U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
NATIONAL METEOROLOGICAL CENTER

OFFICE NOTE 393

THE NATIONAL MARINE VERIFICATION PROGRAM - CONCEPTS AND DATA MANAGEMENT

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National Meteorological Center

May 1993

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
OCEAN PRODUCTS CENTER

TECHNICAL NOTE*

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NATIONAL METEOROLOGICAL CENTER
WASHINGTON, D. C.
MAY 1993

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*OPC Contribution No. 69
NMC OFFICE NOTE NO. 393

OPC CONTRIBUTIONS

No. 1. Burroughs, L. D., 1986: Development of Forecast Guidance for Santa Ana Conditions. National Weather Digest, Vol. 12 No. 1, 8pp.

No. 2. Richardson, W. S., D. J. Schwab, Y. Y. Chao, and D. M. Wright, 1986: Lake Erie Wave Height Forecasts Generated by Empirical and Dynamical Methods -- Comparison and Verification. Technical Note, 23pp.

No. 3. Auer, S. J., 1986: Determination of Errors in LFM Forecasts Surface Lows Over the Northwest Atlantic Ocean. Technical Note/NMC Office Note No. 313, 17pp.

No. 4. Rao, D. B., S. D. Steenrod, and B. V. Sanchez, 1987: A Method of Calculating the Total Flow from A Given Sea Surface Topography. NASA Technical Memorandum 87799., 19pp.

No. 5. Feit, D. M., 1986: Compendium of Marine Meteorological and Oceanographic Products of the Ocean Products Center. NOAA Technical Memorandum NWS NMC 68, 93pp.

No. 6. Auer, S. J., 1986: A Comparison of the LFM, Spectral, and ECMWF Numerical Model Forecasts of Deepening Oceanic Cyclones During One Cool Season. Technical Note/NMC Office Note No. 312, 20pp.

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No. 8. Yu, T. W., 1987: A Technique of Deducing Wind Direction from Satellite Measurements of Wind Speed. Monthly Weather Review, 115, 1929-1939.

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No. 11. Esteva, D. C., 1987: The Editing and Averaging of Altimeter Wave and Wind Data. Technical Note, 4pp.

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No. 17. Yu, T.W., 1987: Analysis of the Atmospheric Mixed Layer Heights Over the Oceans. Conference Preprint, Workshop Proceedings AES/CMOS 2nd Workshop of Operational Meteorology, Halifax, Nova Scotia, 2, 425-432.

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THE NATIONAL MARINE VERIFICATION PROGRAM -

Concepts and Data Management

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INTRODUCTION

The National Marine Verification Program (NMVP) is a component of the National Verification Program (NVP) of the National Weather Service (NWS). The NMVP was initiated about 1982 with a final report issued by the National Verification Committee (NVC) in early 1984. The objective of the NMVP is to verify warnings and forecasts from Weather Service Forecast Offices (WSFO) having marine responsibilities and to compile statistics to aid in evaluating the performance of NWS marine services. The forecasts are for specific buoy and Coastal Marine Automated Network (C-MAN) locations whose observations are representative of the conditions within each WSFO's area of responsibility. The forecasts are sent to the National Meteorological Center (NMC) where they are matched with interpolated data from various guidance products and buoy/C-MAN observations.

It was anticipated that the NMVP would get underway sometime in 1986. The data management software was developed and tested, but for various reasons the program was delayed until March 1992. At that time the Marine Prediction Branch (MPB) of the National Meteorological Center (NMC) took over the project and began completion of the work to make the NMVP operational.

In this TECHNOTE we will discuss the concepts of the NMVP and how the data are collected and matched. In a separate TECHNOTE we will discuss the variables for which statistics are derived and what statistics are used to evaluate the forecasts (Burroughs, 1993). The first statistical report (Burroughs and Nichols, 1993) will also be published in the near future.

PROGRAM CONCEPT

Marine Services is the last of 4 major program areas to be brought under the National Verification Plan. The NMVP was developed to create an effective method for evaluating marine warnings and forecasts by automating the collection of marine verification data. The program will help field forecasters to identify strengths and weaknesses in forecast skill and assist managers to identify strengths and weaknesses in marine services. Automating collection of marine verification data will promote timeliness and minimize impact of the program on the field forecaster's workload.

Each WSFO in the program makes forecasts for specific observation points within their marine area of responsibility. Each observation point is either a buoy or C-MAN location from which data are considered to be representative of the forecast area. The forecast points have been assigned in coordination with the Regions and WSFOs.

Verification forecasts for each data point are made for 2 of the 4 operational forecasts each day. Alaska Region issues 2 operational forecasts daily; both are verified. The verification forecasts are those issued in the early morning containing verification times of 1800 UTC and 0600 UTC and the early evening containing verification times of 0600 UTC and 1800 UTC. These times are 18 and 30 hours from each of the previous 0000 UTC and 1200 UTC NMC model cycles used for the early morning and early evening forecasts, respectively. The 2 verification times, in turn range from about 6 to 9 hours and 18 to 21 hours from the operational forecast issuance times.

Note that verification times of 1200/0000 UTC and 0000/1200 UTC were not selected for the early morning and early evening forecasts, respectively (*i.e*, 12 and 24 hours after the guidance cycles). These times would have set the first period verification too soon after the forecast issuance thereby raising the potential for artificially favorable verification results due to a persistance bias.

The 2 forecasts selected for verification were chosen to give forecasters the opportunity to improve on the guidance by providing the maximum time to consider all available guidance products as well as the most recent data from all sources. Verifying the forecasts issued just after receipt of the latest guidance would tend to work against the forecaster due

to the relatively small amount of time between guidance availability and forecast issuance.

Forecasts consist of wind direction, wind speed, significant wave height, and warning category. Forecasts for 18 and 30 hours from the 0000 UTC and 1200 UTC NMC model cycle times are made for each point. The forecasts are transmitted to NMC over AFOS in the conterminous United States and via other communications circuits for Alaska and Hawaii. They are collected by NMC and archived along with various MPB guidance products and observations from the buoy and C-MAN stations. The MPB guidance products are interpolated to the specific observation points and matched with the forecasts from the WSFOs and the observations. The resulting data set is processed to remove duplicate data and to remove as many errors as possible. These data are sorted by WSFO, and individual floppy data disks are created for each WSFO. The individual disks are sent to each WSFO periodically (currently semi-annually) for use with local programs. The matched data set is also archived at NMC and is used to prepare reports and to do studies as requested. National reports will be issued periodically (currently semi-annually). These reports give statistics for all stations combined and for each coast or region. The statistics are explained in detail in Burroughs (1993).

Table 1 gives the WSFOs that are in the program or will be in the program. The forecast points for each WSFO are also included. Asterisks indicate which WSFOs are not in the program yet. They will come into it later in 1993. Currently, only three WSFOs are active in the program (Washington, San Francisco, and Honolulu). Washington and San Francisco initiated the program in May 1992. Honolulu joined the program in August 1992.

DATA MANAGEMENT

Data management includes archiving the forecasts from the WSFOs for each of the verification points, archiving the MPB guidance products for comparison with the forecasts, and achiving the buoy and C-MAN observations for each verification point. These data are then matched by verification date and time and archived for use in statistical studies at the National and Regional levels. The matched data are also sorted by WSFO, downloaded to floppy disk, and sent to the individual WSFOs for their local use. Figure 1 shows the flow of

Table 1: List of WSFOs participating in the National Marine Verification Program by Region. Also included are the station identifiers, latitudes, longitudes, and forecast area for each verification point. Forecast areas are designated by C (coastal) or, O (offshore). Only coastal stations require small craft advisory as a warning category. Each WSFO is responsible for making forecasts at the verification points listed by their names.

NATIONAL MARINE VERIFICATION PROGRAM					
		Verification Points			
Region	Forecast Office	Point Identifier	Latitude	Longitude	Forecast Area
Eastern	Portland, ME *	MDRM1	44.0 N	68.1 W	C
		MISM1	43.8 N	68.9 W	C
		44007	43.5 N	70.1 W	C
	Boston, MA *	44005	42.6 N	68.6 W	O
		44013	42.4 N	70.8 W	C
		BUZM3	41.4 N	71.0 W	C
		44011	41.1 N	66.6 W	O
		44008	40.5 N	69.4 W	O
	New York, NY *	ALSN1	40.5 N	73.8 W	C
		44025	40.3 N	73.2 W	C
	Philadelphia, PA *	440nn	**	**	C
	Washington, DC	44004	38.5 N	70.7 W	O
		CHLV2	36.9 N	75.7 W	C
		44014	36.6 N	74.8 W	O
		41001	34.9 N	73.0 W	O
		41002	32.3 N	75.2 W	O
	Raleigh, NC *	DSLN7	35.2 N	75.3 W	C
		CLKN7	34.6 N	76.5 W	C
	Columbia, SC *	41004	32.5 N	79.1 W	C
Southern	Miami, FL *	41010	28.9 N	78.5 W	O
		41009	28.5 N	80.2 W	C
		41006	24.6 N	76.5 W	O
		42025	24.9 N	80.4 W	C
		MLRF1	25.0 N	80.4 W	C
	Slidell, LA *	42003	25.9 N	85.9 W	O
		42001	25.9 N	89.7 W	O
		42002	25.9 N	93.6 W	O
		BURL1	28.9 N	89.4 W	C
		42007	30.1 N	88.8 W	C
	San Antonio, TX *	42019	27.9 N	95.0 W	C
		42020	27.0 N	96.5 W	C
Western	Los Angeles, CA *	46048	32.9 N	117.9 W	C
		46025	33.7 N	119.1 W	C
		46023	34.3 N	120.7 W	C
		46047	***	***	C

Verification Points Continued

Region	Forecast Office	Point Identifier	Latitude	Longitude	Forecast Area
Western	San Francisco, CA	46047	32.7 N	119.6 W	O
	***				
		46042	36.8 N	122.4 W	C
		46012	37.4 N	122.7 W	C
		46014	39.2 N	124.0 W	C
		46022	40.7 N	124.5 W	C
	Portland, OR *	46027	41.8 N	124.4 W	C
		CARO3	43.3 N	124.4 W	C
		NWPO3	44.6 N	124.1 W	C
		46050	44.6 N	124.5 W	C
	Seattle, WA *	46002	42.5 N	130.3 W	O
		46005	46.1 N	131.0 W	O
		46029	46.2 N	124.2 W	C
		46041	47.4 N	124.5 W	C
		WPOW1	47.7 N	122.4 W	C
		SISW1	48.3 N	122.8 W	C
		TTIW1	48.4 N	124.7 W	C
Alaska	Juneau, AK *	FFIA2	57.3 N	133.6 W	C
	Anchorage, AK *	46001	56.3 N	148.2 W	O
		46035	57.0 N	177.7 W	O
Pacific	Honolulu, HI	51001	23.4 N	162.3 W	O
		51003	19.3 N	160.8 W	O
		51004	17.4 N	152.5 W	O
		51002	17.2 N	157.8 W	O
	****	51026	21.4 N	157.0 W	C

* Office will join program in mid-1993.
** Buoy to be established in April 1993.
*** Buoy to be moved to Santa Barbara Channel in LAXs forecast area by mid-1993.
**** Additional assignment for Honolulu.

data for the program. The regions boxed by dashed lines show which parts of the program are carried out by the individual WSFOs. All other functions are the responsibility of NMC - specifically the MPB. The parts of the program that are currently operational are connected by solid lines. Future additions to the program are connected by dashed lines. A more complete description is given in the following subsections.

WSFO Forecasts

The WSFOs in the NMVP transmit coded forecasts twice daily to NMC for each verification point assigned in Table 1. The forecasts are for 18- and 30-h from each model

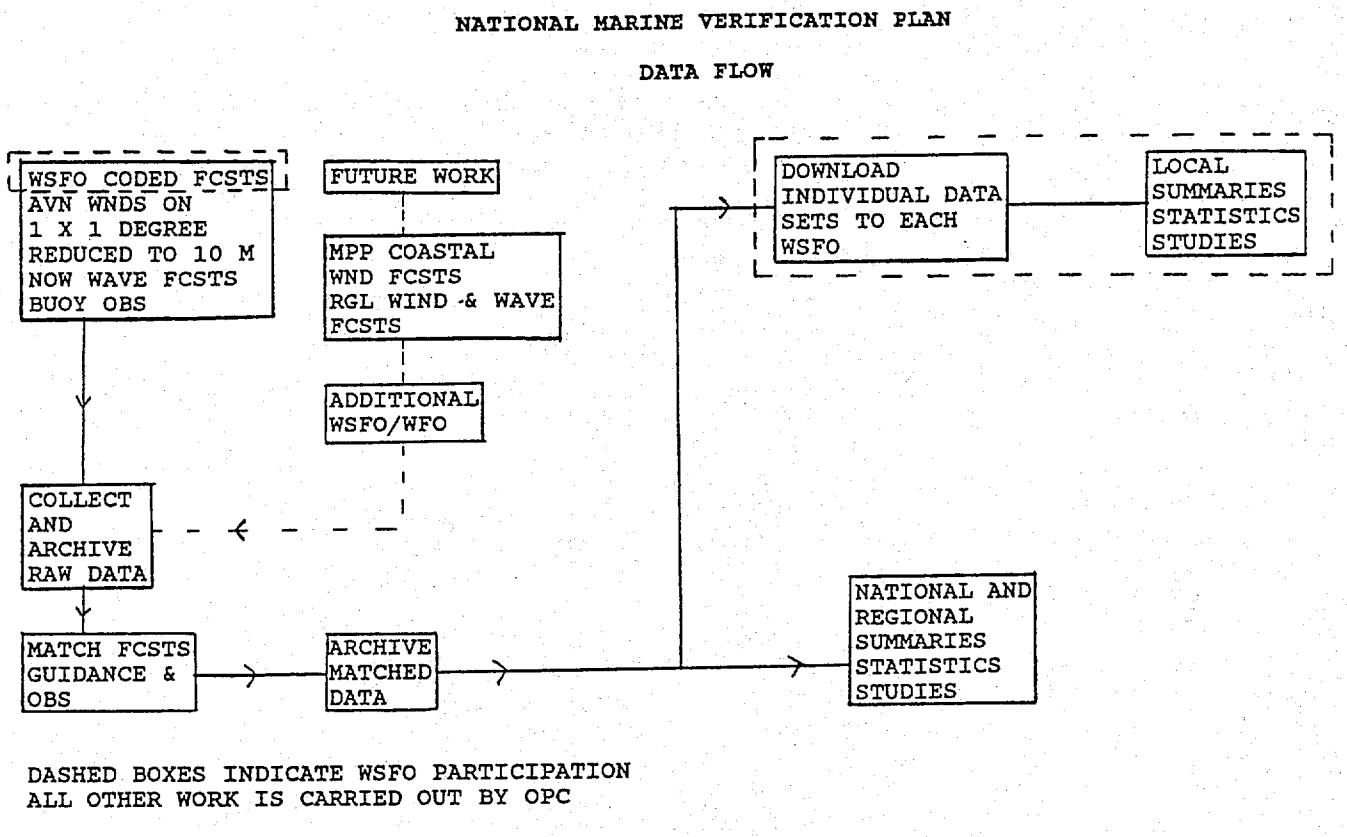

Figure 1: Data flow for the National Marine Verification Program. Areas boxed with dashed lines show WSFO responsibilities. Boxes connected by dashed lines are program additions to be made in the future. All other functions shown are the responsibility of NMC. MPP means modified perfect prognosis see Burroughs (1991a) for full details.

cycle time (0000/1200 UTC). These point forecasts are derived from the coastal or offshore forecasts issued earlier. The coded forecasts may be transmitted up to 2 hours after the issuance times for the coastal or offshore forecasts. Parameters to be verified include wind direction to the nearest 10 degrees, wind speed to the nearest knot, wave height to the nearest foot, and warning catagory - including Small Craft Advisories for coastal verification points. Table 2 shows the World Meteorological Organization (WMO) headers for each WSFO, the AFOS PIL, if applicable, and the issuance times for the area and coded forecasts in UTC. All WSFOs in the conterminous United States send their coded forecasts over AFOS. WSFOs in the Pacific and Alaska Regions send their coded reports on other dedicated communications circuits.

Table 2: WMO bulletin headers, AFOS PILs, area forecast issuance times (UTC), and coded verification point forecast issuance times (UTC) for each NMC model cycle and each WSFO in the NMVP.

NATIONAL MARINE VERIFICATION PROGRAM Verification Forecast Information						
Forecast Office	WMO Header	AFOS PIL	0000 UTC Cycle		1200 UTC Cycle	
			Area FCST Issued by UTC	Coded FCST Issued by UTC	Area FCST Issued by UTC	Coded FCST Issued by UTC
Portland, ME	FXUS41 KPWM	PWMMVF001	0930	1130	2130	2330
Boston, MA	FXUS41 KBOS	BOSMVF001	"	"	"	"
New York, NY	FXUS41 KNYC	NYCMVF001	"	"	"	"
Philadelphia, PA	FXUS41 KPHL	PHLMVF001	"	"	"	"
Washington, DC **	FXUS41 KWBC	WBCMVF001	"	"	"	"
Raleigh, NC	FXUS41 KRDU	RDUMVF001	"	"	"	"
Columbia, SC	FXUS41 KCAE	CAEMVF001	"	"	"	"
Miami, FL	FXUS41 KMIA	MIAMVF001	*	"	*	"
Slidell, LA	FXUS41 KNEW	SILMVF001	0930	1130	2130	2330
San Antonio, TX	FXUS41 KSAT	SATMVF001	"	"	"	"
Los Angeles, CA	FXUS41 KLAX	LAXMVF001	1030	1230	2230	0030
San Francisco, CA **	FXUS41 KSFO	SFOMVF001	"	"	"	"
Portland, OR	FXUS41 KPDX	PDXMVF001	"	"	"	"
Seattle, WA	FXUS41 KSEA	SEAMVF001	"	"	"	"
	FXUS42 KSEA	SEAMVF002	"	"	"	"
Juneau, AK	AXAK90 PAJN		1200	1400	0000	0200
Anchorage, AK	AXAK90 PANC		1100	1300	2300	0100
Honolulu, HI	AXHW90 PHNL		1000	1200	2200	0000

* Coastal forecast issued at 0830 and 2030 UTC; offshore forecast issued at 0930 and 2130 UTC.

** PILs and WMO headers for Washington and San Francisco will change to the above when the other WSFOs come into the NMVP.

Table 3 gives the format for the coded forecasts with a full explanation of each part of the format. Figure 2 gives a sample of a coastal forecast for San Francisco, and Fig. 3 gives the coded verification point forecast that would be derived from the coastal forecast. The Office of Meteorology will be enlisting the support of the Regions to create a standard, user friendly, formatting program to help forecasters code the messages efficiently.

NMC Guidance

NMC marine forecast guidance is developed by the MPB and takes the form of global, regional, and point forecast guidance. Specific guidance currently used by forecasters in the field includes the global boundary layer winds (Gemmill and Kidwell, 1990), the NOAA Ocean Wave (NOW) Model (Esteva and Kidwell, 1990) significant wave heights ($h_{1/3}$), periods, and spectra, and the Gulf of Mexico Regional Wave Model (GMEX) (Chao, 1991).

EXAMPLE COASTAL FORECAST

FZUS6 KSFO
SFOCWFSFO
TTAA00 KSFO 011030

COASTAL MARINE FORECAST
NATIONAL WEATHER SERVICE
SAN FRANCISCO CA
230 AM PST WED JAN 1 1993

COASTAL CALIFORNIA...POINT ST. GEORGE TO POINT CONCEPTION
.SYNOPSIS...(Text)

CAZ506-011630-
POINT ST. GEORGE TO POINT ARENA OUT TO 60 NM
230 AM PST WED JAN 1 1993

...GALE WARNING IN EFFECT...

.TODAY...NORTHWEST WINDS 40 KTS. SEAS 15 FT.
.TONIGHT...WINDS BECOMING NORTH SUBSIDING TO 25 KTS. SEAS LOWERING TO 5 FT.
.THURSDAY...NORTH WINDS DECREASING TO 15 KTS. SEAS 5 FT.

$$

etc...other SFO coastal forecasts.

Figure 2: Examples of a coastal forecast for one of San Francisco's areas.

EXAMPLE CODED FORECAST

FXUS41 KSFO
SFOMVF001
TTAA00 KSFO 011030

%%F01 46022 18/GL/3238/15/06/SC/3623/05
%%F01 46014...*etc.*...
%%F01 46012...*etc.*...
%%F01 46042...*etc.*...
%%F01 46047...*etc.*...*

$$ (message turn-off code)

* This buoy will be moved to the Santa Barbara Channel within LAX's forecast area by summer 1993.

Note: SC (Small Craft Advisory) is indicated for the second verification period based on the wind speed exceeding the advisory threshold. This is not required for the coastal forecast given in Fig. 2, but is required for the coded point verification forecast.

Figure 3: Example of a coastal verification point forecast derived from a coastal forecast for one of San Francisco's areas.

Table 3: Explanation of code used for point verification forecasts by participating WSFOs.

CODE FORMAT	
$\%\%Fnn(space)xxxxx(space)t_1t_1/WW/ddff/hh/t_2t_2/WW/ddff/hh[LF][LF]\$\$$	
$\%\%F$:	Code for NMC computer and delimiter for operational forecast
nn:	Forecaster number. Note: comparative verification will NOT be used as an individual performance measure. However, once statistics become available, individuals should review them for self-improvement and knowledge.
$xxxxx$:	Buoy/C-MAN identifier
t_1t_1:	Verification time 18 hours from NMC model run (18 UTC on 0000 UTC cycle; 06 UTC on 1200 UTC cycle).
WW:	Warning status: NO: No advisory or warning SC: Small Craft Advisory (Coastal Marine Forecast only) GL: Gale Warning ST: Storm Warning TS: Tropical Storm Warning HR: Hurricane Warning
dd:	Wind direction: Tens of degrees. If less than 100 degrees add zero to tens digit, *e.g.*, 07. 100 knots or more add 50, *e.g.*, 57. Code 99 if wind is forecast to be variable based on regional guidelines.
ff:	Wind speed to nearest knot, not to nearest 5 knots as expressed in the area forecast. If less than 10 Knots add zero to tens digit, *e.g.*, 05. 100 knots or more subtract 100, *e.g.*, 110 knots entered as 10 and add 50 to *dd*.
hh:	Significant wave height (combined wind waves and swell). If less than 10 feet add zero to tens digit, *e.g.*, 08.
t_2t_2:	Verification time 30 hours from NMC model run (06 UTC on 0000 UTC cycle; 18 UTC on 1200 UTC cycle).
$[LF][LF]\$\$$:	End bulletin code: 2 line feeds followed by turn off code.

A regional wave model for the Gulf of Alaska (GAKWAV) will soon become operational at NMC. Statistical wind forecasts at many coastal and offshore buoy and C-MAN locations are available from the Coastal Wind Forecast System (Burroughs, 1991a) and the Santa Ana Forecast System (Burroughs, 1991b). At present only guidance from the global boundary layer winds and the NOW Model are being compared with forecasts from the field.

The boundary layer winds are derived from the Aviation (AVN) version of the NMC Global Spectral Model (Kanamitsu *et al*, 1991). For the AVN, the data cutoff is at +3 hours and 30 minutes. The lowest sigma layer winds in the AVN (about 45 m) are reduced to 10 m above the surface via a neutrally stable logrithmic reduction in wind speed. These winds are on a 1 X 1 degree grid. The boundary layer winds are then interpolated to each

verification location with a linear scheme and converted from $msec^{-1}$ to knot.

The $h_{1/3}$ guidance is derived from the NOW Model and is interpolated to all the verification locations that have wave observations available. This includes all the buoy locations and 5 C-MAN locations along the east coast.These wave heights are on a 2.5 X 2.5 degree grid. After interpolation, the wave heights are converted from meters to feet. The interpolation is basically a linear scheme, but a land-sea tag must also be employed. Where there are grid points over land, they are filled with data from the closest seaward grid points. This tends to give coastal verification locations an artificially high bias for $h_{1/3}$.

Observations and Elements Verified

Although the verification forecasts from the WSFOs are for points (buoy/C-MAN), they are intended to represent a subset of the appropriate area forecast (coastal/offshore) in space and time. Therefore, five hourly observations, collected at each point and centered (plus or minus 2 hours) on the verification times (Table 3), are used in the verification scheme described below. It is believed that this approach provides verification results that reflect the temporal and spatial format of the operational forecast as well as significant conditions experienced by the mariner.

I. Advisories and Warnings

A. Verified against highest of 5 hourly wind speed observations.

B. Wind speed threshold adjusted by 2 knots due to sensor accuracy.

1) Observed lower threshold for SCA, minus 2 knots verifies advisory (lower threshold set by Regions).
2) Observed upper threshold for no SCA, plus 2 knots verifies no advisory.
3) Observed 32 - 35 knots verifies SCA, Gale Warning, or Tropical Storm Warning.
4) Observed 46 - 49 knots verifies Gale Warning or Storm Warning.
5) Observed 62 - 65 knots verifies Tropical Storm Warning or Hurricane Warning.

C. SCA also verified against highest of 5 hourly significant wave height observations (thresholds set by Regions) when wind speed does not meet minimum criteria.

Note that it is possible for the verification forecast to include an advisory/warning category along with a wind speed less than the lower threshold (adjusted for 2 knot sensor error). This is because the advisory/warning is verified against the highest of the 5 hourly wind speed observations whereas the forecast wind speed is verified against the average of the 5 observations. An example would be expected increasing/decreasing

winds during the 5 hour verification period warranting indication of advisory/warning, yet the average speed is expected to be below threshold.

Note further that SC (Small Craft Advisory) should be indicated in the second verification period (see example coded forecast in Fig. 3) when wind speed or wave height is expected to be above threshold for at least one of the 5 observations. Although this period is beyond the normal 12 hour advisory lead time, its verification in the second period will measure the skill in forecasting conditions that might lead to later advisory issuance.

II. Wind Speed

A. Coded forecast value to nearest knot verified against average of the 5 hourly wind speed observations.

B. Coded forecast value to nearest knot although given to nearest 5 knots in the operational forecast.

C. Wind speed indicated in the verification forecast although, in the operational forecast, speed is not given below threshold for variable direction as set by the Regions.

III. Wind Direction

A. Coded forecast value to nearest 10 degrees at 8 points of the compass verified against the vector resultant of the 5 hourly wind direction observations.

B. Encoded as 99 when forecast is variable based on Regional criteria.

C. Observed *versus* forecast statistics are not calculated when encoded as 99.

IV. Wave Height

A. Coded forecast value to nearest foot verified against average of the 5 hourly significant wave height observations.

B. Coded forecast value is significant wave height of combined wind waves and swell.

C. Encode as 99 for C-MAN stations not reporting waves.

Data Matching and Distribution

Once a day the raw data which go into the matched data set are archived to disk. This includes the coded verification forecasts from the WSFOs, the wind and wave guidance fields, and the buoy/C-MAN observations. These raw data are transferred to tape for permanent archival every 36 days. The raw data fields are interogated in a batch mode between 0900 and 1000 UTC. These times may slip to as late as 1400 UTC without causing any data loss. Collecting the data in this way allows us to match the data for the forecast from the 0000 UTC model cycle yesterday, and the forecast from the 1200 UTC model cycle the day before yesterday. There is a one day lag time in the data match. Because

Table 4: The data are collected from NMC data files which are interrogated daily. Data match ups are shown in Table 5.

Wind Guidance		Wave Guidance		WSFO Forecasts		Buoy/C-MAN Obs	
0000 cycle	1200 cycle	0000 cycle	1200 cycle	Region	cycle & day	hour	day
day 0	day -1	day 0	day -1	E/S	0000 day 0	00-09	day 0
					1200 day -1	10-23	day -1
					0000 day -1		
				W/A/P	1200 day -1		
					0000 day -1		

Note:
1) day 0 refers to interrogation of data sets today between 0900 and 1000 UTC
2) day -1 means yesterday
3) all times or hours are in UTC
4) E, S, W, A, and P mean Eastern, Southern, Western, Alaska, and Pacific Region respectively
5) An interogation window exists from 0900 through 1400 UTC. As long as data are collected within the window no data loss occurs for verification purposes.

of the interrogation time of the raw data, the verification forecasts for the 0000 UTC cycle today are usually not available for the West Coast, Alaska, and Hawaii, but all the forecasts for the 0000 UTC cycle yesterday are available. When they are matched with the verifying observations, we get two sets of matched data for the same verifying date for the East Coast and Gulf of Mexico stations. This leads to some duplicate matched data which are later removed with additional postprocessing. Table 4 shows when the datasets are interrogated and what data are available for matching from each raw data set. Table 5 shows how the data match ups are made.

The data are matched by verification date and sorted by WSFO, cycle time, and projection. Four data sets are maintained: one for each cycle (0000 and 1200 UTC) and projection (18 and 30 hours). From these data sets individual data sets are created for each WSFO. The data sets for the WSFOs have had all duplicate data removed, and, insofar as possible, bad data has been nined out or corrected. These "clean" data are used to develop the national and regional statistics. They are also downloaded to floppy disk for distribution to the individual WSFOs for use in any local verification or training program. Table 6 gives the format and field description of each record on the disk.

Table 5: How data are matched in the National Marine Verification Program. Data contained in each file are shown in Table 4.

Forecast			Verificaton	Data File Identification		
Date	Cycle	projection	Time	Forecast	Guidance	Verifying Observation
day -2	0000	18	1800 day -2	day -1	day -2	day -1
		30	0600 day -1	day -1	day -2	day -1
day -2	1200	18	0600 day -1	day -1	day -1	day -1
		30	1800 day -1	day -1	day -1	day 0
day -1	0000	18	1800 day -1	day -1	day -1	day 0
		30	0600 day 0	day -1	day -1	day 0

Note: 1) In column 1 day refers to the actual day the WSFO forecast was made.
2) In column 4 day refers to the actual day of the verifying observation.
3) In columns 5 - 7 day refers to the day the data file was created.
4) Forecast refers to the official WSFO forecast.
5) Guidance means products sent to the WSFOs from NMC.

PLANNED ENHANCEMENTS

As the modernization of the NWS continues the NMVP will be expanded and redefined to include all Weather Forecast Offices (WFO) with marine responsibility. Currently offices with Great Lakes responsibility are not included in the program. As the program evolves, they will also be brought into it.

The $h_{1/3}$ guidance from the GMEX Model and the GAKWAV Model will be included for comparison at the applicable verification locations later in 1993. The grid mesh length for both models is 30 n mi. Instead of interpolating the value of $h_{1/3}$ at the surrounding grid points, the value at the grid point nearest the verification location will be used to represent the wave height at the location.

Wind direction and speed forecasts from the Coastal Wind Forecast System and the Santa Ana Forecast System will also be added to the NMVP. These statistical wind forecast guidance systems give forecasts at most of the verification locations. No interpolation is necessary. They are based on model output from the Regional Analysis and Forecast System (RAFS) (NWS, 1985) and are at 6 hour intervals from 6- through 48-h. There is no similar wave prediction system, so only the winds will be compared.

Finally, after the 40 km version of the ETA model is implemented, regional wind forecasts will be added to the NMVP. This model's grid covers the coastal and offshore areas of the conterminous United States and part of Alaska. All stations, except 46035 in the Alaska Region and all Pacific Region stations, will have forecast guidance from this version of the ETA model. The wind direction and speed will be obtained from the gridpoint nearest the verification location.

Acknowledgements. We are indebted to D. B. Rao and W. Gemmill for their helpful comments during the writing of this paper. We are also grateful to P. Jacobs and P. Polger of the Office of Meteorology for their encouragement and interest while the NMVP was getting underway and for their thoughtful comments during the writing of the paper.

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Table 6: Explanation of format used for matched data set downloaded to each WSFO. The record length for each record is 140 ASCII characters.

FORMAT FOR MATCHED DATA		
$xxxxxiiijjjjyymmddhhhh_1dddfffHHhhhh_2dddfffHHhhhh_3dddfffHHhhhh_4dddfffHHhhhh_5ddd$ $fffHHDDDFFFFHHHHWSFOFnnCCPPdddfffHHWWdddfffHHdddfffHHdddfff$ $dddfffHH$		
$xxxxx$:	01 buoy/C-MAN station id.	
iii:	02 station latitude 000 to 900 to nearest 0.1°	
$jjjj$:	03 station longitude 0000 to 3600 east to west to 0.1°	
$yymmdd$:	04 verifying date:	yy - year minus 1900
		mm - month
		dd - day
$hhhh_1$:	05 time of first observation	1600 UTC for 0000 cycle 18-h proj
		0400 UTC for 0000 cycle 30-h proj
		0400 UTC for 1200 cycle 18-h proj
		1600 UTC for 1200 cycle 30-h proj
ddd:	06 observed wind direction 000-360 to nearest 10°	
fff:	07 observed wind speed 000-199 to nearest knot	
HH:	08 observed wave height 00-97 to nearest foot	
$hhhh_2$:	09 time of second observation	1700 UTC for 0000 cycle 18-h proj
		0500 UTC for 0000 cycle 30-h proj
		0500 UTC for 1200 cycle 18-h proj
		1700 UTC for 1200 cycle 30-h proj
ddd:	10 observed wind direction 000-360 to nearest 10°	
fff:	11 observed wind speed 000-199 to nearest knot	
HH:	12 observed wave height 00-97 to nearest foot	
$hhhh_3$:	13 time of third observation	1800 UTC for 0000 cycle 18-h proj
		0600 UTC for 0000 cycle 30-h proj
		0600 UTC for 1200 cycle 18-h proj
		1800 UTC for 1200 cycle 30-h proj
ddd:	14 observed wind direction 000-360 to nearest 10°	
fff:	15 observed wind speed 000-199 to nearest knot	
HH:	16 observed wave height 00-97 to nearest foot	
$hhhh_4$:	17 time of fourth observation	1900 UTC for 0000 cycle 18-h proj
		0700 UTC for 0000 cycle 30-h proj
		0700 UTC for 1200 cycle 18-h proj
		1900 UTC for 1200 cycle 30-h proj
ddd:	18 observed wind direction 000-360 to nearest 10°	
fff:	19 observed wind speed 000-199 to nearest knot	
HH:	20 observed wave height 00-97 to nearest foot	
$hhhh_5$:	21 time of fifth observation	2000 UTC for 0000 cycle 18-h proj
		0800 UTC for 0000 cycle 30-h proj
		0800 UTC for 1200 cycle 18-h proj
		2000 UTC for 1200 cycle 30-h proj
ddd:	22 observed wind direction 000-360 to nearest 10°	
fff:	23 observed wind speed 000-199 to nearest knot	
HH:	24 observed wave height 00-97 to nearest foot	
DDD:	25 Average Wind Direction to nearest degree	
$FFFF$:	26 Average Wind Speed to nearest 0.1 knot	

FORMAT FOR MATCHED DATA CONTINUED

HHHH:	27 Average Wave Height to nearest 0.1 foot
WSFO:	28 WSFO identifier
Fnn:	29 Forecaster identifier
CC:	30 cycle 00/12 UTC
PP:	31 projection 18/30-h
ddd:	32 WSFO forecast wind direction 000-360 to nearest 10°
fff:	33 WSFO forecast wind speed 000-199 to nearest knot
HH:	34 WSFO forecast wave height 00-97 to nearest foot
WW:	35 WSFO forecast warning category: -1 = none -2 = Small Craft Advisory -3 = Gale -4 = Storm -5 = Tropical Storm -6 = Hurricane
ddd:	36 MPB global boundary layer wind direction to nearest degree
fff:	37 MPB global boundary layer wind speed to nearest knot
HH:	38 MPB NOW Model wave height to nearest foot
ddd:	39 reserved for future use
fff:	40 reserved for future use
HH:	41 reserved for future use
ddd:	42 reserved for MPP wind direction to nearest 10°
fff:	43 reserved for MPP wind speed to nearest knot
ddd:	44 reserved for regional model (ETA) wind direction to nearest degree
fff:	45 reserved for regional model (ETA) wind speed to nearest knot
HH:	46 regional model (GMEX/GAKWAV) wave height to nearest foot

Notes:
1) A missing observation time is given as 9999
2) A missing wind direction observation/forecast/guidance is given as 999
3) A missing wind speed observation/forecast/guidance is given as 999
4) A WSFO variable wind direction forecast is also given as 999
5) Field numbers 39 - 46 are currently filled with 9s. A future enhancement will add these to the data set. The MPP data are from the coastal/Santa Ana forecast systems for the buoy/C-MAN stations where guidance exists. There are no corresponding wave forecasts, so no comparisons are possible. The regional wind forecasts will be from the ETA model when a stable version is available. The regional wave guidance will make use of the particular model output for a given area, *i.e.* GMEX for Gulf of Mexico stations, or GAKWAV for Gulf of Alaska stations. Currently, the regional wind guidance is from the global boundary wind guidance which is used to drive both regional wave models. When implemented, the regional wind guidance will be from the 40 km ETA Model which will be used for most coastal areas, except for Hawaii and the western most coasts of Alaska.

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