

enter any of the names on the figure will be displayed containing the name, number and any other pertinent source. There will also be space to s of the contact, if made. The contacts o files, one where contact was made and wasn't established. During the hectic spill, the OSC may then review the files who should have been contacted were

compatibility system will provide glove, boot, and suit material ation for the type of chemical that has ll provide compatibility information for emicals, but will not do mixtures of t Guard is presently seeking a chemical ial. The data concerning suit material nufacturers and the compatibility se suits is being used in order to rial will be optimal. This information ated into the system.

O/COTP/District waterways management ng more detailed and complex, requiring ing of large amounts of information. nplished through the use of computer ide rapid access to this information, contained in manuals, technical reports ary benefit of SRIS is to assist the ively exercising its authority in spill signed by law. The potential benefits e:

n of the technology and the spill tion, making the Coast Guard more ying and monitoring cleanup techniques;

t responding to spills;

hazardous materials remaining in the to affect the environment;

hazardous materials reaching the

for those responding to hazardous

COMPUTER-WORDED MARINE FORECASTS*

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ABSTRACT

A computer program, to aid forecasters in preparing marine forecasts, is presented. This program extracts information about significant marine weather systems and associated marine meteorological and oceanographic forecasts from the National Weather Service's forecast models. This information is used to produce a narrative forecast by assembling words and phrases that describe marine weather systems. A forecast produced by the program is presented and compared with the official forecast.

INTRODUCTION

The National Oceanic and Atmospheric Administration (NOAA) has the responsibility of providing oceanographic services necessary for safe and efficient marine activities on the high seas, in offshore waters, and along the seacoasts. Analyses and forecasts of oceanographic phenomena are provided to support shipping, fishing, offshore drilling and mining, and marine activities in these coastal areas.

Typically marine weather forecasts are distributed to marine users via radio in a narrative format. A computer program has been developed to assist forecasters in preparing such marine forecasts. The program, which extracts information about significant over-water weather systems from forecasts of the National Meteorological Center's (NMC) forecast models, selects and assembles computer-stored words and phrases to describe weather and wave conditions over the High Seas. The High Seas is defined as that portion of the open ocean seaward from the edge of the continental shelf for which the National Weather Service has forecast responsibility.

The purpose of this paper is to present a brief explanation of the existing program that produces computer-worded forecasts for the U.S. high seas. Also included is a discussion of the modified version of the program that will provide computer-worded guidance for offshore and coastal areas of the U.S.

*OPC Contribution No. 32

HIGH SEAS FORECASTS

Forecasts for the seven U.S. high seas areas contain three segments - heading, warnings, and synopsis and forecasts. These areas for the East Coast of the U.S. are shown in Figure 1a.

Warnings

The warnings portion of the message contains forecasts of storms and other significant weather systems with associated winds of 35 kts or greater. When several systems exist, the system with the highest wind speed is listed first with other systems following in order.

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 of the system is also forecast. Maximum wind and wave conditions are forecast and referenced from the center of the weather system. In addition, averaged forecast wind and wave conditions are described. If there is no system, the word "none" is transmitted.

Synopsis and Forecast

This portion 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 kts. Most of the wording for these systems are the same as for systems in the warnings portion of the message. However, the location of maximum wind and wave conditions and the average wind speed and wave height are not worded.

Computer-generated Matrix

A two-dimensional matrix of forecast times and meteorological/oceanographic related elements is formed. At each forecast hour (00, 24, and 36), the latitude and longitude of each low and high are entered. Also entered 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.

Digital forecasts for the Atlantic Ocean are shown in a matrix format in Figure 2a. These forecasts were extracted from an NMC atmospheric forecast model. Keep in mind that these forecasts, which are valid beginning 1800 universal time coordinate (UTC) February 23, 1989, were available approximately 1 hour before the 2200 UTC 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 30 and 42 hours. Here the first forecast hour corresponds to hour 06 of the NMC model forecast from the 1200 UTC run.

How It Works

Let's go through the matrix for the two systems for each of the forecast projections beginning with the 6-h projection. At 1800 UTC on February 23 an area of high winds is forecast near 47 N and 38 W. Note 47/ 35 is displayed, in Figure 2a, next to "location of max wind" for storm or gale winds that are associated with a high pressure system.

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HIGH SEAS FORECASTS

seven U.S. high seas areas contain three systems, and synopsis and forecasts. These areas U.S. are shown in Figure 1a.

Warnings

1 of the message contains forecasts of storms (other systems with associated winds of 35 kts or more) exist, the system with the highest wind speed with other systems following in order.

Location of the system at the initial time of 24- and 36-h projections are given. The wind speed of the system is also forecast. Wind conditions are forecast and referenced from the system. In addition, averaged forecast wind and wave height. If there is no system, the word "none"

Synopsis and Forecast

1 message contains a synopsis and forecast of wind speeds less than gale force (less than 35 kts). Most of the wording for these systems are included in the warnings portion of the message. 2 maximum wind and wave conditions and the wave height are not worded.

Computer-generated Matrix

1 a matrix of forecast times and other related elements is formed. At each hour (36), the latitude and longitude of each low system. Also entered are the central pressure, the wind speeds, and the relationship of the maximum wind of each low and high. Wave heights are included and average wind conditions.

1 in the Atlantic Ocean are shown in a matrix. These forecasts were extracted from an NMC system. Keep in mind that these forecasts, which are universal time coordinate (UTC) February 23, approximately 1 hour before the 2200 UTC issuance system, the five columns, from left to right, are unit of measurement of the element, and the time of the first forecast hour and forecast hours. The first forecast hour corresponds to hour 06 from the 1200 UTC run.

How It Works

1 a matrix for the two systems for each of the systems with the 6-h projection. At 1800 UTC on February 23, the wind speed is forecast near 47 N and 38 W. Note Figure 2a, next to "location of max wind" for the systems are associated with a high pressure system.

The position of these gale winds are in good agreement with the surface weather chart. See Figure 2b.

A low, 1007 mb, is forecast at 35 N and 73 W. The central pressure and location of this system is also in good agreement with the surface chart (Figure 2b). The system is forecast to move towards 30 degs at a speed of 12 kt during the 36-h forecast period. Maximum winds were forecast to be 40 kt, 392 n mi and 70 degs from the center. A maximum wave height of 20 ft was forecast in the area of maximum winds. During the next 24 hours, the low was forecast to move northeast at a speed of 10 kt. The forecast position was 39 N and 71 W. Winds were forecast to be 40 kt with a maximum wave height of 20 ft. These conditions were forecast to occur 469 n mi east of the center of the low. The final forecast projection locates the system at 41 N and 68 W. The forecast movement during the last 12-h period was 17 kt towards the northeast. Maximum wind conditions were forecast to diminish to 35 kt. We will refer to this matrix again when we present the computer-worded forecast.

Computer-worded Forecast

Digital forecasts are the basis for the computer wording. We followed the NWS Operations Manual (1986) in developing the format and wording of the computer generated forecasts. Helpful suggestions were provided by marine forecasters at Weather Service Forecast Offices (WSFO) Washington and San Francisco.

Some of the more than 100 different computer-stored words and phrases, varying in length from two to 23 words, used to construct the computer-worded forecasts are shown in Table 1. These words and phrases describe the type of weather system and its intensity, location and movement, and the associated wind speed and direction.

Let's return to the digital forecast for 1800 UTC February 23, 1989 in matrix form in Figure 2a. As you may recall, the matrix depicts two systems. Figure 3a contains the computer-worded forecast which was generated from the digital forecasts shown in Figure 2a. Shown in the lower portion of Figure 3b is the forecast issued by WSFO Washington. The computer-worded guidance compares very favorably with the official forecast issued by Washington. The computer worded-forecast was generated on the Ocean Products Center's VAX workstation. Geographic displays of significant weather systems and associated pressure patterns can be generated at the workstation. The VAX workstation also makes it possible to interactively change and automatically reword the forecast.

OFFSHORE AND COASTAL FORECASTS

The high seas computer-worded forecast is being expanded into the offshore and coastal waters of the U.S. Offshore waters (15 forecast areas) include portions of oceans, gulfs, and seas. See Figure 1b for U.S. East Coast locations. Coastal waters (42 forecast areas) begin near the mean high water line and extend along the mainland or islands to as much as 100 n mi seaward. Figure 1c shows the locations of the East Coast forecast areas. For example, South Carolina's offshore waters extend from 32 N to 40 N seaward to 65 W. Coastal forecasts extend north from Savannah, Georgia, not including Savannah, to Little River Inlet out to 20 n mi.

While offshore and coastal forecasts cover a smaller area than the area covered by the high seas forecast, offshore and coastal forecast contain more forecast variables and are more detailed. These forecasts, which emphasize wind, weather, visibility, and wave height, are supplemented with small craft advisories, gale and storm warnings, short-fuse severe local storm warnings and statements supplementing tropical cyclone advisories (issued by the National Hurricane Center) including coastal flooding and shore erosion. In addition, warnings and forecasts of surf and breakers are prepared for selected beaches, ports, and local areas. The forecast parameters for the initial, 24-h, and 36-h forecast periods associated with high seas, offshore, and coastal forecasts are shown in Table 2.

Forecast Example

How would the computer generate an offshore and coastal forecast for the waters near Charleston, South Carolina? To ensure consistency in computer wording as well as consistency in overlapping geographic areas, these forecasts would be worded from the following matrices.

High Seas

- North of 32 N
- South of 32 N

Offshore

- Western Central North Atlantic waters
- Southeast North Atlantic waters

Coastal

- Virginia Beach - Little River Inlet
- Little River Inlet - Savannah
- Savannah - St. Augustine

Offshore and coastal forecasts would also have to be compared to forecasts for coastal cities to ensure consistency in adjoining marine and land regions. Referring back to our high seas forecast for 1800 UTC February 23, 1989, our offshore and coastal forecasts for the waters off Charleston, South Carolina might be as shown in Figures 4a and 4b respectively.

FUTURE PLANS

In addition to modifying and expanding the computer-worded marine guidance for the offshore, coastal, and Great Lakes areas, we are modifying the the high seas forecasts to include forecasts of superstructure icing, fog, and visibility. Work also continues on a scheme to better isolate ridges and troughs.

ACKNOWLEDGMENTS

We are very grateful to the many people who have provided guidance and encouragement for this project. In particular, we thank Bob Glahn and Bob Bermowitz of the National Weather Service for their helpful suggestions and computer code. We also thank forecasters at WSFO's Washington and San Francisco for their helpful suggestions.

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and coastal forecasts cover a smaller area than the high seas forecast, offshore and coastal forecast variables and are more detailed. These size wind, weather, visibility, and wave height, small craft advisories, gale and storm warnings, storm warnings and statements supplementing (issued by the National Hurricane Center) ding and shore erosion. In addition, warnings and breakers are prepared for selected beaches. The forecast parameters for the initial, 24-h, periods associated with high seas, offshore, and shown in Table 2.

Forecast Example

Computer generate an offshore and coastal forecast Charleston, South Carolina? To ensure consistency well as consistency in overlapping geographic would be worded from the following matrices.

North Atlantic waters
Atlantic waters

- Little River Inlet
Inlet - Savannah
Augustine

Forecasts would also have to be compared to ties to ensure consistency in adjoining marine going back to our high seas forecast for 1800 our offshore and coastal forecasts for the South Carolina might be as shown in Figures 4a

FUTURE PLANS

Expanding and expanding the computer-worded marine, coastal, and Great Lakes areas, we are high seas forecasts to include forecasts of wind, and visibility. Work also continues on a ridges and troughs.

ACKNOWLEDGMENTS

To the many people who have provided guidance on this project. In particular, we thank Bob Glahn of the National Weather Service for their helpful code. We also thank forecasters at WSFO's for their helpful suggestions.

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Figure 1a. Location of U.S. East Coast high seas forecast areas.

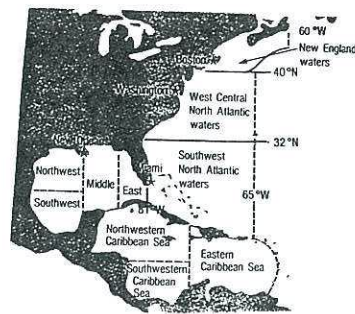


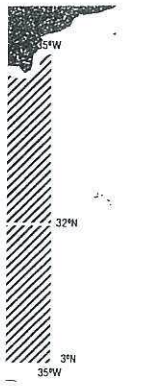
Figure 1b. Location of U.S. East Coast offshore forecast areas.



Figure 1c. Location of U.S. East Coast coastal forecast areas.

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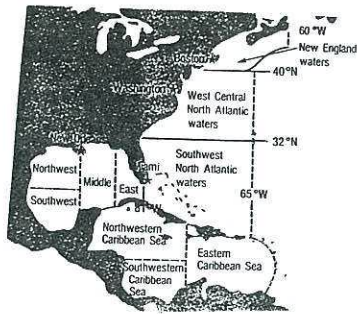


Figure 1b. Location of U.S. East Coast offshore forecast areas.



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HIGH SEAS COMPUTER-WORDED FORECAST FOR
NORTH ATLANTIC NORTH OF 32N AND WEST OF 35W.
VALID 18Z FEB 23 1989 FOR THE NEXT 36 HOURS

ELEMENT	UNITS	18Z	18Z	06Z
TYPE OF WEATHER SYSTEM HIGH				
LAT/LON	DEG	35N/38W	35N/39W	34N/39W
CENTRAL PRESSURE	MBS	1040	1035	1033
MOVEMENT	DEG KT	22 / 2	0 / 0	0 / 0
MAX WIND SPEED	KT	40	30	30
MAX WAVE HEIGHT	FT	20	15	15
LOCATION OF MAX WIND	DEG NM	47 / 38	1 / 669	5 / 624
AVG WIND SPEED	KT	20		
AVG WAVE HEIGHT	FT	5		
TYPE OF WEATHER SYSTEM LOW				
LAT/LON	DEG	35N/73W	39N/71W	41N/68W
CENTRAL PRESSURE	MBS	1007	1003	1002
MOVEMENT	DEG KT	3 / 12	3 / 10	4 / 17
MAX WIND SPEED	KT	40	40	35
MAX WAVE HEIGHT	FT	20	20	20
LOCATION OF MAX WIND	DEG NM	7 / 392	9 / 469	9 / 566
AVG WIND SPEED	KT	25		
AVG WAVE HEIGHT	FT	10		

Figure 2a. Matrix of digital forecasts for the Atlantic Ocean.

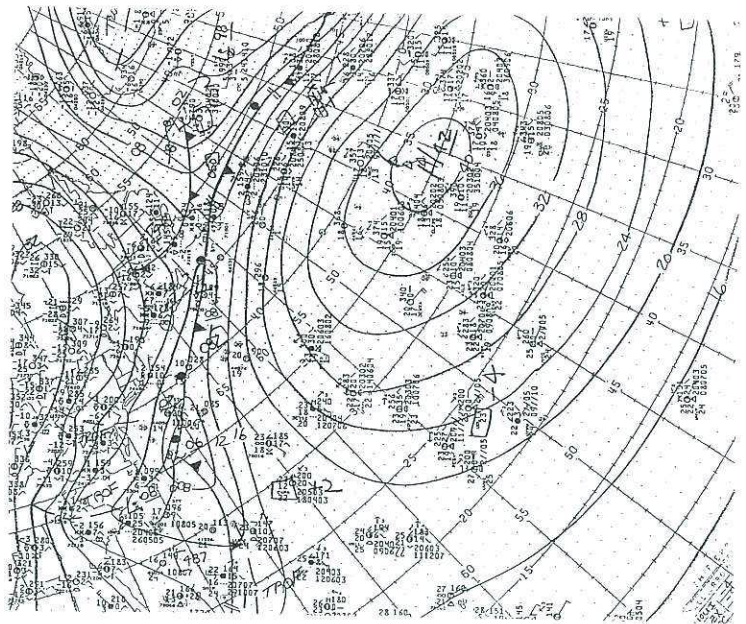


Figure 2b. Atlantic Ocean portion of synoptic weather chart for 1800 UTC February 23, 1989.

Table 1. 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 & WAVE CONDITIONS
Storm	Intense	Can be	Eight points	Increasing
Area of storm winds	Developing	referenced	of the compass	winds
Gale	Weakening	from nearest	Rapidly	Diminishing
Area of gale winds		land or water	Slowly	winds
Low		feature	Stationary	Building
High		About	Merging with	waves
		Just Off	Absorbed by	Diminishing
		Over		waves

Table 2. Meteorological and oceanographic forecast parameters needed for High Seas, Offshore, and Coastal forecasts.

FORECAST PARAMETER	HIGH SEAS	OFFSHORE	COASTAL
System Type	X		
Location	X		
Central Pressure	X		
Movement	X		
Winds	X	X	X
Waves	X	X	X
Visibility	X	X	X
Ice	X	X	X
Superstructure Icing	X	X	X
Weather Type		X	X
Flooding			X
Surf/Breakers			X
Shore Erosion			X

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Figure 3b.

ords and phrases that may be selected to location, and movement of systems and their conditions.

TY	LOCATION	MOVEMENT	WIND & WAVE CONDITIONS
ing ng	Can be referenced from nearest land or water feature About Just Off Over	Eight points of the compass Rapidly Slowly Stationary Merging with Absorbed by	Increasing winds Diminishing winds Building waves Diminishing waves

ical and oceanographic forecast for High Seas, Offshore, and Coastal

HIGH SEAS	OFFSHORE	COASTAL
X		
X		
X		
X		
X	X	X
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X	X	X
X	X	X
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	X	X
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TAA00 KWBC 232200

HIGH SEAS FORECAST
NATIONAL WEATHER SERVICE WASHINGTON D.C.
1800 UTC THU FEB 23 1989

NORTH ATLANTIC 32N TO 65N AND WEST OF 35W
FORECAST VALID 0600 UTC SAT FEB 25 1989

WARNINGS.

AREA OF GALE WINDS 47N 38W. WINDS 40 KTS AND SEAS 20 FT. WINDS AND SEAS DIMINISHING DURING THE NEXT 24 HRS. ELSEWHERE WINDS 20 KTS AND SEAS 5 FT.

GALE CENTER 1007 MBS 35N 73W SLOWLY MOVING NORTHEAST 12 KTS DURING THE NEXT 36 HRS. FORECAST GALE CENTER 1002 MBS 41N 68W. WINDS 40 KTS AND SEAS 20 FT WITHIN 400 NM EAST OF THE CENTER. WINDS AND SEAS DIMINISHING AFTER 24 HRS. ELSEWHERE WINDS 25 KTS AND SEAS 10 FT.

SYNOPSIS AND FORECAST.

EXCEPT AS DESCRIBED IN PART ONE WINDS 25 KTS OR LESS AND SEAS LESS THAN 8 FT WILL CONTINUE DURING THE FORECAST PERIOD.

Figure 3a. Computer-worded High Seas Forecast.

TAA00 KWBC 232234

HIGH SEAS FORECAST
NATIONAL WEATHER SERVICE WASHINGTON D.C.
2200 UTC THU FEB 23 1989

NORTH ATLANTIC 32N TO 65N AND WEST OF 35W
FORECAST VALID 0600 UTC SAT FEB 25 1989

WARNINGS.

GALE 55N 45W 1000 MBS AT 1800 UTC MOVING E 25 KTS AND RAPIDLY INTENSIFYING. WINDS 25 TO 40 KTS SEAS 9 TO 18 FT WITHIN 700 NM OVER S QUADRANT. ELSEWHERE WITHIN 700 NM OF CENTER WINDS 30 KTS SEAS 7 TO 14 FT. FORECAST GALE CENTER E OF AREA. FORECAST WINDS 25 TO 40 KTS SEAS 10 TO 20 FT NE OF A LINE FROM 43N 35W TO 54N 60W.

COMPLEX GALE 35N 74W 1005 MBS AT 1800 UTC WILL MOVE NNE 15 KTS. WINDS 25 TO 40 KTS SEAS 10 TO 20 FT WITHIN 450 NM OVER NE SEMICIRCLE. ELSEWHERE WITHIN 900 NM OF CENTER WINDS TO 30 KTS SEAS 7 TO 14 FT. FORECAST GALE CENTER NEAR 42N 66W 998 MBS. FORECAST WINDS 30 TO 45 KTS SEAS 12 TO 22 FT WITHIN 550 NM OVER NE SEMICIRCLE AND WITHIN 350 NM OVER SW SEMICIRCLE.

SYNOPSIS AND FORECAST.

HIGH PRES 35N 37W 1042 MBS MOVING SLOWLY SE. FORECAST HIGH 33N 37W 1035 MBS.

ELSEWHERE...EXCEPT AS PREVIOUSLY DESCRIBED...WINDS 25 KTS OR LESS

SEAS 8 FT OR LESS.

Figure 3b. High Seas Forecast issued by WSFO Washington.

OFFSHORE FORECAST
NATIONAL WEATHER SERVICE WASHINGTON D.C.

WEST CENTRAL NORTH ATLANTIC BETWEEN THE
100 FATHOM CONTOUR AND 65W, NORTH OF 32N

SYNOPSIS....DEVELOPING GALE 150 NM EAST OF CAPE HATTERAS
WILL INTENSIFY AND MOVE NORTHEAST AT 20 KTS.

....GALE WARNINGS IN EFFECT...

WESTERN PORTION...
NORTHWEST WINDS 30 KTS THIS AFTERNOON INCREASING TO 40 KTS
TONIGHT AND CONTINUING FRIDAY. SEAS 10 FT INCREASING TO
20 FT TONIGHT AND CONTINUING FRIDAY. VISIBILITY 1 NM IN
OCCASIONAL RAIN SHOWERS.

EASTERN PORTION...
SOUTHERLY WINDS 25 KTS BECOMING SOUTHERLY 35 KTS TONIGHT AND
FRIDAY. SEAS 15 FT TONIGHT AND FRIDAY. VISIBILITY 2 NM IN HAZE.

FIGURE 4a. Sample Offshore Forecast for West Central North Atlantic.

COASTAL MARINE FORECAST
NATIONAL WEATHER SERVICE COLUMBIA, S.C.

LITTLE RIVER INLET TO SAVANNAH

SYNOPSIS....LOW PRESSURE CENTERED 150 NM EAST OF CAPE HATTERAS
WILL INTESIFY AND MOVE NORTHEAST AT 20 KTS. HIGH PRESSURE OVER
WESTERN GREAT LAKES WILL MOVE EAST TO MID-ATLANTIC COAST.

....SMALL CRAFT WARNINGS IN EFFECT...
SOUTHEAST WINDS 30 KTS THIS AFTERNOON BECOMING NORTHWESTERLY
30 KTS TONIGHT AND CONTINUING FRIDAY. WINDS DIMINISHING FRIDAY
NIGHT. SEAS BUILDING 8 FT IN UNPROTECTED WATERS THIS AFTERNOON.
SEAS 5 FT FRIDAY AND FRIDAY NIGHT. VISIBILITY 1 NM IN RAIN THIS
AFTERNOON IMPROVING TO GREATER THAN 5 NM TONIGHT.

FIGURE 4b. Sample Coastal Marine Forecast for Little River Inlet to Savannah, Georgia.

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