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COMPUTER WORDED HIGH SEAS FORECASTS

William S. Richardson and Herman P. Perrotti

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1. INTRODUCTION

Forecasts of weather and wave conditions for the open sea are extremely important for protecting the life and property of shippers. The National Weather Service (NWS) has the responsibility "... to provide warnings and special forecasts of weather, wave, and sea-ice and provides data in support of navigation and other operations on the high seas." (National Weather Service, 1981). The high seas are that portion of the open ocean seaward from the edge of the continental shelf (U.S. Naval Oceanographic Office, 1966). Fig. 1 shows the high seas forecast and warning areas for the United States. Weather Service Forecast Office (WSFO) Washington and the National Hurricane Center in Miami share the high seas forecast responsibility for the Atlantic Ocean and Gulf of Mexico. WSFO's San Francisco and Honolulu have the responsibility in the Pacific.

We have developed and are testing a computer program to help marine forecasters prepare high seas forecasts. This program extracts information about significant, over water weather systems from forecasts of the National Meteorological Center's (NMC's) spectral model (Sela, 1980). This information is the basis for selecting and fitting together computer stored words and phrases which describe over water weather events and wave conditions.

This paper describes how digital forecasts are extracted from NMC gridpoint data. Also discussed is the decision process for selecting and fitting computer stored words and phrases which describe over water systems in concise marine terminology. Computer worded forecasts for the Atlantic and Pacific Oceans are compared with high seas forecasts issued by WSFO's Washington and San Francisco. Before we discuss and compare the computer generated forecasts, let's briefly look at the format and content of the high seas forecast.

2. FORECAST FORMAT AND CONTENT

High seas forecasts contain three segments (National Weather Service, 1979):

1. Heading;
2. Part One--Warnings; and
3. Parts Two and Three--Synopsis and Forecast.

A. Heading

The heading consists of the name of the issuing forecast office (Washington, Miami, San Francisco, or Honolulu), the date and time the forecast is issued, and a description of the area covered by the forecast (see Fig. 1).

B. Part One--Warnings

The warnings portion of the message contains forecasts of tropical storms and other significant weather systems with associated winds of 35 kt or

greater. The order that a system appears in the message is determined by wind speed. The system with the highest wind speed is listed first.

Central pressure and location of the system at the initial time of the forecast and at the 24- and 36-h projections are given. The direction of movement and speed at which the system is moving is also forecast. Maximum wind and wave conditions are forecast and referenced from the center of the weather system. In addition, averaged wind and wave conditions are forecast. If there is no system, the word "none" is transmitted.

C. Parts Two and Three--Synopsis and Forecast

This part of the message contains a synopsis and forecast of weather systems with wind speeds less than gale force (less than 35 kt) but greater than 25 kt. Most of the wording for these systems is the same as for systems in Part One of the message. However, the location of maximum wind and wave conditions and the average wind speed and wave height are not worded. If there is no system, the following is transmitted:

> "Except as described in Part One winds 25 kts or less and seas less than 8 ft will continue during the forecast period."

3. EXTRACTING DIGITAL FORECASTS

In developing our computer program we have drawn upon the experience of Glahn (1978). Unlike Glahn, we do not have digital forecasts for weather events which occur over the ocean. These over water forecasts were extracted from the sea level pressure and 1000-mb wind forecasts of NMC's spectral model.

These forecasts, which are available at grid points with a grid spacing of approximately 391 km, are extracted and saved on two rectangular grids--one for the Atlantic and Gulf, and one for the Pacific. Each grid contains 450 gridpoints (25 by 18). Grid layout, gridpoint spacing, and forecast areas are shown in Fig. 2 (the Atlantic and Gulf) and Fig. 3 (Pacific).

A. Selecting Forecast Hours

Digital forecasts associated with low and high pressure systems are extracted at three forecast hours, F1, F2, and F3. The selection of the three forecast hours, which differ by 24 and 36 hours, are a function of the issuance time of the high seas forecast. High seas forecasts are issued four times each day at 0500, 1100, 1700, and 2300 GMT. Forecast hours (F1, F2, and F3) and cycle run time of the spectral model (0000 or 1200 GMT) are matched with the four forecast issuance times as shown in Table 1. This matching insures that forecasts for 1100 and 2300 GMT would be available by 0900 and 2100 GMT or 2 hours before issuance time. For issuance times 1700 and 0500 GMT, guidance would be available approximately 8 hours before the forecast deadline.

At each forecast hour (F1, F2, and F3), the latitude and longitude of each low and high are saved. Also saved are the central pressure, the maximum and average wind speeds, and the relationship of the maximum wind speed from the center of each low and high. Wave heights are calculated from the maximum and average wind conditions.

Table 1. Issuance time of high seas forecasts and matching forecast hours and cycle run times of NMC's spectral model.

Issuance Time GMT	Forecast Hours F1	F2	F3	Cycle Run Time GMT
1100	6	30	42	0000
1700	12	36	48	0000
2300	6	30	42	1200
0500 (next day)	12	36	48	1200

B. Identification of Weather Systems

Sea level pressures at each non-boundary gridpoint are compared to the pressure of the eight closest points. If the gridpoint's pressure is less than that of the eight nearest points and is less than 1012.5 mb, the gridpoint is approximately the center of a low. If the gridpoint's pressure is higher than that of the eight surrounding points and is higher than 1012.5 mb, the gridpoint is located near a high's center. The centers' locations are then determined to within 1/4 grid length with a biquadratic interpolation scheme.

C. Wind and Wave Conditions

For each identified center, the maximum wind is located with reference (distance to the nearest nautical mile and direction to eight points of the compass) to its associated center. When a maximum wind of greater than 34 kts is associated with a high pressure system, the latitude and longitude of the location of the maximum wind is stored in place of the distance and direction of the maximum wind from the center of the associated system.

The maximum wind speed is located by searching up to 4 grid lengths on all sides of the isolated center. Gridpoints which are located on land are not included in the search.

An averaged wind speed is computed from the wind speeds of up to 81 (9 x 9) gridpoints. Overland winds are not used in determining the average wind. The maximum wave height and the average wave height are calculated from the maximum and average wind with the Sverdrup-Munk-Bretschneider wave forecast method (Sverdrup and Munk, 1947; Bretschneider, 1952 and 1970). For these calculations, fetch length (distance over water that wind has essentially constant direction and speed) is limited to 200 n mi. Duration time (length of time the wind has blown over the fetch) is limited to 18 hours.

D. Keeping Track of Identified Systems

After all systems from the three forecast hours (F1, F2, and F3; see Table 1) have been identified, we need to relate systems from different forecasts. As an example, assume that we have two systems, I and II, isolated at forecast hour F1 and one system, A, identified at forecast hour F2. We then need to determine whether system A is a new system which has developed during the 24-h forecast period or if system A is system I or II 24 hours later. This

determination is made in the following manner. System A from forecast hour F2 is compared to the first system, system I, isolated from forecast hour F1. This comparison consists of three checks. Each check must be satisfied if the two systems are the same (matched), i.e., system I is system A 24 hours later. The three checks which must be met are:

(1) systems must be of the same type--a low (high) at one forecast hour must be a low (high) at the next forecast hour;

(2) the deepening or filling of a system must be less than 37 mb during 24 hours (a 1.5 mb/h pressure change for 24 hours); and

(3) a system's speed is limited to 22.5 kt in a westward direction, 45 kt for all other directions.

Criteria for checks (2) and (3) were arrived at from subjective evaluation. If more than one system meets all three checks, then the system which has traveled the shortest distance is saved as the match.

After all systems from forecast hour F2 are compared to the first system from forecast hour F1, all systems from forecast hour F2 are compared to the second system from forecast hour F1. This procedure is continued until all systems from forecast hour F1 have been compared to all systems from forecast hour F2. This comparison procedure is then repeated for all systems from forecast hours F2 and F3. The procedure, which is capable of handling up to 19 different systems for each forecast projection, allows for systems to develop, dissipate, and be absorbed by other systems.

After a system has been tracked over three forecast projections, its speed and direction of movement are calculated. When possible, speeds and directions of movement are calculated for three forecast periods. Periods cover the first 24 hours, the last 12 hours, and the entire 36-h forecast period.

E. Filtering Out "Insignificant" Weather Systems and Areas of High Winds

A system which fits into any one of the following categories is eliminated:

(1) develops 36 hours after the first forecast hour;
(2) develops 24 hours after the first forecast hour and then dissipates during the next 12 hours;
(3) develops at the first forecast hour, dissipates 24 hours later and then redevelops; or
(4) remains over land during the entire 36-h forecast period.

In addition, for situations when there is more than one high pressure system with winds greater than 34 kt, the high with the largest wind speed is the only one retained.

F. Digital Forecast Matrix

Digital forecasts for the Atlantic are shown in a matrix format in Fig. 4. These forecasts were extracted with procedures previously described. Keep in

mind that these forecasts, which are valid beginning 1200 GMT February 10, 1984, were available approximately 8 hours before the 1700 GMT issuance time. For each weather system, the five columns, from left to right, define the element, the unit of measurement of the element, and the forecast of the element at the first forecast hour and forecast hours 36 and 48. Here, the first forecast hour corresponds to hour 12 of the spectral model forecast from the 0000 GMT run.

Let's go through the matrix for the three systems for each forecast projection, beginning with the 12-h projection. At 1200 GMT on February 10, a low pressure system is forecast to have a central pressure of 976 mb. The forecast position of this system is 67°N and 35°W. This forecast position was in very good agreement with the observed position at the verifying time (see Fig. 5). However, the central pressure is forecast to be 18 mb too high. No movement (-9/**) is forecast because the system moved out of the forecast area (east of 35°W). Maximum wind and wave conditions were forecast to be 60 kt and 35 ft, respectively. These conditions were forecast to be 160° and 332 n mi from 67°N and 35°W. Average wind and wave conditions were forecast to be 30 kt and 10 ft, respectively.

A second low, 1006 mb, was forecast at 50°N and 44°W. This low also moved off the grid within 24 hours.

However, a third low center, which was forecast at 63°N and 82°W, remained within the forecast area for all projections. At the first forecast hour 12, the central pressure was forecast to be 992 mb. The observed central pressure (Fig. 5) was 986 mb. The low was forecast to move towards 110° at a speed of 28 kt during the 36-h forecast period. Maximum winds were forecast to be 20 kt, 933 n mi and 120° from the center. A maximum wave height (**) was not forecast because the center of the low was over land. During the next 24 hours, the low was forecast to move east at a speed of 24 kt. The forecast position was 61°N and 62°W. Winds were forecast to increase to 40 kt with a maximum wave height of 20 ft. These maximum conditions were forecast to be 1,237 n mi east of the center. The final forecast projection located the system at 57°N and 51°W. The forecast movement during the last 12-h period was 34 kt towards 120°. Maximum wind and wave conditions remained the same, except that maximum conditions moved about 260 n mi closer to the center of the low. Average wind and wave conditions were forecast to be 25 kt and 10 ft, respectively. We will refer to this matrix again when we present computer worded forecasts for the Atlantic area.

4. COMPUTER WORDING

Digital forecasts are the basis for computer wording. We followed the NWS Operations Manual (1982) in developing the format and wording of the computer generated forecasts. Helpful suggestions were provided by marine forecasters at WSFO's Washington and San Francisco.

More than 100 different computer stored words and phrases, varying in length from two to 23 words, are used to generate computer worded forecasts. These words and phrases describe the type of weather system, intensity, location, movement of system, and wind and wave conditions associated with the system.

A. Types of Weather Systems

The following types of systems are computer worded:

Storm	- a low with associated wind speeds greater than 49 kt;
Area of storm winds	- same criteria as for a storm except winds are associated with a high;
Gale	- a low with associated wind speeds less than 50 kt but greater than 34 kt;
Area of gale winds	- same as for a gale except winds are associated with a high;
Low	- a low with associated winds less than 35 kt but greater than 25 kt; and
High	- a high with associated winds less than 35 kt but greater than 25 kt.

All systems which form or dissipate during the 36-h forecast period are worded to reflect formation or dissipation.

B. System Intensity

Storms and gales may be described as "developing" or "weakening" during the forecast period. In addition, storms with wind speeds greater than 59 kt and a central pressure lower than 961 mb are worded as "intense."

C. System Location

All systems are located by latitude (north or south) and longitude (east or west). At the first forecast hour, systems located in the Atlantic Ocean and Gulf of Mexico are also referenced from the nearest prominent land or water feature. The nearest land feature is also referenced instead of the latitude and longitude when the system is out of the forecast area. The 12 prominent land and water features are shown in Fig. 6. Distances from these features are given to the nearest 20 n mi while directions are to eight points of the compass. Words such as "about," "just off," and "over" are used to more accurately describe distances from features.

D. Movement of Systems

Directions are to eight points of the compass, while speeds are computed to the nearest knot. The following words are used to further describe the forecast speed:

"Remaining nearly stationary"	- speed less than 10 kt;
"Slowly"	- speed between 10 and 14 kt; and
"Rapidly"	- speed greater than 35 kt.

Systems which are forecast to move very near each other may be worded as "absorbed by" or "merging with" another system. The words "absorbed by" are used if the previous system has the lower central pressure. Otherwise, "merging with" is used.

E. Wind and Wave Conditions

We have insured that computer wording for maximum wind and wave conditions are consistent. When wind speeds "increase," the computer words the waves as "building." "Diminishing" winds are accompanied by "diminishing" waves.

Maximum wind and wave conditions are referenced from the center of the associated weather system. Distances are given to the nearest 20 n mi while directions are to eight points of the compass.

F. Summary

Table 2 contains some of the computer stored words and phrases that may be selected to describe type, intensity, location, and movement of systems and their associated wind and wave conditions. These words and phrases are joined with other words and phrases to form concise descriptive forecasts.

5. COMPUTER GENERATED FORECASTS

Two computer generated forecasts are shown, one for the Atlantic Ocean and one for the Pacific Ocean.

A. Atlantic Ocean

For the Atlantic Ocean, let's return to the digital forecasts for 1200 GMT February 10 shown in matrix form in Fig. 4. As you may recall, this matrix depicts three low pressure systems. The top portion of Fig. 7 contains the computer worded forecast which was generated from the digital forecasts shown in Fig. 4. Shown in the lower portion of Fig. 7 is the forecast issued by WSFO Washington. Remember, the computer generated guidance would be available approximately 8 hours before the 1200 GMT issuance deadline.

Table 2. Computer stored words and phrases that may be selected to describe type, intensity, location, and movement of systems and their associated wind and wave conditions.

Type	Intensity	Location	Movement	Wind and Wave Conditions
Storm	Intense	Referenced from nearest land or water feature*	Eight points of the compass	Increasing winds
Area of storm winds	Developing	About	Rapidly	Diminishing winds
Gale	Weakening	Just off	Slowly	Building waves
Area of gale winds		Over	Stationary	Diminishing waves
Low			Merging with	
High			Absorbed by	

*Only for systems located in the Atlantic Ocean and Gulf of Mexico.

The computer worded guidance for "warnings" compares very favorably with the official forecast issued by Washington. All initial positions are referenced to the nearest prominent land feature (see Fig. 6). Note that the word "developing" is selected to describe the third system. "Developing" is used because the low pressure system becomes a gale after the first forecast hour. The words "winds increasing" and "seas building" are used because the wind increases from 20 to 40 kts while seas build to 20 ft.

No significant weather is forecast by the computer guidance for "Parts Two and Three--Forecast and Synopsis." However, the official forecast calls for areas of 30 kt winds.

B. Pacific Ocean

Computer worded guidance (top portion of Fig. 8), valid beginning 1100 GMT February 29, 1984, was constructed from the forecast matrix shown in Fig. 9. The forecast issued by WSFO San Francisco is shown in the lower portion of Fig. 8.

Storm winds in the Gulf of Tehuantepee were not forecast by the computer guidance because this area is not covered by our grid. Gales located at 48°N and 138°W, and 50°N and 145°W also were not forecast. The computer guidance forecast the low at 30°N and 172°W to become a gale by 24 hours. WSFO San Francisco forecast no development. In Parts Two and Three, the computer guidance forecast the high to move northeast at 16 kt. The official forecast was for the high to remain nearly stationary.

6. FUTURE PLANS

We are verifying digital forecasts extracted from spectral model forecasts with surface weather charts. We are also comparing computer worded guidance with forecasts issued by WSFO's Washington and San Francisco. Our preliminary findings are:

(1) digital forecasts for the Atlantic Ocean are better than those for the Pacific Ocean;
(2) deepening of lows is not forecast accurately;
(3) in searching for the maximum wind condition, a scanning radius of 4 grid lengths may be too large; and
(4) further filtering may be needed to eliminate insignificant weather systems.

We are working on a scheme to better isolate troughs and ridges. The program already has stored phrases to generate wording for these weather systems.

In addition to our verification, WSFO's Washington and San Francisco are verifying the high seas guidance on an experimental basis. We hope that in the near future we can transmit the forecast guidance in real time on Automation of Field Operations and Services (AFOS) for a more complete and realistic on-station evaluation. In a real time test mode, forecasters would have the option to modify the forecast matrix and generate new wording and/or change the text through the text-editing capabilities of the AFOS equipment.

ACKNOWLEDGMENTS

We are very grateful to the many people who have provided guidance and encouragement for this project. In particular, we thank Harry Glahn and Robert Bermowitz of TDL for their helpful suggestions and computer code. We also thank Robert Werner and Frank Rosenstein of WSFO Washington and Emil Gunther of WSFO San Francisco for their helpful suggestions. A special thanks to Wilson Shaffer for his careful review and comments and to Darren Wright for his programming and drafting assistance. We are also grateful to NMC for providing spectral model forecasts.

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U.S. Naval Oceanographic Office, 1966: Glossary of Oceanographic Terms, SP-35, Second Edition, Washington, D.C., 204 pp.

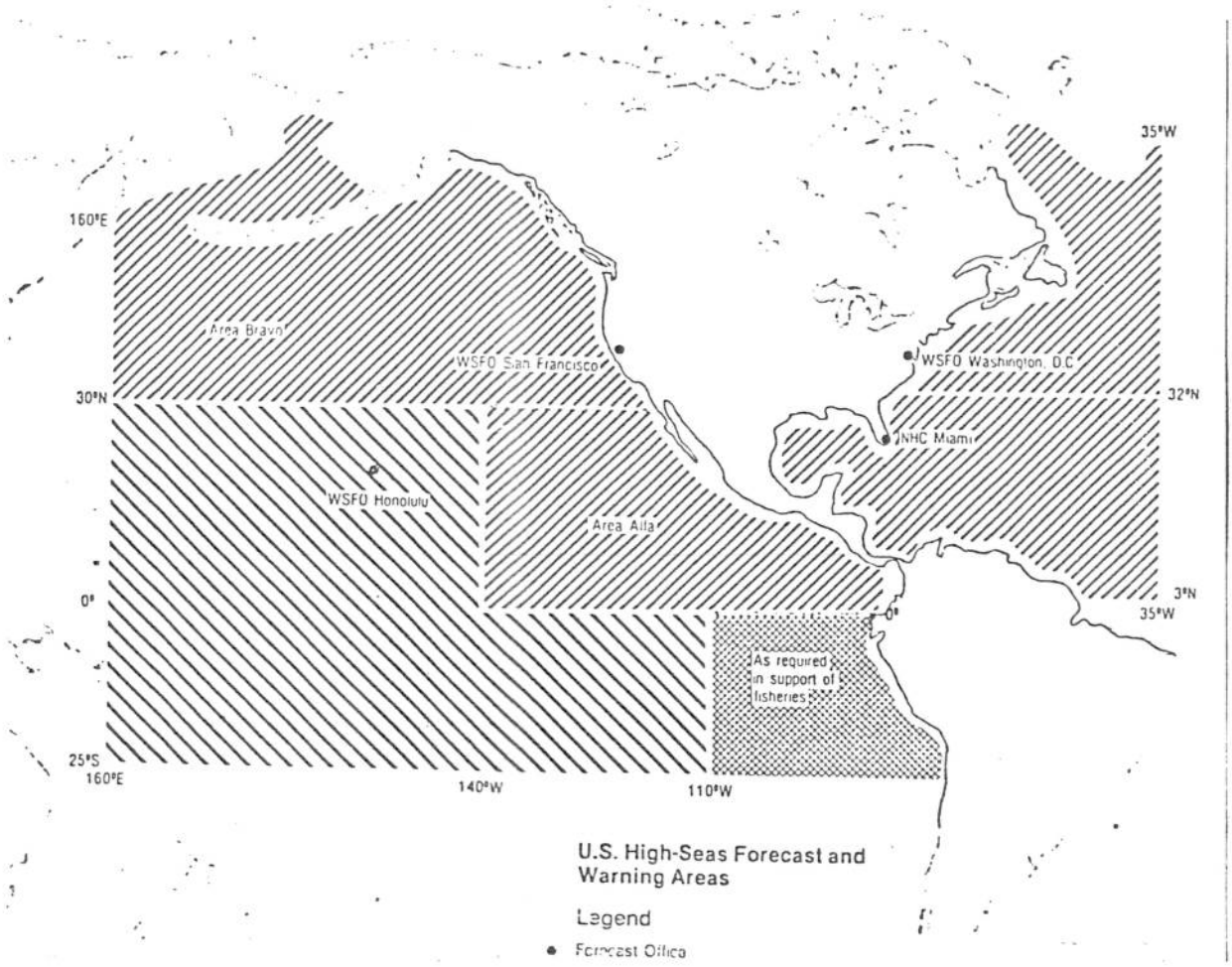

Figure 1. High seas forecast and warning areas for the United States (from National Weather Service, 1981).

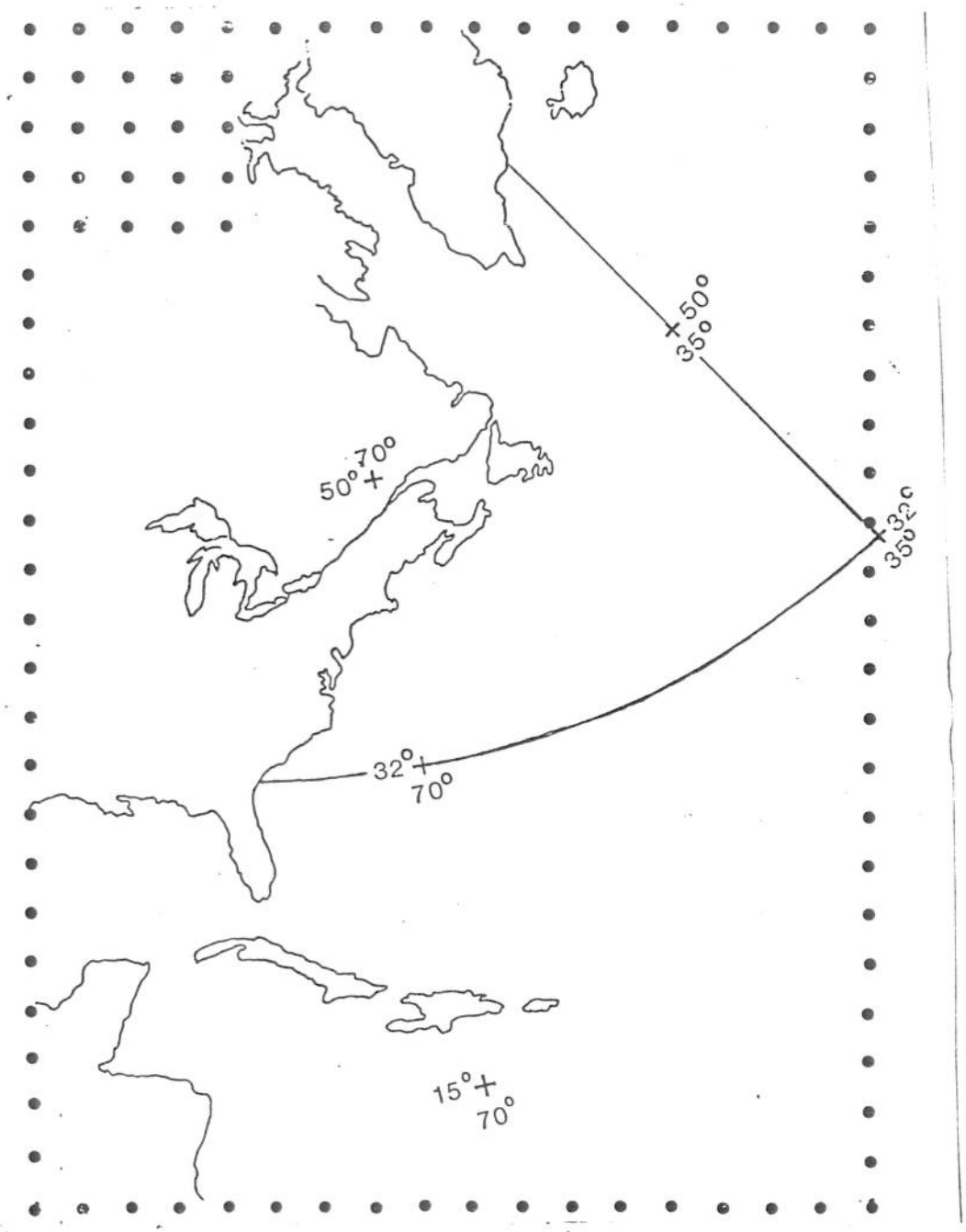

Figure 2. Grid layout, gridpoint spacing, and forecast area in the Atlantic Ocean and Gulf of Mexico.

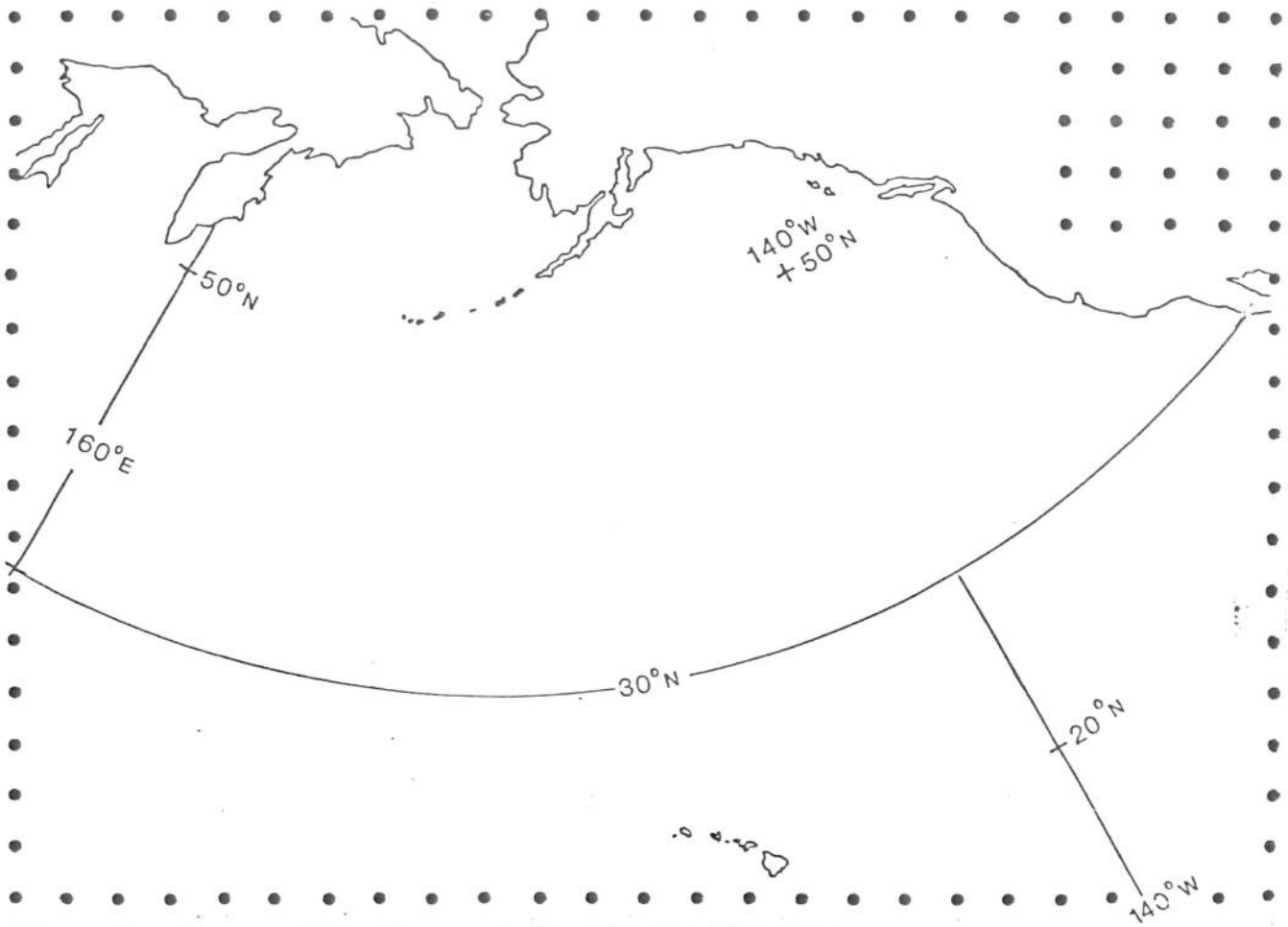

Figure 3. Same as Fig. 2 except for the Pacific Ocean.

HIGH SEAS COMPUTER-WORDED FORECAST FOR NORTH ATLANTIC NORTH OF 32N AND WEST OF 35W.
VALID 12Z FEB 10 1984 FOR THE NEXT 36 HOURS

ELEMENT	UNITS	12Z	12Z	00Z
TYPE OF WEATHER SYSTEM		LOW		
LAT/LON	DEG	67N/35W	***/***	***/***
CENTRAL PRESSURE	MBS	976	-99	-99
MOVEMENT	DEG KT	-9/**	-9/**	-9/**
MAX WIND SPEED	KT	60	**	**
MAX WAVE HEIGHT	FT	35	**	**
LOCATION OF MAX WIND	DEG NM	16/ 332	-9/ -98	-9/ -98
AVG WIND SPEED	KT	30		
AVG WAVE HEIGHT	FT	10		
TYPE OF WEATHER SYSTEM		LOW		
LAT/LON	DEG	50N/44W	***/***	***/***
CENTRAL PRESSURE	MBS	1006	-99	-99
MOVEMENT	DEG KT	-9/**	-9/**	-9/**
MAX WIND SPEED	KT	60	**	**
MAX WAVE HEIGHT	FT	35	**	**
LOCATION OF MAX WIND	DEG NM	3/ 872	-9/ -98	-9/ -98
AVG WIND SPEED	KT	20		
AVG WAVE HEIGHT	FT	10		
TYPE OF WEATHER SYSTEM		LOW		
LAT/LON	DEG	63N/82W	61N/62W	57N/51W
CENTRAL PRESSURE	MBS	992	996	997
MOVEMENT	DEG KT	11/28	10/24	12/34
MAX WIND SPEED	KT	20	40	40
MAX WAVE HEIGHT	FT	**	20	20
LOCATION OF MAX WIND	DEG NM	12/ 933	9/1237	8/ 978
AVG WIND SPEED	KT	25		
AVG WAVE HEIGHT	FT	10		

Figure 4. Digital forecasts for the Atlantic Ocean valid beginning 1200 GMT February 10, 1984.

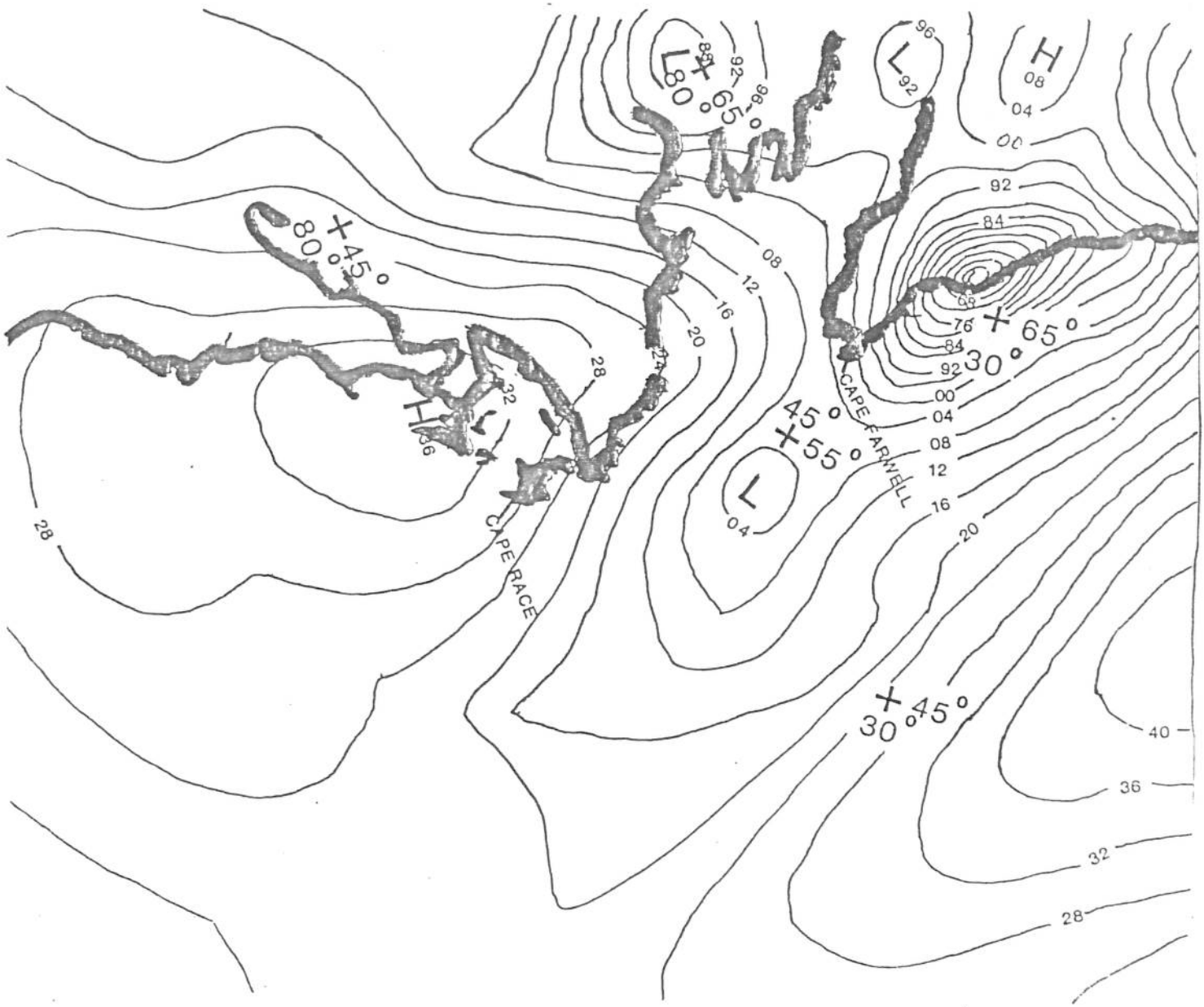

Figure 5. Sea level pressure analysis valid 1200 GMT February 10, 1984.

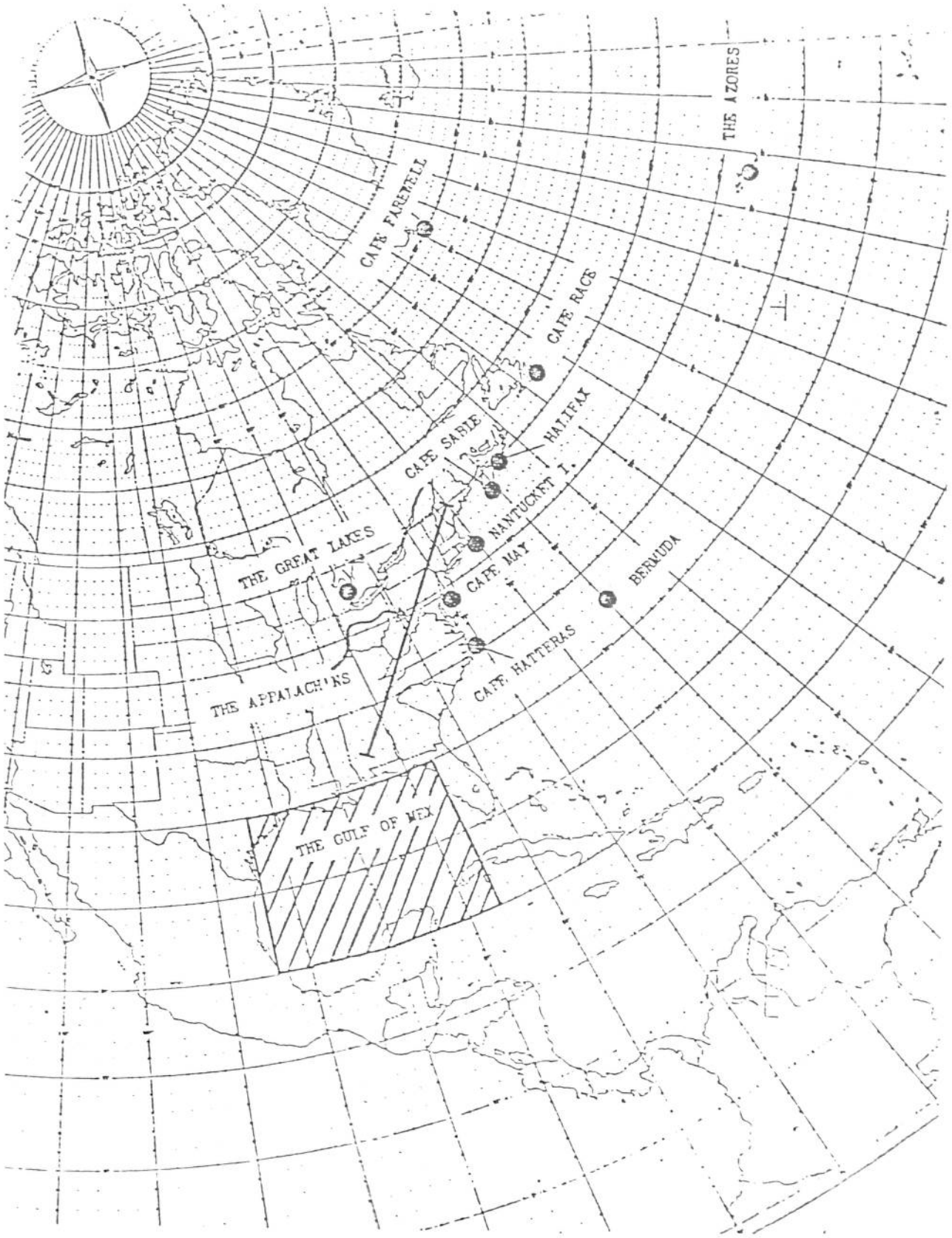

Figure 6. Prominent land and water features for the Atlantic area.

WWN120 KWBC 101700
BULLETIN
NOAA NATIONAL WEATHER SERVICE WASHINGTON HIGH SEAS WARNINGS AND FORECASTS VALID 12Z FEB 10 1984 FOR THE NEXT 36 HOURS FOR THE NORTH ATLANTIC NORTH OF 32N AND WEST OF 35W.
PART ONE. WARNINGS.
STORM CENTER ABOUT 500 MILES NORTHEAST OF CAPE FAREWELL NEAR 67N 35W 976 MBS AT 12Z. WINDS 50 TO 60 KTS AND SEAS 30 TO 35 FT WITHIN 340 MILES SOUTHEAST OF THE CENTER. ELSEWHERE WINDS 20 TO 30 KTS AND SEAS 5 TO 10 FT.
STORM CENTER ABOUT 420 MILES NORTHEAST OF CAPE RACE NEAR 50N 44W 1006 MBS AT 12Z. WINDS 50 TO 60 KTS AND SEAS 30 TO 35 FT WITHIN 880 MILES NORTHEAST OF THE CENTER. ELSEWHERE WINDS 10 TO 20 KTS AND SEAS 5 TO 10 FT.
DEVELOPING GALE CENTER ABOUT 1120 MILES WEST OF CAPE FAREWELL NEAR 63N 82W 992 MBS AT 12Z MOVING EAST 28 KTS DURING THE NEXT 36 HRS. FORECAST GALE CENTER NEAR 61N 62W 996 MBS AT 12Z FEB 11 AND GALE CENTER NEAR 57N 51W 997 MBS AT 00Z FEB 12. WINDS INCREASING TO 30 TO 40 KTS AND SEAS BUILDING TO 15 TO 20 FT WITHIN 1240 MILES EAST OF THE CENTER. ELSEWHERE WINDS 15 TO 25 KTS AND SEAS 5 TO 10 FT.
PARTS TWO AND THREE.
EXCEPT AS DESCRIBED IN PART ONE WINDS 25 KTS OR LESS AND SEAS LESS THAN 8 FT WILL CONTINUE DURING THE FORECAST PERIOD.

II PART ONE II
ZPV/101200Z
1800Z FEB 10 1984

.WESTERN NORTH ATLANTIC STORM WARNING

INTENSE STORM CENTER EAST OF GREENLAND AND EAST OF FORECAST AREA AT 12Z FEB 10 WILL CONTINUE NORTHEASTWARD. OVER FORECAST WATERS NORTH OF 60N AND EAST OF 45W WINDS 35 TO 50 KNOTS AVERAGE SEAS 15 TO 25 FEET.

DEVELOPING STORM CENTER 350 MILES NORTHEAST OF CAPE RACE NEAR 52N 45W 1000 MBS AT 12Z FEB 10 MOVING NORTHEAST 35 KNOTS. WITHIN 12 HOURS CENTER NEAR 57N 36W 995 MB AND BY NEXT 12 HOURS 12Z FEB 11 WELL EAST OF FORECAST AREA AND CONTINUING NORTHEAST MOVEMENT. OVER FORECAST WATERS WITHIN 600 MILES OF GALE CENTER WINDS INCREASING TO 35 TO 45 KNOTS AVERAGE SEAS 10 TO 15 FEET DURING NEXT 12 HOURS AND INCREASING TO WINDS 40 TO 50 KNOTS AND SEAS 15 TO 25 FEET OVER FORECAST WATERS NORTH OF 50N AND EAST OF 45W DURING THE FOLLOWING 12 TO 24 HOURS.

DEVELOPING GALE OVER HUDSONS BAY NEAR 64N 84W 986 MBS AT 12Z FEB 10 FORECAST TO MOVE EAST SOUTHEAST 25 TO 30 KNOTS NEXT 12 HOURS AND EASTWARD 30 TO 35 KNOTS FOLLOWING 12 TO 24 HOURS.
FORECAST GALE CENTER NEAR 62N 60W 984 MBS AT 12Z FEB 11 AND NEAR 62N 40W 980 MBS AT 00Z FEB 12. IN 24 HOURS OVER FORECAST WATERS WITHIN 600 MILES OF CENTER IN SOUTHEAST QUADRANT WINDS INCREASING TO 30 TO 40 KNOTS AND AVERAGE SEAS 10 TO 15 FEET OTHERWISE WITHIN 600 MILES OF CENTER WINDS 25 TO 30 KNOTS AND AVERAGE SEAS 5 TO 10 FEET.

EXCEPT AS MENTIONED IN PART ONE ...

NORTH OF 40N WINDS 20 TO 30 KNOTS AVERAGE SEAS 5 TO 10 FEET. CONDITIONS MOVING EAST 55W NEXT 24 TO 36 HOURS.

SOUTH OF 40N EAST OF 60W WINDS 20 TO 30 KNOTS AVERAGE SEAS 5 TO 10 FEET. WITHIN 24 HOURS CONDITIONS WILL MOVE EAST OF 40W.

Figure 7. Computer worded forecast guidance (upper portion) and forecast issued by WSFO Washington valid beginning 1200 GMT February 10, 1984.

FZPN KSFO 291100
BULLETIN
NOAA NATIONAL WEATHER SERVICE SAN FRANCISCO HIGH SEAS WARNINGS AND FORECASTS VALID 06Z FEB 29 1984 FOR THE NEXT 36 HOURS FOR THE NORTH PACIFIC AREA BRAVO.
PART ONE. WARNINGS.
STORM CENTER NEAR 49N 155E 964 MBS AT 06Z. WINDS 45 TO 55 KTS AND SEAS 25 TO 30 FT WITHIN 480 MILES SOUTHEAST OF THE CENTER. ELSEWHERE WINDS 30 TO 40 KTS AND SEAS 15 TO 20 FT.
GALE CENTER NEAR 55N 148W 985 MBS AT 06Z REMAINING NEARLY STATIONARY DURING THE NEXT 24 HRS. FORECAST GALE CENTER 980 MBS AT 06Z MAR 1. WINDS INCREASING TO 30 TO 40 KTS AND SEAS BUILDING TO 15 TO 20 FT WITHIN 880 MILES WEST OF THE CENTER. ELSEWHERE WINDS 15 TO 25 KTS AND SEAS 5 TO 10 FT.
LOW CENTER NEAR 30N 172W 1012 MBS AT 06Z MOVING EAST 19 KTS DURING THE NEXT 36 HRS. FORECAST GALE CENTER NEAR 33N 163W 1008 MBS AT 06Z MAR 1 AND LOW CENTER NEAR 32N 159W 1005 MBS AT 18Z MAR 1. WINDS INCREASING TO 25 TO 35 KTS and SEAS BUILDING TO 10 TO 15 FT WITHIN 900 MILES NORTHWEST OF THE CENTER. ELSEWHERE WINDS 5 TO 15 KTS AND SEAS 2 TO 5 FT.
PARTS TWO AND THREE.
HIGH CENTER NEAR 27N 128W 1021 MBS AT 06Z MOVING NORTHEAST 16 KTS DURING THE NEXT 36 HRS. FORECAST HIGH CENTER NEAR 35N 123W 1021 MBS AT 18Z MAR 1. WINDS 20 TO 30 KTS AND SEAS 10 TO 15 FT.

WOUS00 KSFO 291100
NATIONAL WEATHER SERVICE SAN FRANCISCO. HIGH SEAS WEATHER 1200 GMT FEBRUARY 29 1984. FORECASTS VALID 1200 GMT MARCH 1 1984.

WARNINGS.

STORM WINDS IN THE GULF OF TEHUANTEPEC 250 MI OF COAST. WIND NORTH 50 KT SEAS 20 FT.

STORM 964 MB 50N 155E. FORECAST 974 MB 52N 147E. WIND 40 TO 60 KT SEAS 20 TO 30 FT WITHIN 600 MI OF CENTER SOUTH QUADRANT AND 500 MI ELSEWHERE.

GALE 985 MB 55N 148W. FORECAST 980 MB 53N 150W. WIND 35 KT SEAS 18 FT 600 MI OF CENTER WEST QUADRANT.

GALE 986 MB 48N 138W. FORECAST 978 MB 50N 139W. WIND 40 KT SEAS 22 FT 450 MI OF CENTER SOUTHEAST SEMICIRCLE.

GALE 986 MB 50N 145W MOVING EAST 20 KT AND FILLING. WIND 35 KT SEAS 18 FT 500 MI OF CENTER SOUTHWEST QUADRANT.

SYNOPSIS.

LOW 1010 MB 31N 172W. FORECAST 1004 MB 33N 161W. WIND 25 KT SEAS 12 FT WITHIN 300 MI OF CENTER NORTHEAST SEMICIRCLE.

LOW 1000 MB 46N 174E. FORECAST 998 MB 46N 165W. WIND 30 KT SEAS 15 FT WITHIN 300 MI OF CENTER NORTHEAST SEMICIRCLE AND SOUTH QUADRANT.

HIGH 1022 MB 27N 128W STATIONARY WITH LITTLE CHANGE.

RIDGE 55N 175W 41N 168W 30N 150W. NORTH PORTION NEARLY STATIONARY. SOUTH PORTION MOVING EAST 15 KT.

INTER TROPICAL CONVERGENCE ZONE...7N 78W 3N 90W 4N 120W 3N 140W. ZONE MODERATELY ACTIVE EAST OF 91W BUT WEAK TO INACTIVE ELSEWHERE.

Figure 8. Same as Fig. 7 except for WSFO San Francisco for 0600 GMT February 29, 1984.

HIGH SEAS COMPUTER-WORDED FORECAST FOR NORTH PACIFIC - AREA BRAVO.
VALID 06Z FEB 29 1984 FOR THE NEXT 36 HOURS

ELEMENT	UNITS	06Z	06Z	18Z
TYPE OF WEATHER SYSTEM		LOW		
LAT/LON	DEG	49N/155E	***/***	***/***
CENTRAL PRESSURE	MBS	964	-99	-99
MOVEMENT	DEG KT	-9/**	-9/**	-9/**
MAX WIND SPEED	KT	55	**	**
MAX WAVE HEIGHT	FT	30	**	**
LOCATION OF MAX WIND	DEG NM	15/ 474	-9/ -98	-9/ -98
AVG WIND SPEED	KT	40		
AVG WAVE HEIGHT	FT	20		
TYPE OF WEATHER SYSTEM		LOW		
LAT/LON	DEG	55N/148W	57N/143W	***/***
CENTRAL PRESSURE	MBS	985	980	-99
MOVEMENT	DEG KT	5/ 9	5/ 9	-9/**
MAX WIND SPEED	KT	35	40	**
MAX WAVE HEIGHT	FT	20	20	**
LOCATION OF MAX WIND	DEG NM	14/ 890	29/ 881	-9/ -98
AVG WIND SPEED	KT	25		
AVG WAVE HEIGHT	FT	10		
TYPE OF WEATHER SYSTEM		LOW		
LAT/LON	DEG	30N/172W	33N/163W	32N/159W
CENTRAL PRESSURE	MBS	1012	1008	1005
MOVEMENT	DEG KT	8/19	7/20	10/18
MAX WIND SPEED	KT	30	35	30
MAX WAVE HEIGHT	FT	15	15	15
LOCATION OF MAX WIND	DEG NM	32/ 799	32/ 896	15/ 207
AVG WIND SPEED	KT	15		
AVG WAVE HEIGHT	FT	5		
TYPE OF WEATHER SYSTEM		HIGH		
LAT/LON	DEG	27N/128W	35N/123W	35N/123W
CENTRAL PRESSURE	MBS	1021	1020	1021
MOVEMENT	DEG KT	3/16	3/24	0/ 0
MAX WIND SPEED	KT	30	25	25
MAX WAVE HEIGHT	FT	15	10	10
LOCATION OF MAX WIND	DEG NM	8/ 256	14/ 504	14/ 504
AVG WIND SPEED	KT	10		
AVG WAVE HEIGHT	FT	5		

Figure 9. Digital forecasts for the Pacific Ocean valid beginning 0600 GMT February 10, 1984.