 NE 122nd Avenue
Portland, OR 97230-1089
Tel: 503-326 2340 ext. 231
Fax: 503-326-2598

National Weather Service Office
4003 Cirrus Drive
Medford, OR 97504
Tel: 503-776-4303
Fax: 503-776-4344

Bill Forwood
National Weather Service Office
300 Startare Drive
Eureka, CA 95501
Tel: 707-443-5610
Fax: 707-443-6195

Jeff Kopps
National Weather Service Forecast Office
21 Grace Hopper Avenue, Stop 5
Monterey, CA 93943-5505
Tel: 408-656-1717
Fax: 408-656-1747

John Henderson
National Weather Service Forecast Office
520 North Elevar Street
Oxnard, CA 93030
Tel: 805-988-6615
Fax: 805-988-6613

Mark Moede
National Weather Service Office
11440 West Bernardo Ct., Suite 230
San Diego, CA 92127-1643
Tel: 619-675-8700
Fax: 619-675-8712

Andrew Brewington
National Weather Service Forecast Office
6930 Sand Lake Road
Anchorage, AK 95502-1845
tel: 907-266-5105

Dave Hefner
National Weather Service Forecast Office
Intl. Arctic Research Ctr. Bldg./UAF
P.O. Box 757345
Fairbanks, AK 99701-6266
Tel: 907-458-3700
Fax: 907-450-3737

Robert Kanan
National Weather Service Forecast Office
8500 Mendenhall Loop Road
Juneau, AK 99801
Tel and Fax: 907-790-6827

Guam
Tel: 011-671-632-1010⚓

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
1315 East-West Highway
Distribution Unit
Silver Spring, MD 20910
Attn: Mariners Weather Log

40

In this Issue: