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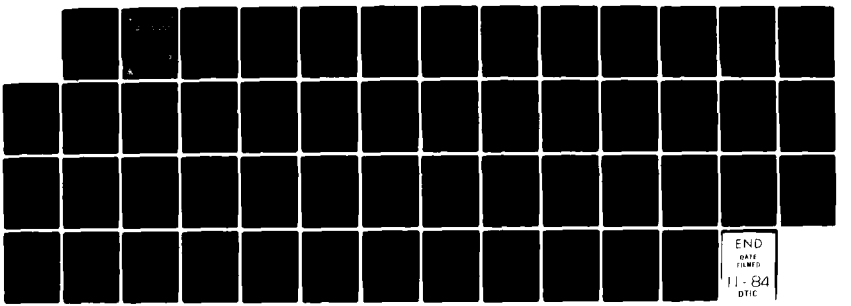

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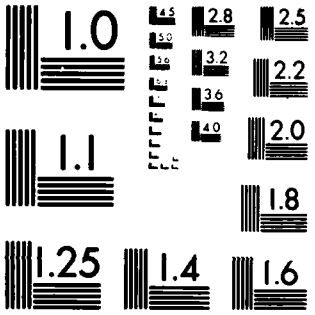

NAVENVPREDRSCHFAC
TECHNICAL REPORT
TR 84-09

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NAVENVPREDRSCHFAC TR 84-09

DOCUMENTATION GUIDE FOR SHIPBOARD NUMERICAL AID PROGRAMS (SNAP)

ENS Robert A. Wimmer, USNR, and Terry Brown
Naval Environmental Prediction Research Facility

JULY 1984

NAVAL ENVIRONMENTAL PREDICTION RESEARCH FACILITY
MONTEREY, CALIFORNIA 93943

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Users guide
GFMPL (Geophysics Fleet Mission Program Library)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Guidelines for documenting applications software are given. These guidelines include users guide format and examples of program submittal forms used by the Geophysical Fleet Mission Program Library (GFMPL).

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601

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CONTENTS

1. INTRODUCTION

1.1 PURPOSE

This document establishes documentation guidelines for all Shipboard Numerical Aid Programs (SNAP). It includes guidance for writing a SNAP user's manual and for completing the Geophysics Fleet Mission Program Library (GFMPL) program submittal forms. This latter guidance is taken from reference (1). The completed submittal forms are then incorporated into reference (2).

Since the internal documentation of program source code with comments is covered in reference (3), this document does not address that subject.

2. REFERENCES

(1) NAVOCEANCOM Instruction 5232.1C, 29 September 1983.

(2) Geophysics Fleet Mission Program Library (GFMPL) HP-9845 DTC User's Manual, Naval Oceanographic Office and Naval Oceanography Command, February 1983.

(3) Programming Guide for Shipboard Numerical Aid Programs (SNAP), Naval Environmental Prediction Research Facility, TR 84-06, June 1984.

3. USER'S MANUAL GUIDELINES

Although section B of the GFMPL submittal forms functions as a user's manual once the SNAP is incorporated into the GFMPL, a separate user's manual for the SNAP is needed during the test and evaluation (TE) phase of program development. Guidance for such a TE manual is given below. Once TE is complete, this user's manual shall be reformatted on the GFMPL submittal forms since much of the same information is required in both documents.

A SNAP TE user's manual shall contain the following sections:

(1) Table of Contents
(2) Descriptive Overview
(3) Sample Run
(4) Program Characteristics
(5) Error Handling
(6) Appendices
(7) Index

These sections are described below.

3.1 TABLE OF CONTENTS

List all numbered sections and subsections and their page numbers.

3.2 DESCRIPTIVE OVERVIEW

This section of the user's manual will become the Abstract and Tactical Application sections of the GFMPL forms.

Summarize the purpose of the program, the methodology used to accomplish the purpose, the tactical application, and the geographical region of applicability.

Give the type and source of the input data, and the approximate time required to run the program. State on which model and option of the HP9845 the program will run.

3.3 SAMPLE RUN

This section of the user's manual is similar to the Example and Instructions sections of the GFMPL forms.

Describe where to insert the tape cartridge(s) and how to load and execute the program. Illustrate a typical application of the program with a sample run. The sample run shall consist of an execution listing and corresponding output products. An execution listing is made by:

(1) depressing the PRTALL key
(2) typing PRINTALL IS 0
(3) pressing the EXECUTE key.

This will produce a hard copy of all the prompts displayed during the sample run and the user's responses. Show the program output at the appropriate location in the execution listing. Identify program prompts with a 1/8 inch black dot. An example of a sample run is shown in Figure 1.

```
●ENTER LOCATION OF DATA: DD.MM(N OR S) / DDD.MM(E OR W) - use no commas
 37.50N/163.20E
●ENTER DATE/TIME OF DATA (EXAMPLE: 26 JAN 80/1200Z)
 22 JUN 84 1200Z
●ENTER D-VALUE INCREMENT IN FEET OR METERS (EXAMPLE: 500,F OR 200,M)
 200,M
●PRESS CONT WHEN READY TO PROCEED>

●WILL YOU BE ENTERING HEIGHTS IN FEET OR METERS (F OR M)?
 M
●ENTER PRESSURE(mb) AND HEIGHT(meters).(EXAMPLE: 850,1570) OR END (E)
 1002,16
●ENTER PRESSURE(mb) AND HEIGHT(meters).(EXAMPLE: 850,1570) OR END (E)
 850,1348
●ENTER PRESSURE(mb) AND HEIGHT(meters).(EXAMPLE: 850,1570) OR END (E)
 700,2889
●ENTER PRESSURE(mb) AND HEIGHT(meters).(EXAMPLE: 850,1570) OR END (E)
 500,5440
●ENTER PRESSURE(mb) AND HEIGHT(meters).(EXAMPLE: 850,1570) OR END (E)
 E
●ANY CORRECTIONS (Y OR N)?
 N
●FOR HARD COPY TYPE `Q' AND PRESS `CONT', OTHERWISE JUST PRESS `CONT'
 Q
 LOCATION :  37.50N/163.20E
 DATE/TIME:  22 JUN 84 1200Z
 D-VALUE INCREMENT:  200 METERS

  HEIGHT  (M)       D-VALUE (+ OR - M)

       0 M              -74
     200 M              -82
     400 M              -89
     600 M              -95
     800 M              -99
    1000 M             -103
    1200 M             -107
    1400 M             -109
    1600 M             -113
    1800 M             -117
    2000 M             -121
    2200 M             -123
    2400 M             -125
    2600 M             -125
    2800 M             -125
    3000 M             -123
    3200 M             -129
    3400 M             -135
    3600 M             -140
    3800 M             -144
    4000 M             -147
    4200 M             -149
    4400 M             -150
    4600 M             -149
    4800 M             -148
    5000 M             -146
    5200 M             -143
    5400 M             -139

●DO YOU WANT ANOTHER COPY (Y or N)?
 N
●WANT TO CHANGE THE INCREMENT VALUE OR UNITS FOR THE D-VALS JUST COMPUTED (Y/N)?
 N
●DO YOU WANT TO DO ANOTHER D-VALUE COMPUTATION (Y OR N)?
 N
```

Figure 1. Sample run. Black dots identify program prompts.

3.4 PROGRAM CHARACTERISTICS

This section of the user's manual is similar to the Operating Guidelines, Instructions and Keys sections of the GFMPL forms.

3.4.1 Capabilities

Describe any unique features or functions of the program; for example, map projection zoom, tape storage of input data, or multiple ship and storm plotting.

List any special function key(s) definitions.

3.4.2 Assumptions

Describe major assumptions; for example, units of measurement, data precision, homogeneous or adiabatic conditions.

3.4.3 Limitations.

Describe any constraints on the input data; for example, the maximum or minimum number of observations or allowable ranges of values. Summarize the sensitivity of the program to inaccurate or imprecise input data. Describe any latitude and longitude limitations or map projection distortion. List any special cases which the program can not handle. Describe any interdependence of the various program functions, options, modes, and overlays; for example, a program consists of six functions (F1,F2,...,F6). F1,F2 and F3 can run be independently but F4,F5 and F6 require that F3 be run first.

3.5 ERROR HANDLING

This section of the user's manual contains information that shall be included in the Operating Guidelines section of the GFMPL forms.

List all program error messages and describe the corrective action needed. Describe data editing procedures.

A blank SNAP Evaluation Sheet shall be included as Appendix D of the SNAP user's manual and the user shall be directed to use this form to report any trouble with the SNAP or user's manual. An evaluation sheet is supplied in Appendix D of this document.

3.6 APPENDICES

Appendices A,B,C and D below are required in each SNAP user's manual, while E and F are included if necessary:

A - Glossary of terms and acronyms
B - HP9845 data cartridge information, including the procedure to convert a data format tape to a program format tape
C - References
D - SNAP Evaluation Sheet
E - Additional output examples
F - More detailed description of the program's methodology. This appendix is similar to the Discussion and Analysis section of the GFMPL forms.

3.7 INDEX

The index shall list alphabetically the user's manual page number for the various topics, functions, input, products and procedures of the SNAP.

4. GFMPL SUBMITTAL FORMS

Since the SNAPs are to be included in the GFMPL, each program shall be documented in accordance with reference (1) and GFMPL program submittal forms shall be completed for each SNAP. If available, a Program Performance Specification (PPS) shall supplement the GFMPL submittal forms.

The developer of each SNAP shall complete the GFMPL forms as described in Appendix A of this document, which reproduces the guidance of reference (1). Samples of completed and blank program submittal forms are included in Appendices B and C respectively.

A tape cartridge containing program source code shall accompany the GFMPL forms and user's manual. Forward all SNAP's material to:

Commanding Officer
Naval Environmental Prediction Research Facility
ATTN: SNAP 6.2-34
Monterey, CA 93943

APPENDIX A

GFMPL SUBMITTAL FORMS - INSTRUCTIONS

COMMANDER NAVAL OCEANOGRAPHY COMMAND

GEOPHYSICS FLEET MISSION PROGRAM LIBRARY

PROGRAM SUBMITTAL FORM

IDENTIFICATION NUMBER/MOD leave blank

I. ( ) SUMMARY

A. ( ) PROGRAM TYPE: Check applicable category

___METEOROLOGY
___GEOLOGY
___PHYSICAL OCEANOGRAPHY
___GRAVITY
___MAGNETICS
___ACOUSTICS
___REMOTE SENSING
___HYDROGRAPHY
___OTHER (list type)

B. ( ) PROGRAM CLASSIFICATION: Enter overall security classification

C. ( ) PROGRAM TITLE: Use concise, descriptive, unclassified key words. Use no more than 46 characters.

D. ( ) DATE: EFFECTIVE Submittal date CANCELLED leave blank

E. ( ) COMMAND: ORIGINATOR Author's command
CONTROL Naval Oceanographic Office
CONTACT Author's name TEL. Commerical and Autovon

F. ( ) TACTICAL REFERENCES:

1. ( ) TITLE List only if applicable (Tactical programs require NWP reference)

REPORT NO. ___ ORIGINATOR ___
DATE ___ FTL ACC. NO. Fleet Tactical Library Numbe

2. ( ) TITLE ___

REPORT NO. ___ ORIGINATOR ___
DATE ___ FTL ACC. NO. ___

G. ( ) APPLICATION:

EQUIPMENT HP-9845 or HP-9845B Option 275 if so limited
SOFTWARE/LANGUAGE HP BASIC

H. ( ) STORAGE MEDIA:

___MAGNETIC CARDS ___MAGNETIC TAPE ___MAGNETIC DISKETTE
X CASSETTE ___MAGNETIC CARTRIDGE ___OTHER

I. ( ) PLATFORM: Check all applicable categories

___SHORE-BASED PATROL AIRCRAFT ___TACTICAL AIRCRAFT ___SHORE ACTIVITIES
___CARRIER-BASED ASW AIRCRAFT ___SURFACE SHIP ___ALL FLEET UNITS
___ROTARY WING AIRCRAFT ___SUBMARINE

IDENTIFICATION NUMBER/MOD Leave blank

J. ( ) TACTICAL APPLICATION

Describe the situations in which the program should be used, including those in which the program is most effective. Describe any limits to the program's tactical use.

K. ( ) ABSTRACT

Summarize:

- Purpose of the program.
- How this purpose is accomplished (methodology).
- Expected results and their accuracy.

Explain the theoretical background of the program and the need it fills. Cite any prerequisite programs.

IDENTIFICATION NUMBER/MOD Leave blank

B. ( ) USER INSTRUCTIONS

KEY INSTRUCTIONS
Note the repetitive use of a single key. For example, using the CONT key to enter a response to a program generated prompt. Define each special function key(s) used by the program.

STEP	INSTRUCTIONS
	Provide detailed, step-by-step instructions for program execution. List each prompt as it appears on the screen. Describe the operator action associated with each prompt. Include a description of the options available to the user. This section shall function as a user's guide.

IDENTIFICATION NUMBER/MOD Leave blank

II. ( ) OPERATING GUIDELINES

A. ( ) GENERAL GUIDELINES AND LIMITATIONS

Describe aspects of the program that will help the user enter data, understand the output and recognize program limitations.

Points to cover are:

- Special input rules or formats.
- Output peculiarities such as differing output modes or special output formats.
- Describe possible errors. Consider cases where the accuracy of the results is particularly error sensitive. Note which operations of the program are most likely to introduce errors.
- Describe special cases which will not compute.
- Describe each input and output parameter.

IDENTIFICATION NUMBER/MOD Leave blank

B. ( ) USER INSTRUCTIONS (CONT'D)

STEP	INSTRUCTIONS
	Use continuation sheets as needed.

IDENTIFICATION NUMBER/MOD Leave blank

C.( ) EXAMPLE

Provide a set of realistic input values and an actual example of the program output including graphic displays. More than one example may be given for clarity and to demonstrate multiple options.

IDENTIFICATION NUMBER/MOD Leave blank

C. ( ) EXAMPLE (CONT'D)

Use continuation sheets as needed.

IDENTIFICATION NUMBER/MOD Leave blank

III. ( ) PROGRAM DOCUMENTATION

A. ( ) DISCUSSION/ANALYSIS

Describe the algorithms and their derivations used in the program. If these are available in reference publications, then it is sufficient to list the algorithms and cite the reference. These references shall be listed in section III B. of this document and cited by number, e.g. reference (1), etc.

Describe the mathematical calculations performed.

Explanations of program logic, including flow charts, are appropriate.

Describe the accuracy of each approximation or assumption made in the program.

Use blank pages for continuation sheets.

IDENTIFICATION NUMBER/MOD Leave blank

B. ( ) TECHNICAL REFERENCES

List those references containing material used for the formulation and implementation of the program.

APPENDIX B

GFMPL SUBMITTAL FORMS - SAMPLES

COMMANDER NAVAL OCEANOGRAPHY COMMAND

GEOPHYSICS FLEET MISSION PROGRAM LIBRARY

PROGRAM SUBMITTAL FORM

IDENTIFICATION NUMBER/MOD CNOC U71006

I. (U) SUMMARY

A. (U) PROGRAM TYPE:

X METEOROLOGY	___ MAGNETICS
___ GEOLOGY	___ ACOUSTICS
___ PHYSICAL OCEANOGRAPHY	___ REMOTE SENSING
___ GRAVITY	___ HYDROGRAPHY
	___ OTHER

B. (U) PROGRAM CLASSIFICATION: Unclassified

C. (U) PROGRAM TITLE: METBAL (Shipboard Gunfire Ballistics)

D. (U) DATE: EFFECTIVE 1 Apr 1983 CANCELLED ___

E. (U) COMMAND: ORIGINATOR Naval Environmental Prediction Research Facility

CONTROL Naval Oceanographic Office

CONTACT NAVOCEANO (Code 9200) TEL. (601) 688-4270

AV 485-4270

F. ( ) TACTICAL REFERENCES:

1. ( ) TITLE ___

REPORT NO. ___ ORIGINATOR ___

DATE ___ FTL ACC. NO. ___

2. ( ) TITLE ___

REPORT NO. ___ ORIGINATOR ___

DATE ___ FTL ACC. NO. ___

G. (U) APPLICATION:

EQUIPMENT HP-9845B Option 275

SOFTWARE/LANGUAGE HP BASIC

H. (U) STORAGE MEDIA:

___ MAGNETIC CARDS	___ MAGNETIC TAPE	___ MAGNETIC DISKETTE
X CASSETTE	___ MAGNETIC CARTRIDGE	___ OTHER

I. (U) PLATFORM:

___ SHORE-BASED PATROL AIRCRAFT	___ TACTICAL AIRCRAFT	X SHORE ACTIVITIES
___ CARRIER-BASED ASW AIRCRAFT	X SURFACE SHIP	___ ALL FLEET UNITS
___ ROTARY WING AIRCRAFT	___ SUBMARINE	

IDENTIFICATION NUMBER/MOD CNOC U71006

J. (U) TACTICAL APPLICATION

Ballistic correction factors are used by gunfire support personnel to correct for current or forecast atmospheric conditions. These correction factors are required in order to obtain close hits with initial firings of naval guns.

K. (U) ABSTRACT

The Shipboard Gunfire Ballistics program (which was derived from the SNAP 8.0 program developed by NEPRF) uses upper-air environmental data to compute and output ballistic winds and ballistic density correction factors. Ballistic winds and ballistic density correction factors are output for surface-to-surface firing for less than 16 inch weapons, surface-to-air firing for less than 16 inch weapons, and surface-to-surface firing for MK58-0 RAP (Rocket Assisted Projectile) 5"/54 weapons. Ballistic density correction factors are output for both U.S. Navy and NATO gunfire support. This document describes the operating guidelines, tactical applications, and limitations of the Shipboard Gunfire Ballistics program. An overview of the program's major functions and main equations is also provided.

II. (U) OPERATING GUIDELINES

A. (U) GENERAL GUIDELINES AND LIMITATIONS

While running the Shipboard Gunfire Ballistics program, the primary function of the operator is to provide data entry. The program allows for variations in the input data formats and units; this allows for input data to be taken from local observations, rawinsonde messages, upper-air analyses or upper-air forecast charts. Gross error checks are performed during data entry, and error messages are displayed when necessary. After entering a set of data the operator is given the opportunity to correct any errors that may have been made.

Data entry is limited to 50 levels of thermodynamic parameters and 50 wind levels. The accuracy of the ballistic winds and the ballistic density correction factors is a function of the accuracy and resolution of the input data only. Ballistic data will only be output to the zone through which the highest environmental data are available.

8. (U) USER INSTRUCTIONS

KEY INSTRUCTIONS
Press CONT key to enter response following each prompt. No special function keys are defined for the Shipboard Gunfire Ballistics program.

STEP	INSTRUCTIONS
1	Insert Shipboard Gunfire Ballistics tape in T15. Depress AUTOST key. Turn machine on. CRT PROMPT: "OPTIONS Execute METBAL program 1 Generate METBAL INPUT DATA FORM 2 SELECT OPTION" If response is 2 go to step 31.
2	CRT TEXT DISPLAY: Summary of program input and output data. CRT PROMPT: "TO PROCEED - PRESS 'CONT' "
3	CRT TEXT DISPLAY: Instructions describing program inputs.
4	CRT PROMPT: "ENTER LAT, LONG LOCATION OF FIRING (EXAMPLE: 15.3 N, 162.5 E)"
5	CRT PROMPT: "ENTER DAY OF THE MONTH (1 THRU 31)"

B. (U) USER INSTRUCTIONS (CONT'D)

STEP	INSTRUCTIONS
6	CRT PROMPT: "ENTER BEGINNING TIME OF BALLISTIC FORECAST (EXAMPLE: 1200) [DEFAULT=0000]"
7	CRT PROMPT: "ENTER DURATION OF FORECAST PERIOD IN WHOLE HOURS (1 THRU 12) [DEFAULT=4]"
8	CRT PROMPT: "ENTER NAME OF SHIP OR STATION (UP TO 20 CHAR)"
9	CRT PROMPT: "CHECK INPUT - IF OK PRESS 'CONT' - OTHERWISE ENTER NOGO" If response is NOGO go to step 3.
10	CRT PROMPT: "DATA FORMAT FOR BALLISTIC CALCULATIONS YOU MAY SUPPLY DATA IN 2 FORMATS: 1 UPPER AIR SOUNDING (SFC, SIGNIFICANT, MANDATORY LEVELS) 2 STANDARD LEVELS [DEFAULT] - (SFC, 850 mb, 700 mb, 500 mb, ETC) ENTER DATA FORMAT, BY NUMBER (1 OR 2) [DEFAULT=2]"
11	CRT TEXT DISPLAY: Data input instructions. CRT PROMPT: "TO PROCEED - PRESS 'CONT' "
12	CRT PROMPT: "THE STATION HT OR RADIOSONDE RELEASE ALTITUDE IS THE FIRST DATA ENTRY. SELECT UNITS FOR ENTERING HT OR RELEASE ALTITUDE. 1 - METERS [DEFAULT] 2 - FEET OR END TO BY-PASS BALLISTIC DENSITY COMPUTATIONS ENTER 1 FOR METERS [DEFAULT]. 2 FOR FEET - (OR END)" If response is END go to step 21.
13	CRT PROMPT: "ENTER STATION HT OR RELEASE ALTITUDE [DEFAULT=0]"
14	CRT PROMPT: "ENTER SEA LEVEL PRESSURE (mb)"
15	CRT TEXT DISPLAY: Instructions for selecting method of entering humidity. CRT PROMPT: "ENTER 1 FOR DEW PT., 2 FOR DEW PT. DEPRESSION [DEFAULT=2]" If response is 1 and response to step 10 (data format) is 1 go to step 16. If response is 1 and response to step 10 is 2 go to step 17.

B. (U) USER INSTRUCTIONS (CONT'D)

STEP	INSTRUCTIONS
	If response is 2 and response to step 10 is 1 go to step 18. If response is 2 and response to step 10 is 2 go to step 19.
16	CRT PROMPT: "ENTER PRESS, TEMP, DEW PT (OR END) FOR LEVEL ___" Prompt repeats until response is END. Go to step 20.
17	CRT PROMPT: "ENTER PRESS, TEMP, DEW PT, HEIGHT (OR END) FOR LEVEL ___" Prompt repeats until response is END. Go to step 20.
18	CRT PROMPT: "ENTER PRESS, TEMP, DEW PT DEP (OR END) FOR LEVEL ___" Prompt repeats until response is END. Go to step 20.
19	CRT PROMPT: "ENTER PRESS, TEMP, DEW PT DEP, HEIGHT (OR END) FOR LEVEL ___" Prompt repeats until response is END.
20	CRT PROMPT: "CHECK INPUT DATA - IF OK PRESS 'CONT' - OTHERWISE ENTER NOGO" If response is NOGO go to step 12. Otherwise go to step 22.
21	CRT MESSAGE: "END HAS BEEN ENTERED SIGNIFYING NO BALLISTIC DENSITY INPUT. BALLISTIC DENSITY COMPUTATIONS BY-PASSED" CRT PROMPT: "TO PROCEED - PRESS 'CONT' "
22	CRT TEXT DISPLAY: DATA INPUT INSTRUCTIONS CRT PROMPT: "TO PROCEED - PRESS 'CONT' " If data is entered at standard levels go to step 24.
23	CRT PROMPT: "SELECT UNITS FOR ENTERING HEIGHTS: 1 - METERS [DEFAULT] 2 - FEET OR END TO BY-PASS BALLISTIC WIND COMPUTATIONS ENTER 1 FOR METERS [DEFAULT], 2 FOR FEET - (OR END)" If response is END go to step 28.
24	CRT PROMPT: "SELECT UNITS FOR ENTERING WIND SPEED: 1 - METERS/SECOND

B. (U) USER INSTRUCTIONS (CONT'D)

STEP	INSTRUCTIONS
	2 - KNOTS [DEFAULT] OR END TO BY-PASS BALLISTIC WIND COMPUTATIONS ENTER 1 FOR M/S, 2 FOR KTS [DEFAULT] - (OR END)" If response is END go to step 28. If data is entered at standard levels go to step 26.
25	CRT PROMPT: "ENTER HT, WIND DIR, AND SPD (OR END) FOR LEVEL ___" Prompt repeats until response is END. Go to step 27.
26	CRT PROMPT: "ENTER ___ LEVEL WIND DIR, SPD (OR END)" Prompt repeats until response is END or until data has been input for every level.
27	CRT PROMPT: "CHECK INPUT DATA - IF OK PRESS 'CONT' - OTHERWISE ENTER NOGO" If response is NOGO go to step 25 or 26. Otherwise, go to step 29.
28	CRT MESSAGE: "END HAS BEEN ENTERED SIGNIFYING NO BALLISTIC WIND INPUT. BALLISTIC WIND COMPUTATIONS BY-PASSED"
29	CRT PROMPT: "METBAL PRINT OPTIONS 1 - INPUT DATA LISTING 2 - BALLISTIC DENSITY AND WIND CORRECTION FACTORS 3 - BALLISTIC MESSAGES (U.S. NAVY AND NATO) 4 - ALL OF THE ABOVE [DEFAULT] 5 - NONE OF THE ABOVE (TERMINATES PROGRAM) SELECT DESIRED OPTION BY NUMBER (1 THRU 5) ENTER PRINT OPTION BY NUMBER (1 THRU 5) [DEFAULT=4]" THERMAL PRINTER OUTPUT: OPTION SELECTED ABOVE Prompt repeats until response is 5.
30	CRT MESSAGE: "METBAL PROGRAM COMPLETE"
31	CRT MESSAGE: "METBAL INPUT DATA FORM GENERATOR. TO PRODUCE HARD COPY OF FORM, PROCEED AS PROMPTED. ENSURE PAPER IS AT TOP OF FORM."

B. (U) USER INSTRUCTIONS (CONT'D)

STEP	INSTRUCTIONS
32	CRT PROMPT: "ENTER NUMBER OF LEVELS OF DATA ON FORM [MIN=10, DEFAULT=30, MAX=50] - PRESS 'CONT' "
33	THERMAL PRINTER OUTPUT: METBAL INPUT DATA FORM
34	CRT MESSAGE: "FORM GENERATION COMPLETE"
35	CRT PROMPT: "OPTIONS GENERATE ANOTHER FORM 1 EXECUTE METBAL PROGRAM 2 STOP 3 SELECT OPTION" If response is 1 go to step 32. If response is 2 go to step 2. If response is 3 program terminates.

IDENTIFICATION NUMBER/MOD CNOC U71006

C. (U) EXAMPLE

METBAL INPUT DATA

LOCATION; 14.5N, 123.1E
FORECAST PERIOD: 12 HR FCST BEGINNING 230000Z
PREPARED BY: SHIP

LEVEL	PRESS	TEMP	DEW PT	DP DEP	LEVEL	HEIGHT(m)	DIR SPD(kts)
1	1000.0	4.0	3.5	.5	1	20	330 008
2	850.0	2.0	-6.8	8.8	2	1350	250 023
3	700.0	-7.2	-7.8	.6	3	2890	225 035
4	500.0	-22.7	-29.8	7.1	4	5440	225 065
5	400.0	-33.8	-39.8	6.0	5	7400	220 080
6	300.0	-49.5	-79.5	30.0	6	8990	220 080
7	200.0	-57.3	-87.3	30.0	7	11580	230 090
8	100.0	-59.0	-89.0	30.0	8	15910	250 065
9	70.0	-60.6	-90.6	30.0	9	18130	250 055

SAMPLE OUTPUT OF OPTION 1 - INPUT DATA LISTING

C. (U) EXAMPLE (CONT'D)

BALLISTIC CORRECTION FACTORS

LOCATION: 14.5N, 123.1E
FORECAST PERIOD: 12 HR FCST BEGINNING 230000Z
PREPARED BY: SHIP

BALLISTIC DENSITY CORRECTION FACTORS

U.S. NAVY

ZONE	SFC TO SFC 16 INCH*	SFC TO SFC <16 IN	SFC TO AIR <16 IN	SFC TO SFC RAP
1	104.0	104.0	104.0	104.0
2	103.6	103.8	103.9	103.8
3	103.0	103.5	103.6	103.3
4	102.3	103.2	103.4	103.0
5	102.0	103.0	103.2	102.8
6	102.0	102.8	103.0	102.6
7	101.7	102.6	102.8	102.4
8	101.5	102.3	102.7	102.2
9	101.3	102.2	102.6	102.1
10	101.1	101.6	102.3	101.6
11	100.5	100.8	101.8	100.9
12	97.5	99.6	101.4	99.6
13		98.1	100.7	98.2
14		97.1	99.8	
15		96.2	98.9	

NATO

ZONE	MEAN DENSITY RATIO(%)	SFC TO SFC <16 IN	SFC TO AIR <16 IN	SFC TO SFC RAP
1	102.1	102.1	102.1	102.1
2	101.6	101.8	101.9	101.7
3	100.8	101.3	101.6	101.2
4	99.9	100.9	101.3	100.7
5	99.5	100.6	101.0	100.4
6	99.3	100.2	100.6	100.0
7	98.9	99.9	100.3	99.7
8	98.7	99.6	100.1	99.5
9	98.7	99.5	99.9	99.4
10	98.8	99.3	99.7	99.4
11	98.9	99.2	99.5	99.3
12	96.8	98.9	99.5	98.9
13	97.1	98.8	99.3	98.9
14	97.2	98.8	99.1	
15	97.4	98.8	99.0	

BALLISTIC WIND CORRECTION FACTORS

U.S. NAVY-NATO

ZONE	MEAN WIND*	SFC TO SFC <16 IN	SFC TO AIR <16 IN	RAP CROSS WIND	RAP RANGE WIND
1	325/009	325/009	325/009	325/009	325/009
2	310/012	312/011	316/010	312/011	312/011
3	286/016	292/014	301/012	292/014	291/015
4	257/022	269/017	286/014	274/016	268/018
5	244/026	254/021	274/015	263/018	254/021
6	231/032	239/026	256/019	246/023	238/027
7	225/042	232/033	245/023	238/027	230/035
8	225/054	229/040	239/027	234/031	228/043
9	225/065	228/046	235/031	233/033	227/051
10	221/076	224/060	230/040	231/037	223/063
11	221/081	223/064	227/047	229/043	223/067
12	228/087	225/068	228/047	236/042	225/071
13	237/092	228/068	228/052	248/036	230/072
14	246/070	230/066	229/054		
15	250/060	231/064	231/056		

* UNWEIGHTED - USE FOR 16 INCH GUNFIRE

SAMPLE OUTPUT OF OPTION 2 - BALLISTIC DENSITY AND WIND CORRECTION FACTORS

C. (U) EXAMPLE (CONT'D)

```
12HR S S BALLISTIC FCST
COMMENCING 230000Z
ZONE      14.5N123.1E
 1       325/09/040/3
 2       312/11/038/9
 3       292/14/035/6
 4       269/17/032/0
 5       254/21/030/7
 6       239/26/028/2
 7       232 33/026/1
 8       229/40/023/2
 9       228/46/022/6
10       224/60/016/1
11       223/64/008/5
12       225/68/996/7
13       228/68/981/4
14       230/66/971/4
15       231/64/962/3

12HR S/A BALLISTIC FCST
COMMENCING 230000Z
ZONE      14.5N123.1E
 1       325/09/040/3
 2       316/10/039/3
 3       301/12/036/6
 4       286/14/034/8
 5       274/15/032/4
 6       256/19/030/6
 7       245/23/028/6
 8       239/27/027/2
 9       235/31/026/2
10       230/40/023/4
11       227/47/018/1
12       228/47/014/8
13       228/52/007/6
14       229/54/998/8
15       231/56/989/3

12HR RAP BALLISTIC FCST COMMENCING 230000Z
ZONE      14.5N123.1E
 1       325/09/325/09/040/2
 2       312/11/312/11/038/7
 3       292/14/291/15/033/2
 4       274/16/268/18/030/8
 5       263/18/254/21/028/4
 6       246/23/238/27/026/7
 7       238/27/230/35/024/1
 8       234/31/228/43/022/6
 9       233/33/227/51/021/4
10       231/37/223/63/016/9
11       229/43/223/67/009/9
12       236/42/225/71/996/8
13       248/36/230/72/982/6

NATO S A BALLISTIC FCST COMMENCING 230000Z
METB22  145231  230009  000987
005909  965023  015809  966021  025610  970019  035412  977016
045114  984013  054915  987010  064619  988006  074423  989003
084227  990001  094231  990999  104140  986997  114047  978995
124147  985995  134152  994993  144154  990991  154156  985990

NATO S S BALLISTIC FCST COMMENCING 230000Z
METB32  145231  230009  000987
005908  965023  015809  966021  025611  970018  035214  977013
044617  984009  054521  987006  064226  988002  074133  989999
084140  990996  094146  990995  104060  986993  114064  978992
124068  985989  134168  994988  144166  990988  154164  985988
```

SAMPLE OUTPUT OF OPTION 3 - BALLISTIC MESSAGES (U.S. NAVY AND NATO)

III. (U) PROGRAM DOCUMENTATION

A. (U) DISCUSSION/ANALYSIS

The Shipboard Gunfire Ballistics program is composed of two main functions: one computes ballistic density correction factors while the other computes ballistic winds. Although normally the two functions are run in conjunction with one another, the operator can run either function separately.

1. Program Inputs

Three types of information are normally entered into the Shipboard Gunfire Ballistics program: header information, thermodynamic data, and wind data. The header information is not processed by the program, but is used only to label the output data. The header information is composed of the location of firing (latitude and longitude), the day of the month, the beginning time of the ballistic forecast, the duration of the forecast, and the name of the ship or station preparing the forecast.

Thermodynamic data are entered when ballistic density correction factors are required. If the operator wishes to enter standard level data, he is prompted to enter pressure (mb), temperature (C), dew point temperature (or dew point depression), and height (ft or m) for each level. If the operator chooses to enter significant level data, he is prompted to input pressure (mb), temperature (C), and dew point temperature (or dew point depression). Standard level data can be taken from the TTAA and TTCC sections of a radiosonde message or from upper-air analyses. Significant level data can be taken from a local observation or from the TTBB and TTDD sections of a radiosonde message.

Winds aloft data must be entered in order to compute ballistic winds. The program prompts the operator to enter the height (ft or m), wind direction, and wind speed (knots or m/s) for up to 50 levels in the vertical. These data are normally taken from the PPBB and PPDD sections of a rawinsonde message, a local winds-aloft observation, or from upper-air analyses.

2. Ballistic Density Correction Factors

Ballistic density correction factors are used by gunfire support personnel to correct for deviations of the local atmospheric density profile from the density profile of the standard atmosphere. The procedure used by this program to compute these correction factors is given below.

When the operator enters significant level data into the program, the height (m) of each significant level is first computed using the hypsometric equation:

$$(1) \quad Z_i = \left[\frac{287}{9.8} \cdot \frac{T_i^* + T_{i-1}^*}{2} \cdot \ln \frac{P_{i-1}}{P_i} \right] + Z_{i-1} \quad \text{for } i = 2 \text{ to } n$$

Here n is the number of input levels, T^* is the virtual temperature (K) and P is the pressure (mb). The virtual temperature (T^*) is defined as follows:

(2) $T^* = (T + 273.16)/(1 - .379\frac{e}{p})$

where

(3) $e = 6.1078 \cdot \exp [17.26939\ Td/(T + 237.33]$

(4) $Td = T - DPD$

Here T is the temperature (C), e is the vapor pressure (mb), Td is the dew point temperature (C) and DPD is the dew point depression (C).

The density (ρ) is kilograms per cubic meter is calculated for each input level using the following equation.

(5) $\rho = P/(2.87T^*)$

The mean density for each ballistic zone is then calculated using the assumption that the atmospheric density decreases logarithmically with respect to height. The table below shows the height limits and standard mean densities for each ballistic zone.

NATO Standard Values

Zone	Height Limits	Standard Values*	
	m above MSL	Temperature (K)	Density (Kg/m^3)
1	0 - 200	287.500	1.2133
2	200 - 500	285.875	1.1844
3	500 - 1,000	283.275	1.1392
4	1,000 - 1,500	280.025	1.0846
5	1,500 - 2,000	276.775	1.0320
6	2,000 - 3,000	271.900	.95686
7	3,000 - 4,000	265.400	.86323
8	4,000 - 5,000	258.900	.77677
9	5,000 - 6,000	252.400	.69711
10	6,000 - 8,000	242.650	.58950
11	8,000 - 10,000	229.650	.46635
12	10,000 - 12,000	218.275	.36121
13	12,000 - 14,000	216.650	.26548
14	14,000 - 16,000	216.650	.19367
15	16,000 - 18,000	216.650	.14129

*Means for the ICAO Standard Atmosphere

The mean density ratio (DR) is calculated for each ballistic zone:

$$(6) \quad DR = \left(\frac{\overline{\rho}}{\overline{\rho}_s} \right) \cdot 100$$

where $\overline{\rho}$ is the actual mean density for the ballistic zone and $\overline{\rho}_s$ is the average density of the same zone in the IAOC Standard Atmosphere.

Mean density ratios are used in conjunction with ballistic weighting factors (Wt) to compute ballistic density correction factors (C):

$$(7) \quad C_m = \sum_{i=1}^{m} DR_i \cdot Wt_i$$

C_m refers to the ballistic density correction factor which is applied to a projectile which travels through m zones. C_m values are calculated for various types of projectiles (SS<16", SA<16", SS RAP) for each zone. Ballistic weighting factors vary with projectile type and the number of zones the projectile travels through.

3. Ballistic Winds

The trajectory of a projectile is altered by the effect of winds aloft; ballistic winds are calculated to correct for these effects. The method used by this program to calculate ballistic winds is summarized below.

Mean wind speeds and directions are first calculated for each ballistic zone. The speed of the ballistic wind, for a projectile traveling through m ballistic zones, can then be calculated using the following equation:

$$(8) \quad BWS_m = \sum_{i=1}^{m} \overline{WS}_i \cdot Wt_i$$

BWS_m is the speed of the ballistic wind for a projectile traveling through m ballistic zones; $\overline{WS}_i$ is the mean wind speed of zone i; Wt_i is a weighting factor which depends on projectile type and the number of zones through which a projectile travels. The direction of the ballistic wind for zone m is computed by vectorially adding the weighted winds for each zone from zones 1 through m. The weighted winds in each zone i have magnitudes of $\overline{WS}_i \cdot Wt_i$ and directions $\overline{D}_i$; $\overline{D}_i$ is the mean wind direction in zone i.

4. Outputs

The program's outputs are printed both in tables and as coded messages. The first two tables contain mean density ratios for each zone and ballistic density correction factors for various projectiles (SS<16", SA<16",

SS RAP) for each zone; the first table contains values computed using the U.S. Navy Ballistic Atmosphere, and the second table contains values computed using the ICAO Standard Atmosphere (for NATO gunfire support). The third table contains ballistic winds for various projectiles, and also listed are the mean winds for each ballistic zone. Finally, coded ballistic messages are output in both the standard U.S. Navy format and in the standard NATO format.

B. (U) TECHNICAL REFERENCES

1. Naval Ordinance Systems Command, Ballistic Wind and Density for Naval Gunfire (NAVORD OP 3784), 1 Nov 1969.

APPENDIX C

GFMPL SUBMITTAL FORMS - BLANKS

COMMANDER NAVAL OCEANOGRAPHY COMMAND

GEOPHYSICS FLEET MISSION PROGRAM LIBRARY

PROGRAM SUBMITTAL FORM

*IDENTIFICATION NUMBER/MOD*_____

I. ( ) SUMMARY

A. ( ) PROGRAM TYPE:

___METEOROLOGY
___GEOLOGY
___PHYSICAL OCEANOGRAPHY
___GRAVITY
___MAGNETICS
___ACOUSTICS
___REMOTE SENSING
___HYDROGRAPHY
___OTHER

B. ( ) PROGRAM CLASSIFICATION: _____

C. ( ) PROGRAM TITLE: _____

_____

D. ( ) DATE: EFFECTIVE_____ CANCELLED _____

E. ( ) COMMAND: ORIGINATOR_____

CONTROL _____

CONTACT_____ TEL. _____

F. ( ) TACTICAL REFERENCES:

1. ( ) TITLE _____

_____

REPORT NO._____ ORIGINATOR_____

DATE _____ *FTL ACC. NO.* _____

2. ( ) TITLE _____

_____

REPORT NO._____ ORIGINATOR _____

DATE _____ *FTL ACC. NO.* _____

G. ( ) APPLICATION:

EQUIPMENT _____

SOFTWARE/LANGUAGE _____

H. ( ) STORAGE MEDIA: ___MAGNETIC CARDS ___MAGNETIC TAPE ___MAGNETIC DISKETTE
___CASSETTE ___MAGNETIC CARTRIDGE ___OTHER

I. ( ) PLATFORM:

___SHORE-BASED PATROL AIRCRAFT ___TACTICAL AIRCRAFT ___SHORE ACTIVITIES
___CARRIER-BASED ASW AIRCRAFT ___SURFACE SHIP ___ALL FLEET UNITS
___ROTARY WING AIRCRAFT ___SUBMARINE

IDENTIFICATION NUMBER/MOD _____

J. ( ) TACTICAL APPLICATION

K. ( ) ABSTRACT

IDENTIFICATION NUMBER/MOD _____

II. ( ) OPERATING GUIDELINES

A. ( ) GENERAL GUIDELINES AND LIMITATIONS

IDENTIFICATION NUMBER/MOD _____

B. ( ) USER INSTRUCTIONS

KEY INSTRUCTIONS

STEP	INSTRUCTIONS

IDENTIFICATION NUMBER/MOD _____

B. ( ) USER INSTRUCTIONS (CONT'D)

STEP	INSTRUCTIONS

IDENTIFICATION NUMBER/MOD _____

C. ( ) EXAMPLE

IDENTIFICATION NUMBER/MOD _____

C. ( ) EXAMPLE (CONT'D)

IDENTIFICATION NUMBER/MOD _____

III. ( ) PROGRAM DOCUMENTATION

A. ( ) DISCUSSION/ANALYSIS

IDENTIFICATION NUMBER/MOD _____

8. ( ) TECHNICAL REFERENCES

APPENDIX D

SNAP EVALUATION SHEET

SHIPBOARD NUMERICAL AID PROGRAM EVALUATION SHEET

PROGRAM TITLE: _____

DATE : _____

COMMAND : _____

USER'S NAME : _____

TOTAL NUMBER OF TEST RUNS : _____

RETURN TO:
COMMANDING OFFICER
NAVAL ENVIRONMENTAL PREDICTION
RESEARCH FACILITY
ATTN: SNAP 6.2-34
MONTEREY, CA 93943

A. TERMS REQUIRING DEFINITION OR CLARIFICATION

_____
_____
_____
_____
_____
_____

B. UNCLEAR OR INCORRECT PROMPTS

_____
_____
_____
_____
_____
_____

C. HP SYSTEM ERRORS

ERROR NO._____ IN LINE_____DESCRIPTION_____

ERROR NO._____ IN LINE_____DESCRIPTION_____

ERROR NO._____ IN LINE_____DESCRIPTION_____

ERROR NO._____ IN LINE_____DESCRIPTION_____

ERROR NO._____ IN LINE_____DESCRIPTION_____

ERROR NO._____ IN LINE_____DESCRIPTION_____

D. PROGRAMMING ERRORS

DESCRIPTION_____

DESCRIPTION_____

DESCRIPTION_____

DESCRIPTION_____

DESCRIPTION_____

DESCRIPTION_____

E. OTHER COMMENTS (INCLUDING USER'S MANUAL CRITIQUE)

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ATTN: METEOROLOGICAL OFFICER
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NAVAL BASE
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NAVAL AIR STATION
MOFFETT FIELD, CA 94035

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FPO NEW YORK 09557

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