NOAA Western Region Computer Programs and
Problems NWS WRCP - NO. 49

HEMISPHERIC SPECTRAL WAVE ANALYSIS (WAVES 0 TO 7)

Salt Lake City, Utah
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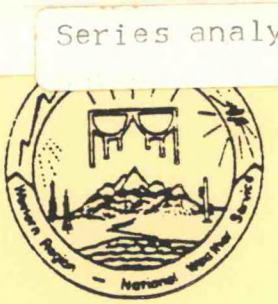
U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration / National Weather Service



PREFACE

This Western Region publication series is considered as a subset of our Technical Memorandum series. This series will be devoted exclusively to the exchange of information on and documentation of computer programs and related subjects. This series was initiated because it did not seem appropriate to publish computer program papers as Technical Memoranda; yet, we wanted to share this type of information with all Western Region forecasters in a systematic way. Another reason was our concern that in the developing AFOS-era there will be unnecessary and wasteful duplication of effort in writing computer programs in National Weather Service (NWS). Documentation and exchange of ideas and programs envisioned in this series hopefully will reduce such duplication. We also believe that by publishing the programming work of our forecasters, we will stimulate others to use these programs or develop their own programs to take advantage of the computing capabilities AFOS makes available.

We solicit computer-oriented papers and computer programs from forecasters for us to publish in this series. Simple and short programs should not be prejudged as unsuitable.

The great potential of the AFOS-era is strongly related to local computer facilities permitting meteorologists to practice in a more scientific environment. It is our hope that this new series will help in developing this potential into reality.

NOAA WESTERN REGION COMPUTER PROGRAMS AND PROBLEMS NWS WRCP

1 Standardized Format for Computer Series. REVISED January 1984. (PB85 109668)
2 AFOS Crop and Soil Information Report Programs. Ken Mielke, July 1979. (PB85 110419)
3 Decoder for Significant Level Transmissions of Raobs. John A. Jannuzzi, August 1979. (PB85 109676)
4 Precipitable Water Estimate. Elizabeth Morse, October 1979.
5 Utah Recreational Temperature Program. Kenneth M. Labas, November 1979.
6 Normal Maximum/Minimum Temperature Program for Montana, Kenneth Mielke, December 1979. (PB85 1128
7 Plotting of Ocean Wave Energy Spectral Data. John R. Zimmerman, December 1979. (PB85 112860)
8 Raob Plot and Analysis Routines. John A. Jannuzzi, January 1980.
9 The SWAB Program. Morris S. Webb, Jr., April 1980. (PB80-196041)
10 Flash-Flood Procedure. Donald P. Laurine and Ralph C. Hatch, April 1980. (PB80-298658)
11 Program to Forecast Probability of Summer Stratus in Seattle Using the Durst Objective Method. John R. Zimmerman, May 1980.
12 Probability of Sequences of Wet and Dry Days. Hazen H. Bedke, June 1980. (PB80-223340)
13 Automated Montana Hourly Weather Roundup. Joe L. Johnston, July 1980. (PB81-102576)
14 Lightning Activity Levels. Mark A. Mollner, July 1980. (PB81-108300)
15 Two Fortran Applications of Wind-Driven Ekman Water Transport Theory: Upwelling Index and Storm Tide. Kent S. Short, July 1980. (PB81-102568)
16 AFOS System Local Data Base Save and Rebuild Procedures or A Master Doomsday Program. Brian W. Finke, July 1980. (PB81-108342)
17 AFOS/RDOS Translator Subroutine. Morris S. Webb, Jr., August 1980. (PB81-108334)
18 AFOS Graphics Creation from Fortran. Alexander E. MacDonald, August 1980. (PB81-205304)
19 DATAKEYØ Repair Program. Paul D. Tolleson, August 1980. (PB81-102543)
20 Contiguous File Transfer from the DPCM to the DCM. Paul D. Tolleson, September 1980. (PB81-128035)
21 Freezing Level Program. Kenneth B. Mielke, September 1980. (PB81-128043)
22 Radar Boresighting Verification Program. Thomas E. Adler, November 1980. (PPB81-182677)
23 Accessing the AFOS Data Base. Matthew Peroutka, January 1981.(PB81-190266)
24 AFOS Work Processor. Morris S. Webb, Jr., February 1981. (PB81-210007)
25 Automated Weather Log for Terminal Forecasting. John A. Jannuzzi, February 1981. (PB81-210999)
26 Program to Computer Downwind Concentrations from a Toxic Spill. John R. Zimmerman, February 1981. (PB81-205296)
27 Animation of AFOS Graphics. Joe Wakefield and Jim Fors, April 1981. (PB85 109833)
28 AFOS Interactive Graphics. Jim Fors, Don Laurine, and Sandy MacDonald, April 1981(PB85 110401)
29 Computer Programs for Aviation Forecast Transmission. Kenneth B. Mielke and Matthew R. Peroutka, May 1981.(PB85 110518)
30 AFOS Product Collective Program. Morris S. Webb, Jr., September 1981. (PB85 109841)
31 Graphic Display of FOUS Output. Stephen D. Steenrod, September 1981. (PB85 109817)
32 Automation of Hourly Aviation Observation Calculations. W. Paul Duval, October 1981. (PB85 109650)
33 Mesoscale Objective Analysis. Andrew J. Spry and Jeffrey L. Anderson, December 1981. (PB85 109825)
34 Orographic Snowfall Rate Model for Alta, Utah. Steven K. Todd and Glenn E. Rasch, December 1981. (PB85 109874)
35 F-6 Monthly Climatic Summary Program for AFOS. Peter G. Mueller, May 1982. (PB85 109858)

NOAA Western Region Computer Programs and Problems NWS WRCP NO. 49

HEMISPHERIC SPECTRAL WAVE ANALYSIS (WAVES 0 TO 7)

Mary F. Milkovich
Scientific Services Division, WRH
Salt Lake City, Utah

August 1985

UNITED STATES
DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and
Atmospheric Administration
John V. Byrne, Administrator

National Weather
Service
Richard E. Hallgren, Director

This technical publication has been reviewed and is approved for publication by Scientific Services Division, Western Region.

Glenn E. Rasch

Glenn E. Rasch, Chief
Scientific Services Division
Western Region Headquarters
Salt Lake City, Utah

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HEMISPHERIC SPECTRAL WAVE ANALYSIS (WAVES 0 TO 7)

Mary F. Milkovich
Scientific Services Division, WRH

I. INTRODUCTION

A. Purpose

This program performs a spectral analysis of 500mb heights from hemispheric analyses and Medium Range Forecast (MRF) model data as received on AFOS. Wave energy amplitudes and wave phases are calculated over seven latitude circles (35N-55N) for waves 0 to 7. The program also chains to a graphics program which calculates phase speeds for waves 0 to 7 and produces an AFOS graphic depicting wave amplitudes and phase speeds. Both programs are designed to run on the Data General AOS system only, and they will not run on AFOS.

B. Motivation for Development

The program was developed to provide a new tool for field forecasters to use as an aid in determining the evolution of the atmosphere's large scale patterns.

C. Benefits

The program determines dominant wave features as well as wave retrogression/progression based on a spectral analysis of 500mb heights. The graphic allows the forecaster to see the following: a current analysis of the amplitudes of waves 1 to 7, and phase speeds (waves 1 to 6); a recent history (30 days) of waves 0 to 7; wave retrogression and progression; and prognostic values of amplitude and phase out to 120 hours. Thus, this spectral wave chart will help forecasters gain a better understanding of large scale patterns as the patterns develop. The program will run automatically on AOS when triggered by a user-specified file name.

II. METHODOLOGY AND SOFTWARE STRUCTURE

A. Description

The main program STRTWVE obtains gridded 500mb height analysis and prog data from grid files NMCGRD(5NH-5XH). The data has been broken down into gridded form using programs outlined in WRCP-50. The grid is dimensioned to be 73x25, but the program only uses 7 (35N to 55N) of the 25 latitude circles. A spectral analysis of 500mb heights is performed using a Fast Fourier Transform (FFT) to calculate wave energy amplitude and phase for waves 0 to 7 (see Subroutine STAT). The values returned are stored in data file "WVEDATA" which contains up to 35 days

of data including progs out to 120hrs (see Figure 1 for WVEDATA's format). The graphics program AMPSPD uses the entries in WVEDATA to calculate a summation of energy amplitudes by wave number and the phase speed for each individual wave. Finally, AMPSPD produces a graphic spectral wave chart for display on AFOS.

The following is a description of each program segment:

1. Main Program: STRTWVE

Purpose:

STRTWVE is responsible for calling the subroutines which perform the spectral analysis of 500mb heights and update WVEDATA. The program starts by reading WVEDATA (see Figure 1 for WVEDATA format) and eliminating the prog entries from the previous execution of the program. Next, the grid files NMCGRD(5NH-5XH) are read using a subroutine to obtain the new analysis and prog data. The new data is passed to another subroutine to calculate wave energy amplitude and wave phase. Finally, a subroutine is called to rewrite the WVEDATA file by inserting the newly calculated values and deleting the oldest "history" entry to maintain 35 days worth of data. At the conclusion, STRTWVE chains to AMPSPD, the graphics program (see Figure 2 for program structure).

1a. Subroutine RDATA

Parameters:

MAXDAY	=	maximum number of days allowed to be in the data file WVEDATA; to 50
DYSFND	=	number of entries found in WVEDATA
IMTH,IDAY	=	date of data
MISSING	=	missing data flag array
PROG	=	prog data flag array
AMP	=	wave energy amplitude array
PHASE	=	wave phase array
FILE	=	datafile WVEDATA

Purpose:

RDATA reads data from WVEDATA until the end of the file is reached. Subroutine also counts the number of entries (days) found in the file.

1b. Subroutine GETGRID

Parameters:

GRID	=	73x25 data grid
DTG	=	date time group
GRIDNAME	=	last three characters of NMCGRD___

Purpose:

Reads grid file to obtain prog data. For detailed description, see WRCP-50.

1c. Subroutine VDATE

Parameters:

DTG	=	date time group
IFILE	=	designator for prog data from grid file
IFLAG	=	data validity flag

Purpose:

Routine determines the validity of the prog data by checking the difference in dates converted to scalar values. If the time of the data is not 00Z, routine ends and returns to STRTWVE; otherwise, routine checks the date of the data.

1d. Subroutine STAT

Parameters:

GRID	=	grid files NMCGRD(5NH-5HX)
MAXDAY	=	maximum number of entries allowed in data file WVEDATA
SI	=	"storage index" corresponding to DYSFND, number of days found in WVEDATA
AMP	=	wave energy amplitude array
PHASE	=	wave phase array

Purpose:

STAT performs the spectral analysis for heights obtained from the grid files (NMCGPH(5NH-5XH)). First, the heights are averaged over 35N to 55N to obtain mean height values at each of the 73 longitudinal grid points. These values are then passed to subroutine FFTRANS (called by STAT) which performs an FFT. The FFT returns complex components in the form of $A\cos\theta + B\sin\theta$ which are needed to compute wave phase and wave energy amplitude. Phase is obtained for each wave (1-7) by dividing the imaginary part of the complex component by the real part of the component. Phase is defined as the arctangent of this quantity. Phase for wave zero is set to zero. Values are stored in WVEDATA for waves 0 to 7. Wave energy amplitude is the square root of the sum of the squares of the two coefficients, A and B. Amplitude values for waves 0 to 7 are stored in WVEDATA. Note that the amplitude value is computed using 500mb heights averaged over seven latitude circles.

1e. Subroutine FFTRANS

Parameters: COMP = complex components
HAVG = array of averaged gridded heights

Purpose:

FFTRANS performs the FFT to obtain complex components of 500mb heights to use in the phase and wave energy amplitude calculations. STAT passes an averaged height field to FFTRANS to be decomposed at an arbitrary latitude circle. FFTRANS returns a complex component in the form of $A\cos\theta+B\sin\theta$ for each wave to be used in calculations. See Figure 3 for the FFTRANS code and Reference 2.

1f. Subroutine CLEAN

Parameters:

IMTH,IDAY	=	date of data
AMP	=	wave energy amplitude array
PHASE	=	wave phase array
NUMWNT	=	number of entries (days) wanted in WVEDATA; set to be 35 in STRTWVE
PROG	=	prog flag array
MISSING	=	missing data flag array
MAXDAY	=	maximum number of entries allowed in WVEDATA
FILE	=	datafile WVEDATA

Purpose:

CLEAN updates WVEDATA. Specific functions include: eliminating duplicate entries; placing zeros in arrays for missing data; and setting the missing flag for missing data indications. It will also allow late arriving data to be entered in place of missing data as long as the late data is the current day's. WVEDATA is rewritten to contain 35 entries by eliminating the oldest entry and inserting the new analysis/prog data. Prog data is flagged. See Figure 1 for WVEDATA's format.

2. Graphics Main Program: AMPSPD

Purpose:

AMPSPD is responsible for calling subroutines to calculate phase speeds and draw a graphic for AFOS display. Within the main program, a summation of amplitudes is calculated each day by adding all of the wave amplitudes for waves 1 to 7. The summation value is stored in an array called AMPS. If amplitude data is missing for a particular date, a missing flag is set. In addition, the program writes the titles on the graphic (see Figure 2 for program structure).

2a. Subroutine RDATA

Parameters:

Purpose: Reads updated WVEDATA file. See 1a. for detailed description.

2b. Subroutine OUTLINE

Parameters:

GRID	=	grid files NMCGRD(5NH-5XH)
DYSFND	=	number of entries found in WVEDATA
IXS,IYS	=	x-and y-axis coordinates
MTH,DAY	=	date of data
SCLFTR	=	scale factor for y-axis values

Purpose:

OUTLINE draws and labels the x- and y-axes for the wave energy amplitude display. The y-axis is labeled in meters ranging from 0 to 500 by increments of 50. This corresponds to the spectral amplitude of each wave number in meters ranging from 0 to 500 by increments of 50, + or - the mean amplitude value (wave 0). The x-axis is labeled with every fifth date of data up to 35 days.

2c. Subroutine AMPLINE

Parameters:

DYSFND	=	number of entries in WVEDATA
AMPS	=	amplitude summation array
SCLFTR	=	y-axis scale factor
WVNUM	=	wave number

Purpose:

AMPLINE draws the vectors for the summation of amplitude values passed by AMPSPD in the array AMPS. Vectors are labeled with the appropriate wave numbers which appear when the spectral wave chart is displayed at a 4:1 or greater zoom factor. Missing data is flagged in AMPSPD and is drawn as blank vectors.

2d. Subroutine PHSPDIAG

Parameters:

IXMIN	=	minimum x coordinate
IXMAX	=	maximum x coordinate
IYMIN	=	minimum y coordinate
IYMAX	=	maximum y coordinate
WVNUM	=	wave number

Purpose:

PHSPDIAG draws the axes for the phase speed portion of the AFOS graphic. Routine is called six times by AMPSPD, each time with different parameter values. This is necessary to draw six separate sets of axes, each one corresponding to a specific wave number. The x-axis is divided into 12 segments to allow 12 days of phase speed data to be plotted. These 12 days include past analyses, the current day's analysis, and prog data out to 120hrs. The current day is noted by the longer tick mark along the x-axis. The y-axis is labeled to correspond to the maximum possible phase speeds which can be determined for each wave. This value is obtained by dividing 180 by the appropriate wave number being plotted. See Subroutine SPEED for the phase speed calculation.

2e. Subroutine SPEED

Parameters:

PHASE	=	phase array
DYSFND	=	number of entries found in WVEDATA
PHSPE	=	phase speed array
MISSING	=	missing data flag array

Purpose:

SPEED calculates the phase speeds for each wave 0 to 7; although, values are only plotted for waves 1 to 6. The calculation is based on a one-day-backwards differencing of the phase values stored in WVEDATA for each wave. Because of this method of calculation, the phase speeds for the first entries in WVEDATA are set to be zero. In addition, phase speeds for wave zero are set to be zero because the phase for wave zero is zero. If the phase value is missing for either the current day or the previous day, the phase speed for the current day is flagged as missing. Otherwise, if phase data is found for two consective days, phase speed is calculated for waves 1 to 7. The phase speed is calculated in such a way that it is always less than plus or minus one-half the wavelength. See Section III.D for interpretation of the phase speeds plotted by Subroutine PHSLINE.

2f. Subroutine PHSLINE

Parameters:

PHSPD	=	phase speed array
START	=	last day of prog data - 11 days
DYSFND	=	number of entries in WVEDATA
WVNUM	=	wave number
IXMIN	=	minimum x coordinate
IXMAX	=	maximum x coordinate

IYMIN = minimum y coordinate
IYMAX = maximum y coordinate

Purpose:

PHSLINE draws the vectors to display the phase speeds for waves 1 to 6 on the correct axes drawn by the PHSPDIAG subroutine (see Figure 4). Phase speed is plotted for 12 days of data. PHSLINE is called six times, each time for a different wave number. The corresponding axis coordinates are defined in AMPSPD. If the phase speed is flagged as missing, blank vectors will be drawn. See Section III.D for graphic interpretation.

B. Equations and Algorithms

STRTWVE's Phase and Amplitude Calculations:

Subroutine FFTRANS computes a complex component of the averaged gridded heights for each wave and returns it to STAT. It is of the form $A\cos\theta+B\sin\theta$. The amplitude of the wave is $\sqrt{A^2+B^2}$. The phase in degrees is $(360/2\pi)*\tan^{-1}(B/A)$. The phase calculated refers to the phase of the wave at 0 degrees. The global wave positions defined by this phase are dependent upon this phase value as well as the wave number (see Figure 5).

C. File Structure

STRTWVE requires the following input data files:

-- NMCGRD(5NH-5XH): gridded height data off the 00Z MRF model run. See WRCP-50 for grid program details and Figure 3 for file interactions.

-- WVEDATA: contains phase and amplitude data for waves 0 to 7; see Figures 1 and 6 for further information.

STRTWVE produces the following output data file:

-- WVEDATA: updated verions of input file WVEDATA

AMPSPD, the graphics program requires the following input data file:

-- WVEDATA: the output file produced by STRTWVE

III. CAUTIONS AND RESTRICTIONS

A. Data File Contents

WVEDATA's contents change each day that the program is run. The oldest entry is deleted; and the current day's analysis and prog flags are updated to reflect the new dates of the prog data. A total of 35 days including 5 days of progs are included in WVEDATA. This number may be changed by altering the value of the NUMWNT parameter set in STRTWVE. However, the new value may not be larger than 50 as set by the parameter MAXDAY in STRTWVE. Figure 1 shows the format for WVEDATA.

Data will be flagged as missing if the grid file data is missing or invalid. Zeros will be placed in WVEDATA to represent amplitude and phase values.

In the event that the grid data is not missing, but is late coming in, the programs can be run manually to update WVEDATA. A new graphic will be drawn to reflect these changes.

B. Amplitude and Phase Calculations

Amplitude and Phase calculations are based on the returned products of an FFT (see Subroutine FFTRANS and STAT) performed on averaged height data. Input data are the 500mb heights received from the grid files, averaged over seven latitude circles (35N to 55N) before the FFT is performed. The latitude values are centered at approximately 35, 38, 41, 44, 47, 50, and 53 degrees.

C. Graphic Display

Blanks in the amplitude lines indicate missing data. Printed numbers appear staggered by days on the amplitude lines to indicate wave numbers. The wave number can only be seen when the graphic is displayed at a 4:1 zoom factor on AFOS. The y-axis is incremented from 0 to 500 in steps of 50 meters to denote amplitude values. The final five days plotted are prog data out to 120hrs. These values change each day the program is run.

Blanks in the phase speed lines are due to missing phase speed values. This is due to a day of missing phase values resulting in two consecutive days of missing phase speeds. Twelve days of data are plotted for each wave (waves 1 to 6). Note that the longer tick mark along the x-axis indicates the current day. Those dates to the right are prog dates, and those to the left are "history" (see Figures 4 and 1).

D. Graphic Interpretation

The Spectral Wave Analysis chart (see Figure 4) is a combination of two sets of data. Wave energy amplitude is depicted on the top half of the chart and wave phase speed is shown on the bottom half. Wave energy amplitudes are plotted for waves 1 to 7 using a summation method. To determine the amplitude of a specific wave, do the following:

Amplitude of Wave 1 = values as shown
Amplitude of Wave 2 = value of Wave 2 - Wave 1
Amplitude of Wave 3 = value of Wave 3 - (Wave 2 + Wave 1)

The largest amplitudes indicate the most dominant waves.

Phase speeds are shown for waves 1 to 6. Due to space limitations, the phase speeds for wave 7 are not plotted. Interpretation of the phase speed output is as follows: negative values indicate westward movement (retrogression) of the waves; positive values indicate eastward movement (progression) of the waves. Phase speed values for each wave range from +180/wave number to -180/wave number.

E. Program Execution

STRTWVE and AMPSPD will NOT run on AFOS at anytime.

STRTWVE requires a trigger filename to run automatically on AOS. If the user-specified trigger file doesn't run for some reason, STRTWVE will not run. As a result, no graphic will be produced because STRTWVE chains to AMPSPD.

The manual execution command is as follows:

X STRTWVE trigger file NMCGPHW5S addressee

Since STRTWVE chains to APSPD, only one execution command is required. One final note: STRTWVE is designed to run on 00Z data off of the MRF model run only.

IV. REFERENCES

1. Anderson, Jeffrey L. and Mark A. Mathewson, 1985: "AOS Graphic to Grid Point Conversion and Departure form Normal Programs", NOAA Western Region Computer Programs and Problems NWS WRCP NO. 50, August 1985.

2. Peterson, Craig, 1985: "Hemispheric Spectral Analysis Program", to be published.

HEMISPHERIC SPECTRAL WAVE ANALYSIS (WAVES 0 TO 7)

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: STRTWVE

AAL:
REVISION NO:

PURPOSE: STRTWVE performs a spectral analysis of 500mb heights, calculating wave energy amplitude and wave phase for waves 0 to 7. STRTWVE runs on AOS and chains to a graphics program which also runs on AOS. The graphics program produces a chart for AFOS display. STRTWVE and AMPSPD will not run on AFOS.

PROGRAM INFORMATION:

Development Programer(s):
M. Milkovich
Location: WRH:SSD
Phone: FTS 588-5131

Maintenance Programmer(s):
WRH:SSD
Location: WRH:SSD
Phone: FTS 588-5131

Language: FORTRAN V
Type: AOS 06.05; FORTRAN 6.16
Save File Creation Date: N/A

Running Time: 2 minutes (including graphics program runtime)

Disk Space: Program files (includes graphic program) and all sources -- 451 blocks

PROGRAM REQUIREMENTS:

Program Files

Name:	Comments:
STRTWVE	Spectral analysis and Data file update program

Data Files

Name:	DP Location:	Read/Write:	Comments:
NMCGRD(5NH-5XH)	:UDD:GRID	Read	Height grid files from programs based on the MRF (AFOS) products; see WRCP NO. 50 for program descriptions
WVEDATA	:UDD:SPECTRAL	R/W	Amplitude and phase values

AFOS Products:	Action:	Comments:
See Part A of AMPSPD for graphic information		

LOAD LINE:

F5LD/QCALLS/DATABASE/REV=1.00 STRTWVE RDATA GETGRID VDATE STAT FFTRANS CLEAN

PROGRAM INSTALLATION:

1. Contact AOS System Manager at WRH:SSD.

HEMISPHERIC SPECTRAL WAVE ANALYSIS (WAVES 0 TO 7)

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: STRTWVE

AAL ID:
REVISION NO:

PROGRAM EXECUTION

1. Program can be run manually on AOS using the following:

   X STRTWVE_____NMCGPHW5S_____

2. The first set of blanks is the user-specified trigger filename.

3. The second set of blanks refers to the addressee.

4. Program will run automatically on AOS (i.e., in a procedure) by using an existing file in the procedure as a trigger file.

ERROR CONDITIONS:

1. None.

HEMISPHERIC SPECTRAL WAVE ANALYSIS (WAVES 0 TO 7)

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: AMPSPD

AAL:
REVISION NO.:

PURPOSE: AMPSPD calculates a summation of wave amplitudes, calculates phase speed, and draws a graphic for AFOS display. Program runs on AOS only and is chained to STRTWVE to run when STRTWVE runs.

PROGRAM INFORMATION:

Development Programmer(s):
M. Milkovich
Location: WRH:SSD
Phone: FTS 588-5131

Maintenance Programmer(s):
WRH:SSD
Location: WRH:SSD
Phone: FTS 588-5131

Language: FORTRAN V
Save File Creation Date: N/A

Type: AOS 6.05; FORTRAN 6.16

Running Time: 2 minutes (including runtime for STRTWVE)

Disk Space: Program Files (including STRTWVE) and all sources -- 451 AOS blocks

PROGRAM REQUIREMENTS:

Program Files

Name:	Comments:
AMPSPD	Graphics Program

Data Files

Name:	DP Location	Read/Write	Comments:
WVEDATA	:UDD:SPECTRAL	Read	Updated version of WVEDATA from STRTWVE

AFOS Products:	Action:	Comments:
NMCGPHW5S	Graphic	Displays phase speed and wave energy amplitude

LOAD LINE:

F5LD/QCALLS/DATABASE/AFOSGPH/REV=1.00 AMPSPD RDATA OUTLINE AMPLINE PHSPDIAG SPEED PHSLINE

PROGRAM INSTALLATION:

1. Contact AOS System Manager at WRH:SSD.

HEMISPHERIC SPECTRAL WAVE ANALYSIS (WAVE 0 TO 7)

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: AMPSPD

AAL:
REVISION NO.:

PROGRAM EXECUTION:

1. Program can be run manually as long as the WVEDATA file exists by using the following commands:

   X AMPSPD NMCGPHW5S ADR

   where ADR is the addressee.

2. Program is chained to STRTWVE to run automatically on AOS when STRTWVE is run.

ERROR CONDITIONS:

1. None.

```
 7 310   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 7 410   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 7 510   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 7 610   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 7 710   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 7 810   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 7 910   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 71010   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 71110   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 71210   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 71310   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 71410   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 71510   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 71610   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 71710   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 71810   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 71910   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 72010   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 72110   .0  .000  .000  .000  .000  .000  .000  .000   0.   0.   0.   0.   0.   0.   0.   0.
 72200580.1 1.376 1.488 3.952 2.452 1.344 1.306  .979   0.  30. -46.   1. 125.  15.-112.  68.
 72300580.2 2.278 2.137 3.379 1.817 1.572 2.068 1.278   0.  59. -40.  28. 124.  -7.-101.  21.
 72400580.8 2.941 2.402 3.157 1.092 1.683 1.852 1.887   0.  83. -43.  48.  88. -54.-105. -57.
 72500581.0 4.742 1.433 1.601  .559 2.631 1.501 1.294   0.  85.   5.  79.   7. -39. -51.-143.
 72600581.1 5.395 1.673 1.701 1.111 2.469 2.462  .779   0.  97. 122. 100. 153. -47. -56.-168.
 72700580.9 5.019 2.387 1.091 2.121 2.425 3.186  .908   0. 110. 114. -22. 121. -79. -68. -82.
 72800580.2 3.493 1.911 1.942 1.774 2.130 3.935 1.727   0. 133. 170. -23. 117.-123. -95.-110.
 72900580.0 3.653 2.354 2.249 1.627 1.716 3.167 1.764   0.  85. 172.  69.-162.-149.-117.-150.
 73000579.6 3.672 1.446 1.456 1.640 1.189 3.113  .763   0.  66. 155.  89.-122.-159.-125.-152.
 73100580.1 3.132  .709 1.386  .841 1.712 3.119 1.439   0.  86.  78. 100. -87. 142.-150.-145.
**8 100580.3 2.641  .580  .891  .890 2.105 1.777 1.527   0.  92.  83.  29.  33. 149.-141. 149.**
 8 201578.9  .547  .516  .608 1.762 2.425 2.223 1.256   0.  -7.-134. -15.  60. 122.-106.  86.
 8 302578.1 2.566  .976 1.037 2.045 1.721 2.759 1.257   0. -23.-170. -63. 102. 119. -92.  46.
 8 403577.7 4.684 1.112 1.048 1.578 1.606 2.181  .408   0.   7.-106.   3. 104. 115. -91.  27.
 8 504577.0 3.973 1.433 1.145  .816 3.092 1.675  .731   0.  36.-121. 142.  86. 126. -96. 151.
 8 605575.8 3.201  .241 1.518  .276 3.589 1.182 1.245   0.  90. 150. 179. 122. 131. -95. 109.
```

** = current date- August 1

WORDS	DESCRIPTION
1	MONTH OF DATA (2 DIGIT NUMBER)
2	DAY OF DATA (2 DIGIT NUMBER)
3	MISSING FLAG; 1=MISSING, 0=FOUND
4	PROG FLAG; 0= ANALYSIS, 1=24HR-5=120HR
5-12	WAVE ENERGY AMPLITUDES (DEKAMETERS); WAVES 0 TO 7
13-20	WAVE PHASES (DEGREES); WAVES 0 TO 7

Figure 1: Data file "WVEDATA" format

MAIN PROGRAM

STRTWVE

SUBROUTINES

- RDATA
- GETGRID
- VDATE
- STAT ⟶ FFTRANS
- CLEAN

Load Line:

```
F5LD/QCALLS/DATABASE/REV=1.00 STRTWVE RDATA GETGRID VDATE STAT FFTRANS CLEAN
```

GRAPHICS PROGRAM

AMPSPD

SUBROUTINES

- RDATA
- OUTLINE
- AMPLINE
- PHSPDIAG
- SPEED
- PHSLINE

Load Line:

```
F5LD/QCALLS/DATABASE/AFOSGPH/REV=1.00 AMPSPD RDATA OUTLINE AMPLINE PHSPDIAG SPEED PHSLINE
```

Figure 2: Program Structure

```
C     ************************************************************
C     MAIN PROGRAM:STRTWVE  M.MILKOVICH WRH/SSD 7/22/85 VER 1.00
C
C     STRTWVE IS THE MAIN PROGRAM USED TO UPDATE THE DATA FILE
C     FOR THE SPECTRAL WAVE GRAPHIC.  IT INCORPORATES FIVE
C     SUBROUTINES : RDATA,GETGRID,VERIFY,STAT W/FFT,AND CLEAN.
C     THE PROGRAM QCHAINS TO WVEDIAG TO PRODUCE THE GRAPHIC.
C
C        PROGRAM QCHAINS TO AMPSPD AT END TO DRAW GRAPHIC
C     COMMAND LINE:    X UPDWAVE TRIGFILE OUTPIL OUTADR
C                       TRIGFILE NOT USED
C     ************************************************************
C          *** DIRECTORY OF VARIABLES ***

C        IFILE=INDEX REFERRING TO THE WAVE GRAPHICS DATA
C             (BASED ON 5NH-5XH)
C        PROG= PROG DATA ARRAY
C        MISSING= MISSING DATA INDICATOR
C        DYSFND= NUMBER OF DAYS FOUND
C        FLAG= MARKER TO INDICATE VALID DATA
C        MAXDAY=MAXIMUM NUMBER OF DAYS ALLOWED BY PROGRAM
C        MTH,DAY,TIME= DATE AND TIME IDENTIFIERS
C        WMTH,WDAY=DESIRED DATE
C        NUMWNT= NUMBER OF DAYS OF DATA WANTED
C        MON,DAY1=  DATE INDICATOR
C        AMP=WAVE AMPLITUDE
C        PHASE=  PHASE OF THE WAVES
C        GRID= DATA FILE FOR SPECTRAL DATA
C
      ******************************************************
           PARAMETER NUMWNT=35
           PARAMETER MAXDAY=50
           INTEGER NUMWNT,IFILE,MISSING(MAXDAY),DYSFND,FLAG,TRGFILE(40),
     1       MAXDAY,SI,MTH,MON,DAY,WMTH,WDAY,TIME,DAY1,PIL(5),
     2       IMTH(MAXDAY),IDAY(MAXDAY),PROG(MAXDAY),DTG(3),IHEAD(0:6)
           REAL AMP(0:7,MAXDAY),PHASE(0:7,MAXDAY),
     1       GRID(73,25),GFILE(10),ADR
           STATIC FILE(2)/'WVED','ATA<0>'/
           STATIC GRDEXT(0:5)/'5NH<0>','5PH<0>','5RH<0>','5TH<0>',
     1       '5VH<0>','5XH<0>'/

C READ COMMAND LINE
          CALL COMINIT (0,IER)
          CALL CHECK (IER)
          CALL GASCII (TRGFILE)          ;PGM NAME
          CALL GASCII (TRGFILE)          ;TRIGGER FILENAME
          CALL GASCII (PIL)              ;OUTPUT GRAPHIC PIL
          CALL GASCII (ADR)              ;OUTPUT GRAPHIC ADDRESSEE
          CALL COMTERM (0,IER)
          CALL CHECK (IER)

C SET DEFAULT ACCESS CONTROL LIST
          CALL DACL ('SPECTRAL<0><37>+<0><3>',IER)
          CALL CHECK (IER)

           CALL RDATA(MAXDAY,DYSFND,IMTH,IDAY,MISSING,
     1       PROG,AMP,PHASE,FILE)


           IF(DYSFND.EQ.0) GO TO 8
           DO 5 I=1,DYSFND
```

Figure 3: Program Code

```
          IF (PROG(I).NE.0) GO TO 7
 5       CONTINUE
         GO TO 8
 7        DYSFND=I-1
 8       CONTINUE

         DO 10 IFILE=0,5

          CALL GETGRID(GRID,DTG,GRDEXT(IFILE)); READS THE GRID FILE
           IF (DTG(3).EQ.0) GO TO 10       ; IF MTH MISSING GO ON
          CALL VDATE(DTG,IFILE+1,FLAG)  ; IF MTH FOUND VERIFY DAY

           IF (FLAG.EQ.0)GO TO 10

             DYSFND=DYSFND+1

          CALL STAT(GRID,MAXDAY,DYSFND,AMP,PHASE) ; CALCULATIONS

           PROG(DYSFND) =IFILE
           MISSING(DYSFND)=0
           IMTH(DYSFND)=DTG(3)
           IDAY(DYSFND)=DTG(2)

 10      CONTINUE

          CALL CLEAN(IMTH,IDAY,AMP,PHASE,DYSFND,NUMWNT,PROG,
     1       MISSING, MAXDAY,FILE)        ; CLEANS UP 'WVEDATA' FILE

C         ** NOW CHAIN TO AMPSPD **
        ENCODE(TRGFILE,500) (PIL(I),I=1,5),ADR
500     FORMAT('AMPSPD.PR,',4A2,A1,',',A3,'<0>')
        IHEAD(1)=100000K        ;SET CLI FORMAT
        IHEAD(5)=12             ;12 WORDS COMMAND LINE

        CALL QCHAIN ('AMPSPD.PR',2,IHEAD,TRGFILE,IER); COMPLETE CHAIN
        CALL CHECK (IER)

        END
```

```
C       ********************************************************
C       SUBROUTINE RDATA  M.MILKOVICH WRH/SSD 7/22/85  VER 1.00
C
        SUBROUTINE COUNTS THE DATA AND READS THE DATA FILE
C        'WVEDATA'.
C
C        CALL SUBROUTINE RDATA(MAXDAY,DYSFND,IMTH,IDAY,MISSING,
C                 PROG,AMP,MISSING,FILE)
C       ********************************************************
C              DIRECTORY OF VARIABLES
C
C       MAXDAY= MAXIMUM AMOUNT OF DATA ALLOWED
C       DYSFND= NUMBER OF DAYS FOUND
C       MISSING= ARRAY FOR MISSING DATA NOTIFICATION
C       PROG= PROG DATA
C       AMP=AMPLITUDE DATA
C       FILE= DATA FILE
C       PHASE=PHASE OF WAVES
C       IMTH,IDAY=DATE OF DATA
C       ********************************************************
        SUBROUTINE  RDATA(MAXDAY,DYSFND,IMTH,IDAY
     1   ,MISSING,PROG,AMP,PHASE,FILE)

        INTEGER MAXDAY,DYSFND,IMTH (MAXDAY),IDAY(MAXDAY),
     1   PROG(MAXDAY),MISSING (MAXDAY),
     2  NUMWNT,DIFF,RECRDS(70)
        REAL AMP(0:7,MAXDAY),PHASE(0:7,MAXDAY),FILE(1)

            WRITE (10,11)(FILE(I),I=1,2)
 11         FORMAT(1X,2A4)
             OPEN 3,FILE

           I=1
C   *** READ DATA FROM DATA FILE 'WVEDATA' ***
 45         READ(3,46,END=50) IMTH(I),IDAY(I),MISSING(I),PROG(I),
     1       (AMP(J,I),J=0,7),(PHASE(K,I),K=0,7)
 46         FORMAT(I2,I2,I1,I1,F5.1,7F6.3,8F5.0)
             I=I+1
           GO TO 45
 50        DYSFND=I-1
           CLOSE 3
           RETURN
           END
```

```
C-----------------------------------------------------------------------
C  SUBROUTINE GETGRID   J. ANDERSON WRH/SSD     7/5/85
C
C  READS IN A 73 BY 25 REAL DATA GRID.  CAN READ IN 7300 BYTE
C  FILES WITHOUT DATE TIME GROUP OR 7306 BYTE FILES WITH A DTG.
C       PARAMETERS:
C  GRID--       73X25 DATA GRID
C  DTG--        DATE TIME GROUP
C  GRIDNAME--   LAST 3 CHARACTERS OF GRIDFILE TO BE READ NMCGRD___
C-----------------------------------------------------------------------
       SUBROUTINE GETGRID(GRID, DTG, GRIDNAME)

       REAL GRID(73, 25)
       INTEGER DTG(3), INFO(0:22), GRIDNAME(1), GRIDFILE(20)
       CALL STADD ('NMCGRD',GRIDNAME,GRIDFILE,OK,ISIZ)
       OPEN 1, GRIDFILE, ERR=100
C  CHECK TO SEE IF THE FILE HAS A DTG OR NOT
       CALL QFSTAT(0, GRIDFILE, INFO, IER)
       CALL CHECK(IER)                  ;CHECK FOR ERRORS
C  COMPUTE LENGTH OF FILE IN BYTES
       FLEN = 65536.*INFO(17K)+FLOAT(INFO(20K).AND.77777K)+32768.*ITEST(INFO(20K),15)
       IF((FLEN - 7300.) .LT. 0.1) GOTO 900    ;NO DTG
       READ BINARY(1) DTG
C  READ IN THE GRIDDED DATA FILE
 900   DO 20 I = 1, 73
             DO 20 J = 1, 25
 20                READ BINARY (1) GRID(I, J)
       CLOSE 1
       RETURN

C ERROR
100    DTG(3)=0                ;RETURN MONTH=0 FOR NO GOOD
       RETURN

       END
```

```
C*****************************************************
C       VERIFY FORECAST DATE FOR DEPART PROGRAM
C-----------------------------------------------------
C M. MATHEWSON          JUL 5, 1985     VER 1.00
C-----------------------------------------------------
C *** CALL VDATE (DTG, IFILE, IFLAG)
C       DTG = SUPPLIED GRID DATE TIME GROUP (1-HR,2-DAY,3-MTH)
C       IFILE = 1-6  (1-5NH, 6=5XH)
C       IFLAG = RETURNED 0 NO GOOD, 1 GOOD
C*****************************************************

        SUBROUTINE VDATE (DTG, IFILE, IFLAG)

        INTEGER DTG(3)

C INITIALIZE TO NO GOOD
        IFLAG = 0

C CHECK FOR 0000Z
        IF(DTG(1).NE.0) RETURN                  ;RETURN

C GET CURRENT DATE
        CALL FGDAY(IMTH,IDAY,IYR)

C CALCULATE SCALER FOR TODAY
        CALL GFDAY (IDAY, IMTH, IYR, ITOD, IER)

C CALCULATE SCALER FOR SUPPLIED DTG
        CALL GFDAY (DTG(2), DTG(3), IYR, ITOD1, IER)

C CHECK FOR VALID
        IF(ITOD1-ITOD.EQ.IFILE-1) IFLAG = 1     ;SET TO GOOD

C RETURN
        RETURN
        END
```

```
C     ************************************************************
C        SUBROUTINE STAT  M.MILKOVICH WRH/SSD 7/22/85  VER 1.00
C
C       SUBROUTINE STAT CALCULATES THE PHASE,PHASE SPEED,AND
C          AMPLITUDE OF WAVES 0 TO 7. IT CALLS SUBROUTINE
C          FFTRANS TO CALCULATE THE COMPLEX COMPONENTS USED IN
C          THE PHASE CALCULATION.  CALCULATIONS ARE BASED ON A
C          SPECTRAL ANALYSIS OF 500 MB HEIGHTS.
C
C          CALL SUBROUTINE STAT(GRID,MAXDAY,SI,AMP,PHASE)
C
C     ************************************************************
C               DIRECTORY OF VARIABLES
C
C      GRID=DATA FILE
C      MAXDAY=MAXIMUM DAYS ALLOWED BY PROGRAM
C      SI=STORAGE INDEX
C      AMP=AMPLITUDE OF WAVES
C      PHASE=PHASE OF WAVES
C      LATMIN=MIN LATCIRCLE% (35°N)
C      LATMAX=MAX LATCIRCLE% (55°N)
C      WVNUM=WAVE NUMBER
C      CONV=CONVERSION TO DEGREES
C      DIMAG= IMAGINARY FACTOR
C      COMP= QUANTITY RETURNED FROM THE FFT
C             FOR EACH WAVE.
C      RRE= REAL PART OF COMPLEX NUMBER
C      RIN=IMAGINARY PART OF COMPLEX NUMBER USED IN PHASE
C      HAVG= AVERAGED HEIGHTS ARRAY
C     ************************************************************
C
      PARAMETER LATMIN=6
      PARAMETER LATMAX=12

      SUBROUTINE STAT(GRID,MAXDAY,SI,AMP,PHASE)

      INTEGER SI,J,LATMIN,LATMAX,WVNUM,N,LATAVG
      REAL AMP(0:7,MAXDAY),PHASE(0:7,MAXDAY),
     1   CONV,GRID(73,25),HAVG(73)
      COMPLEX COMP(0:7),DIMAG,SUM,INDE,INDEX,C,CC(4,18)

      CONV=(2.0*3.1416)/360.0
      DIMAG=(0.0,1.0)

       DO 4 K=1,73
        HAVG(K)=0.
       DO 5 J= LATMIN,LATMAX
            HAVG(K) = (HAVG(K)+GRID(K,J))
 5     CONTINUE
          HAVG(K)=HAVG(K)/(LATMAX-LATMIN+1)
 4     CONTINUE
      CALL FFTRANS(COMP,HAVG)                ; CALCULATE COMPLEX COMPS

C  CALCULATE PHASE FOR WAVES 1 TO 7 AT 45DEG N LOCATION


        PHASE(0,SI)=0.
       DO 260 WVNUM=1,7
          RRE=REAL(COMP(WVNUM))
          RIN=-REAL(DIMAG*COMP(WVNUM))
          PHASE(WVNUM,SI)=ATAN2(RIN,RRE)/CONV
```

```
 260    CONTINUE

C   ** CALCULATE THE AMPLITUDE OF EACH WAVE AT EACH LATITUDE **

       DO 275 WVNUM=0,7
          AMP(WVNUM,SI)=CABS(COMP(WVNUM))

 275     CONTINUE
C
       RETURN
       END
```

```
C     ************************************************************
C       SUBROUTINE FFTRANS  WRH/SSD 7/22/85 VER 1.00

C        FFTRANS COMPUTES THE FAST FOURIER TRANSFORM
C          TO OBTAIN COMPONENTS TO CALCULATE PHASE

C              CALL FFTRANS(COMP,HAVG)
C     ************************************************************
C               DIRECTORY OF VARIABLES
C        M*K= NUMBER OF GRIDPOINTS AND FFT BREAKDOWN
C        HAVG= VALUE OF HEIGHT
C        COMP= COMPLEX COMPONENT
C     ************************************************
       SUBROUTINE FFTRANS(COMP,HAVG)

       INTEGER K,M
       REAL TWOPI,HAVG(73)
       COMPLEX COMP(0:7),SUM,INDE,INDX,
     1         CC(4,18),DIMAG
          K=18
          M=4
          TWOPI=3.1416*2.0
          DIMAG=(0.0,1.0)
           DO 6 IJOP1=1,M
             IJ0=IJOP1-1
            DO 8 IR0P1=1,K
              IR0=IR0P1-1
              SUM=(0.0,0.0)
             DO 3 IR1P1=1,M
               IR1=IR1P1-1
               INDE=-(DIMAG*TWOPI*IJ0*IR1)/M
               IND=IR1*K+IR0+1
               SUM=SUM+HAVG(IND)*CEXP(INDE)
   3         CONTINUE
              CC(IJOP1,IR0P1)=(2.0*SUM)/(M*K)
   8        CONTINUE
   6       CONTINUE
C       CALCULATE COMP(J);NOTE 1 TO 8 =WAVES 0 TO 7
          DO 20 IJP1=1,8
            IJ=IJP1-1
            IJ0P1=MOD(IJ,4)+1
            SUM=(0.0,0.0)
           DO 25 IR0P1=1,K
             IR0=IR0P1-1
             INDX= -(TWOPI*DIMAG*IJ*IR0)/(M*K)
             SUM=SUM+CC(IJ0P1,IR0P1)*CEXP(INDX)
  25         CONTINUE
          COMP(IJ )     =SUM
          IF(IJ  .EQ.0) COMP(IJ  )=SUM/2.0
  20      CONTINUE
         RETURN
         END
```

```
C     ********************************************************
C     SUBROUTINE CLEAN  M.MILKOVICH WRH/SSD  7/22/85 VER 1.00

C     SUBROUTINE CLEAN ELIMINATES DUPLICATE DATA, 'ADDS'
C     MISSING DECLARATION, AND 'RELOADS' THE FILE 'WVEDATA'
C     WITH THE PROPER DATA.

C       CALL SUBROUTINE CLEAN(IMTH,IDAY,AMP,PHASE,NUMWNT,
C                 PROG,MISSING,MAXDAY,FILE)

C     ************************************************************
C              DIRECTORY OF VARIABLES
C       MISSING=MISSING DATA
C       IMTH,IDAY= DATE OF DATA ;ARRAY
C       WMTH,WDAY=DESIRED DATE
C       AMP= ARRAY WITH AMPLITUDE VALUES
C       PHASE= PHASE VALUES FOR EACH WAVE
C       PRVIEW= PROG DAYS
C       CUR=CURRENT DAYS
C       START=START DAY
C       DYSFND= DAYS OF DATA FOUND (#)
C       NUMWNT= NUMBER OF DAYS WANTED
C       PROG=PROG DATA ARRAY
C       FILE=DATA STORAGE
C       IMATCH=INDEX USED TO SEARCH FOR MATCHING DATA
C       ID= DAYS FROM START TO PRVIEW
C      ************************************************************
C
      SUBROUTINE CLEAN(IMTH,IDAY,AMP,PHASE,
     1    DYSFND, NUMWNT,PROG,MISSING,MAXDAY,FILE)
      INTEGER IMTH(MAXDAY),IDAY(MAXDAY),WMTH,WDAY,PRVIEW,CUR,
     1 NUMWNT, START, IMATCH,ID,PFLAG,MISSING(MAXDAY),
     2 DYSFND,PROG(MAXDAY)
      REAL AMP(0:7,MAXDAY),PHASE(0:7,MAXDAY),FILE(1)


      OPEN 3,FILE                ; OPEN DATA FILE

      CALL FGDAY(JMTH,JDAY,JYR)
      CALL QFDAY(JDAY,JMTH,JYR,CUR,IER)

C     INITIALIZATIONS
      PRVIEW=CUR+5               ;INCLUDES PROG DATA
      START=CUR+6-NUMWNT         ; FIRST DATE OF DATA

      DO 120 ID=START,PRVIEW


C       SEARCH FOR DUPLICATE DATES; ELIMINATE DUPLICATES;
C       FLAGS MISSING DATES W/ A ZERO FLAG; RELOADS 'WVEDATA'

         CALL QCDAY(ID, WDAY,WMTH,WYR,IER)

          IF(DYSFND.EQ.0) GO TO 141
          DO 140  IMATCH=1,DYSFND

           IF ((IMTH(IMATCH).NE.WMTH).OR. (IDAY(IMATCH).NE.WDAY))
     1        GO TO 140

C        ** VALID DATA **
```

```
              WRITE(3,2) IMTH(IMATCH),IDAY(IMATCH),MISSING(IMATCH),
     1         PROG(IMATCH),(AMP(K,IMATCH),K=0,7),(PHASE(J,IMATCH),
     2         J=0,7)
  2           FORMAT(I2,I2,I1,I1,F5.1,7F6.3,8F5.0)
               GO TO 120
  140       CONTINUE

C          ** MISSING DATA **

  141        PFLAG=0
           IF(ID.GT.CUR) PFLAG=ID-CUR
            IC=1
           WRITE(3,4) WMTH,WDAY,IC,PFLAG  ,(0.,K=1,16)
  4          FORMAT(I2,I2,I1,I1,F5.1,7F6.3,8F5.0)

  120     CONTINUE
          CLOSE 3
          RETURN
          END
```

```
C      ****************************************************************
C       MAIN PROGRAM:AMPSPD  M.MILKOVICH  WRH/SSD 7/22/85 REV 1.00

C        AMPSPD IS THE MAIN PROGRAM USED TO DRAW THE GRAPHIC
C         FOR SPECTRAL WAVE (WAVES 1-7) AMPLITUDES AND SPEC-
C         TRAL WAVE (WAVES 1-6) PHASE SPEEDS, SUBROUTINES
C         INCLUDE OUTLINE, AMPLINE, PHSPDIAG, SPEED, AND
C         PHSPDIAG.
C      ****************************************************************
C             ***DIRECTORY OF VARIABLES***

C          IXS,IYS= COORDINATE POINTS
C          DYSFND= NUMBER OF DAYS FOUND IN WVEDATA
C          WVNUM= WAVE NUMBER
C          MISSING= MISSING DATA ARRAY
C          IMTH,IDAY= DATE OF DATA
C          PROG= PROG DATA ARRAY
C          MAXDAY= MAXIMUM DAYS ALLOWED IN FILE
C          TEXT,DATE= JUNK ARRAYS
C          PIL= ARRAY FOR DECODING GRAPHIC PIL
C          SCLFTR= SCALE FACTOR FOR Y-AXIS
C          AMPS= AMPLITUDE SUMMATION ARRAY
C          GRID= GRIDFILE
C          ADR= ADDRESSEE FOR GRAPHIC
C          FILE=WVEDATA
C          XMNTH= MONTH OF DATA
C          IXMIN,IXMAX,IYMIN,IYMAX= COORDINATE PARAMETERS
C          MTH(MAXDAY),DAY(MAXDAY)= DATES USED IN PLOTTING DATES
C          IY(MAXDAY),IX(MAXDAY)=COORDINATE ARRAYS
C          IXL,IYL,IXJ,IYJ= COORDINATE VARIABLES
C          SI= STORAGE INDEX;CORRESPONDS TO DYSFND
C
C     ****************************************************************
      PARAMETER MAXDAY=50

      INTEGER IXS(MAXDAY),IYS(MAXDAY),MTH(MAXDAY),DYSFND,DAY(MAXDAY),
     1  IX(MAXDAY),IY(MAXDAY),IXL(MAXDAY),IYL(MAXDAY),SI,IXJ(MAXDAY),
     2  IYJ(MAXDAY),WVNUM,MISSING(MAXDAY),IDAY(MAXDAY),IMTH(MAXDAY),
     3   PROG(MAXDAY),MAXDAY,TEXT(50),PIL(5)
      REAL  XCNT(MAXDAY),SCLFTR,AMPS(0:7,MAXDAY),PHASE(0:7,MAXDAY),
     1  PHSPD(0:7,MAXDAY),AMP(0:7,MAXDAY),XNUM,SCLFCT,DATE(5),
     2   GRID(25,73),ADR
      STATIC FILE(2)/'WVED','ATA<0>'/
      STATIC XMNTH(12)/'JAN','FEB','MAR','APR','MAY','JUN','JUL',
     1  'AUG','SEP','OCT','NOV','DEC'/
      STATIC IXMIN(6)/250,250,250,1150,1150,1150/
      STATIC IXMAX(6)/850,850,850,1750,1750,1750/
      STATIC IYMIN(6)/500,350,200,500,350,200/
      STATIC IYMAX(6)/600,450,300,600,450,300/

      CALL COMINIT(0,IER)
      CALL CHECK (IER)
      CALL GASCII(TEXT)          ;PGM NAME
      CALL GASCII(PIL)           ;PIL
      CALL GASCII(ADR)           ;ADDRESSEE
      CALL COMTERM(0,IER)

C SET DEFAULT ACCESS CONTROL LIST
        CALL DACL ('SPECTRAL<0><37>+<0><3>',IER)
        CALL CHECK (IER)
```

```
C       ** READ DATA FROM 'WVEDATA' **

      CALL RDATA(MAXDAY,DYSFND,IMTH,IDAY,MISSING,PROG,AMP,PHASE,FILE)
      CALL AHDTR('@AFOS',PIL,ADR,1)

      CALL FGDAY(IMNTH,JDAY,IYR); GET CURRENT DATE
        ENCODE(DATE,95) XMNTH(IMNTH),JDAY,IYR
 95     FORMAT(A3,1X,I2,1X,'19',I2,'<0>')
      DO 97 J=5,10,5
           IF(BYTE(DATE,J).EQ.40K)BYTE(DATE,J)=60K
 97   CONTINUE
        WRITE (10,111) (DATE(KKK),KKK=1,5); WRITE CURRENT DATE
 111    FORMAT(1X,'DATE ',5A4)
        CALL ATEXT(DATE,50,50,0,3)

C            * WRITE TITLES ON GRAPHIC *
      CALL ATEXT('SPECTRAL WAVE ANALYSIS',900,50,0,3)
      CALL ATEXT('AMPLITUDES',900,1510,0,0)
      CALL ATEXT('PHASE SPEED',900,590,0,0)

C            * DRAW OUTLINE FOR AMPLITUDE GRAPHIC *
      CALL OUTLINE(GRID,DYSFND,IXS,IYS,IMTH,IDAY,SCLFTR)

C            * CALCULATE SUM OF AMPS FOR GRAPH *
                 DO 21 J=1,DYSFND   ;  SET AMPLITUDES FOR WAVE 0= 0,
                  AMPS(0,J)=0.0
 21               CONTINUE
                  DO 20 WVNUM=1,7
                     DO 92 J=1,DYSFND
                      AMPS(WVNUM,J)= AMP(WVNUM,J)+AMPS(WVNUM-1,J)
                      IF(MISSING(J).EQ.1) AMPS(WVNUM,J)=-1.0
 92                  CONTINUE

C                       *DRAW THE AMPLITUDE LINES*
                   CALL AMPLINE(DYSFND,AMPS,SCLFTR,WVNUM)
 20                CONTINUE

C       * DRAW OUTLINE FOR PHASE SPEED GRAPHIC *
             DO 57 WVNUM=1,6
 57            CALL PHSPDIAG(IXMIN(WVNUM),IXMAX(WVNUM),IYMIN(WVNUM),
     1                IYMAX(WVNUM),WVNUM)

C       * CALCULATE THE PHASE SPEED FOR WAVES 1 TO 6 *
          CALL SPEED(PHASE,DYSFND,PHSPD,MISSING)

C       * DRAW THE PHASE SPEED LINES ON THE GRAPHIC *
             DO 55 WVNUM=1,6
               CALL PHSLINE(PHSPD,DYSFND-11,DYSFND,WVNUM,IXMIN(WVNUM)
     1              ,IXMAX(WVNUM),IYMIN(WVNUM),IYMAX(WVNUM))
 55          CONTINUE
      CALL ATRAIL
      CALL GRETURN (0,1,IER)
      END
```

```
C       ********************************************************
C       SUBROUTINE RDATA  M.MILKOVICH WRH/SSD 7/22/85  VER 1.00
C
C       SUBROUTINE COUNTS THE DATA AND READS THE DATA FILE
C        'WVEDATA'.
C
C        CALL SUBROUTINE RDATA(MAXDAY,DYSFND,IMTH,IDAY,MISSING,
C                 PROG,AMP,MISSING,FILE)
C       ********************************************************
C              DIRECTORY OF VARIABLES
C
C       MAXDAY= MAXIMUM AMOUNT OF DATA ALLOWED
C       DYSFND= NUMBER OF DAYS FOUND
C       MISSING= ARRAY FOR MISSING DATA NOTIFICATION
C       PROG= PROG DATA
C       AMP=AMPLITUDE DATA
C       FILE= DATA FILE
C       PHASE=PHASE OF WAVES
C       IMTH,IDAY=DATE OF DATA
C       ********************************************************
        SUBROUTINE  RDATA(MAXDAY,DYSFND,IMTH,IDAY
     1   ,MISSING,PROG,AMP,PHASE,FILE)

        INTEGER MAXDAY,DYSFND,IMTH (MAXDAY),IDAY(MAXDAY),
     1    PROG(MAXDAY),MISSING (MAXDAY),
     2   NUMWNT,DIFF,RECRDS(70)
        REAL AMP(0:7,MAXDAY),PHASE(0:7,MAXDAY),FILE(1)

            WRITE (10,11)(FILE(I),I=1,2)
 11         FORMAT(1X,2A4)
             OPEN 3,FILE

           I=1
C   *** READ DATA FROM DATA FILE 'WVEDATA' ***
 45         READ(3,46,END=50) IMTH(I),IDAY(I),MISSING(I),PROG(I),
     1       (AMP(J,I),J=0,7),(PHASE(K,I),K=0,7)
 46         FORMAT(I2,I2,I1,I1,F5.1,7F6.3,8F5.0)
             I=I+1
           GO TO 45
 50        DYSFND=I-1
           CLOSE 3
           RETURN
           END
```

```
C      ************************************************************
C       SUBROUTINE OUTLINE  M.MILKOVICH  WRH/SSD 7/22/85  VER 1.00

C       SUBROUTINE OUTLINE DRAWS THE OUTLINE FOR THE GRAPHIC
C        TO DISPLAY WAVE AMPLITUDES FOR WAVES 1 TO 7. ROUTINE
C        ALSO LABELS BOTH AXES APPROPRIATELY WITH Y-AXIS HAVING
C        NUMBER VALUES AND X- AXIS HAVING DATES.

C       CALL SUBROUTINE OUTLINE(GRID,DYSFND,IXS,IYS,MTH,DAY,SCLFTR)
C      ************************************************************
C          **** DIRECTORY OF VARIABLES ****
C      IXMAX= MAXIMUM X VALUE
C      IXMIN= MINUMUM X VALUE
C      IYMAX= MAXIMUM Y VALUE
C      IYMIN= MINUMUM Y VALUE
C      GRID= DATA FILE
C      DYSFND=NUMBER OF DAYS FOUND
C      IXS,IYS= X AND Y COORDINATES
C      MTH,DAY=DATE OF INFORMATION
C      XMTH=ARRAY FOR DATE DATA
C      DAY= ARRAY FOR DATE DATA
C      SCLFTR=SCALE FACTOR
C      DELX=CHANGE IN X 'VALUE'
C      JUNK= ARRAY USED FOR ENCODING DATE INFORMATION
C      XINC= X INCREMENT
C      ************************************************************
       PARAMETER IXMAX=2000
       PARAMETER IXMIN=150
       PARAMETER IYMAX=1500
       PARAMETER IYMIN=700
       PARAMETER MAXDAY=50
       SUBROUTINE OUTLINE(GRID,DYSFND,IXS,IYS,MTH,DAY,SCLFTR)

       INTEGER IXS(MAXDAY),IYS(MAXDAY),JUNK(200),DYSFND,
     1    DAY(MAXDAY),MTH(MAXDAY),IXV(200),IYV(200),IX,IY
      REAL D,DELX,SCLFTR,GRID(25,73)
      STATIC XMTH(12)/'JAN','FEB','MAR','APR','MAY','JUN','JUL',
     1    'AUG','SEP','OCT','NOV','DEC'/

                XMAX=50
C       *CALCULATE THE SCALE FACTOR FOR THE Y-AXIS*
          SCLFTR=(IYMAX-IYMIN)/XMAX

C       *CALCULATE DELTA X*
          DELX=(IXMAX-IXMIN)/FLOAT(DYSFND-1)

C       *DRAW THE X AXIS AND Y AXIS*
          IXS(1)=IXS(2)=IXMIN
          IXS(3)=IXMAX
          IYS(1)=IYMAX
          IYS(2)=IYS(3)=IYMIN
         CALL ALINE(IXS,IYS,3,0)

C       *LABEL THE Y-AXIS *
                XINC=5.
                IP=0
          DO 40 D=0.,XMAX,XINC
             ENCODE (JUNK,11) D*10.
  11         FORMAT (F4.0,'<02>')
             IX=IXMIN-60
             IY=IYMIN+INT(D*SCLFTR)
```

```
            CALL ATEXT(JUNK,IX,IY,0,0)

C       * DRAW INCREMENT MARKS ALONG Y-AXIS *
            IXV(IP+1)=10-IXMIN
            IXV(IP+2)=IXMIN+10
            IYV(IP+1)=IYV(IP+2)=IYMIN+INT(D*SCLFTR)
              IP=IP+2
 40          CONTINUE
            CALL ALINE (IXV,IYV,IP,0)

C         * LABEL THE X AXIS WITH THE CORRECT DATES; DATES
C             ARE INCREMENTED FROM LEFT TO RIGHT WITH THE
C             FAR RIGHT DATE BEING THE DATE OF THE 120 HR PROG *

            DO 22 I=1,DYSFND
               IX=IXMIN+DELX*(I-1)
               IY=IYMIN
               IX1=IX-25
               IY1=IY-25

C            *DRAW THE DATE MARKER ALONG THE X-AXIS*
                  N1=(I*2)-1
                  N2=I*2
               IXV(N1)=IXV(N2)=IX
               IYV(N1)=IYMIN-10
               IYV(N2)=IYMIN+10
               IXV(N1)=-IXV(N1)

C          *WRITE THE CORRECT DATE ; MONTH WILL APPEAR ON ONE LINE
C            AND DAY ON THE LINE BELOW THE CORRESPONDING MONTH*
               ENCODE (JUNK,92) XMTH(MTH(I)),DAY(I)
 92            FORMAT( A3,'<15>',I2,'<0>')

              IF (MOD(I,5).EQ.0)CALL ATEXT(JUNK,IX1,IY1,0,0);EVERY 5 DAYS
 22         CONTINUE
           CALL ALINE (IXV,IYV,2*DYSFND,0)
           RETURN
           END
```

```
C     ************************************************************
C      SUBROUTINE AMPLINE  M.MILKOVICH WRH/SSD 7/22/85 VER 1.00

C     SUBROUTINE DRAWS THE LINES FOR THE AMPLITUDES
C       OF WAVES 1 TO 7 (IN SUMMATION FORM)

C      CALL SUBROUTINE AMPLINE(DYSFND,AMPS,SCLFTR,WVNUM)

C     ************************************************************
C           DIRECTORY OF VARIABLES

C       AMPS= ARRAY OF NUMBERS REPRESENTING AMPLITUDES
C       DYSFND= NUMBER OF DAYS FOUND
C       IY=Y-COORDINATE ARRAY
C       IX=X-COORDINATE ARRAY
C       SCLFTR=SCALE FACTOR FOR Y-VALUES
C       IXMAX,IXMIN=MINIMUM AND MAX X-COORDINATES
C       IYMIN,IYMAX= MINIMUM AND MAX Y-COORDINATES
C     ************************************************************

      PARAMETER IXMAX=2000
      PARAMETER IXMIN=150
      PARAMETER IYMIN=700
      PARAMETER IYMAX=1400

     SUBROUTINE AMPLINE(DYSFND,AMPS,SCLFTR,WVNUM)
        REAL AMPS(0:7,DYSFND),SCLFTR
        INTEGER DYSFND,IX(50),IY(50),WVNUM,J

          XSCALE = FLOAT(IXMAX-IXMIN)/FLOAT(DYSFND-1)
        DO 24 I=1,DYSFND   ;    CALCULATE X AND Y VALUES FOR GRAPH
          IX(I)=IXMIN + XSCALE*FLOAT(I-1)
          IY(I)=AMPS(WVNUM,I)*SCLFTR +IYMIN

         IF(AMPS(WVNUM,I).EQ.-1.0) GO TO 23  ;MISSING
         IF(MOD(I,7).NE.WVNUM-1) GO TO 24    ;DON'T LABEL THIS ONE
         ENCODE(INUM,19) WVNUM
19       FORMAT(I1,'<0>')
         CALL ATEXT (INUM,IX(I),IY(I),1,0)   ;WRITE WVNUM
              GO TO 24
23       IX(I)=-IX(I)             ; NEGATIVE TO DRAW BLANKS
24      CONTINUE
                    K=I=0
              DO 22 L=1,DYSFND
                IF (IX(L).LT.0) GO TO 21
                    I=I+1
                  IX(I)=IX(L)
                  IY(I)=IY(L)
                IF (K.EQ.1) IX(I)=-IX(I)
                    K=0
                  GO TO 22
21                  K=1
22              CONTINUE
            CALL ALINE(IX,IY,I,0)
      RETURN
      END
```

```
C     ************************************************************
C      SUBROUTINE PHSPDIAG  M.MILKOVICH WRH/SSD 7/22/85 VER 1.00
C
C      SUBROUTINE PHSPDIAG DRAWS THE DIAGRAM FOR THE PHASE
C      SPEED GRAPHIC.

C       CALL SUBROUTINE PHSPDIAG(IXMIN,IXMAX,IYMIN,IYMAX,WVNUM)
C     ************************************************************

C       *** DIRECTORY OF VARIABLES***

C       IXMIN,IXMAX,IYMIN,IYMAX= PARAMETERS FOR GRAPHIC
C       WVNUM=WAVE NUMBER
C       IX,IY= COORDINATES OF VECTORS
C       IYAVE= Y-AXIS BISECTOR
C       DELX= DELTA X VALUE
C       N1,N2= VARIABLES FOR EVEN AND ODD VALUES

C     ************************************************************

      SUBROUTINE PHSPDIAG(IXMIN,IXMAX,IYMIN,IYMAX,WVNUM)
       INTEGER IXMIN ,IXMAX,IYMIN,IYMAX,WVNUM,LABEL(4),
     2         IX(24),IY(24)
       REAL DELX,IYAVE

            IYAVE=(IYMAX+IYMIN)/2 ; BISECTS THE Y-AXIS
            IX(1)=IX(2)=IX(3)=IXMIN
            IX(4)=IXMAX
            IY(1)=IYMIN
            IY(2)=IYMAX
            IY(3)=IY(4)=(IYMAX+IYMIN)/2
           CALL ALINE(IX,IY,4,0)        ; DRAW OUTLINE

              DELX= (IXMAX-IXMIN)/11.  ; ALLOWS 12 DAYS
             DO 20 I=1,12              ; DRAW 12 TICK MARKS
                N1=(I*2)-1             ; ODD # ARE BLANK VECTORS
                N2=I*2
                IX(N1)=IX(N2)=IXMIN+DELX*(I-1)
                IY(N1)=((IYMAX+IYMIN)/2)-10
                IY(N2)=((IYMAX+IYMIN)/2)+10
                IX(N1)=-IX(N1)
                IF (I.NE.7) GO TO 20
                IY(N1)=IY(N1)-20
                IY(N2)=IY(N2)+20
  20           CONTINUE
          CALL ALINE (IX,IY,24,0)

C           ** WRITE +-LABELS ON Y-AXIS **
       IVALUE = 180/WVNUM
       ENCODE(LABEL,25) IVALUE
  25   FORMAT(I4,'<0>')
       CALL ATEXT (LABEL,IXMIN-50,IYMAX,0,0)
       ENCODE(LABEL,25) -IVALUE
       CALL ATEXT (LABEL,IXMIN-50,IYMIN-20,0,0)

C           ** WRITE WVNUM ALONG Y-AXIS **
       ENCODE(LABEL,15) WVNUM
   15  FORMAT('WAVE ',I1,'<0>')
       CALL ATEXT (LABEL,IXMIN-150,(IYMIN+IYMAX)/2,0,0)

      RETURN
```

```
END
```

```
C     ************************************************************
C      SUBROUTINE PHSLINE  M.MILKOVICH WRH/SSD 7/22/85 VER 1.00

C        ROUTINE DRAWS VECTORS FOR THE PHASE SPEEDS OF
C             WAVES 1 TO 6 ON THE CORRECT DIAGRAM.
C             BLANK VECTORS ARE DRAWN IF THERE ARE NOT
C             TWO CONSECUTIVE DAYS OF DATA.

C         CALL SUBROUTINE PHSLINE(PHSPD,START,DYSFND,WVNUM,
C                IXMIN,IXMAX,IYMIN,IYMAX)

C     ************************************************************
C          ** DIRECTORY OF VARIABLES **

C        PHSPD=PHASE SPEED
C        START= FIRST DAY OF DATA USED (LAST DAY OF PROGS-11)
C        DYSFND= DAYS OF DATA FOUND
C        WVNUM=WAVE NUMBER
C        IXMIN,IXMAX,IYMIN,IYMAX= COORDINATE PARAMETERS
C        SCLFCT= Y-SCALE FACTOR
C        XSCALE= X-SCALE FACTOR
C        IYAVE = BISECTS THE Y-AXIS INTO +/- SECTIONS
C        VALUE= CONVERTS PHASE SPEED INTO A POSITIVE NUMBER
C        PIXEL= LOGARITHMIC Y-SCALE VALUE

C     ************************************************************

      SUBROUTINE PHSLINE(PHSPD,START,DYSFND,WVNUM,
     1       IXMIN,IXMAX,IYMIN,IYMAX)

       INTEGER DYSFND
       REAL PHSPD(0:7,DYSFND),SCLFCT
       INTEGER IX(50),IY(50),WVNUM,START

         XSCALE = FLOAT(IXMAX-IXMIN)/FLOAT(DYSFND-START)
         IYAVE=(IYMAX+IYMIN)/2
         SCLFCT=(IYMAX-IYMIN)/(2*180.)

C     ** CALCULATE THE  X AND Y COORDINATES FOR DRAWING LINES **
      DO 23 L=START,DYSFND
         IX(L)=IXMIN + XSCALE*FLOAT(L-START)
         IY(L)=IYAVE-SCLFCT*PHSPD(WVNUM,L)
         IF(PHSPD(WVNUM,L).EQ.-1000.) IX(L)=-IX(L)
 23   CONTINUE
              K=I=0
      DO 22 L=START,DYSFND
         IF (IX(L).LT.0) GO TO 21
           I=I+1
           IX(I)=IX(L)
           IY(I)=IY(L)
         IF (K.EQ.1) IX(I)=-IX(I)  ; BLANK VECTORS FOR MISSING
               K=0
             GO TO 22
 21            K=1
 22   CONTINUE
      CALL ALINE(IX,IY,I,0)
      RETURN
      END
```

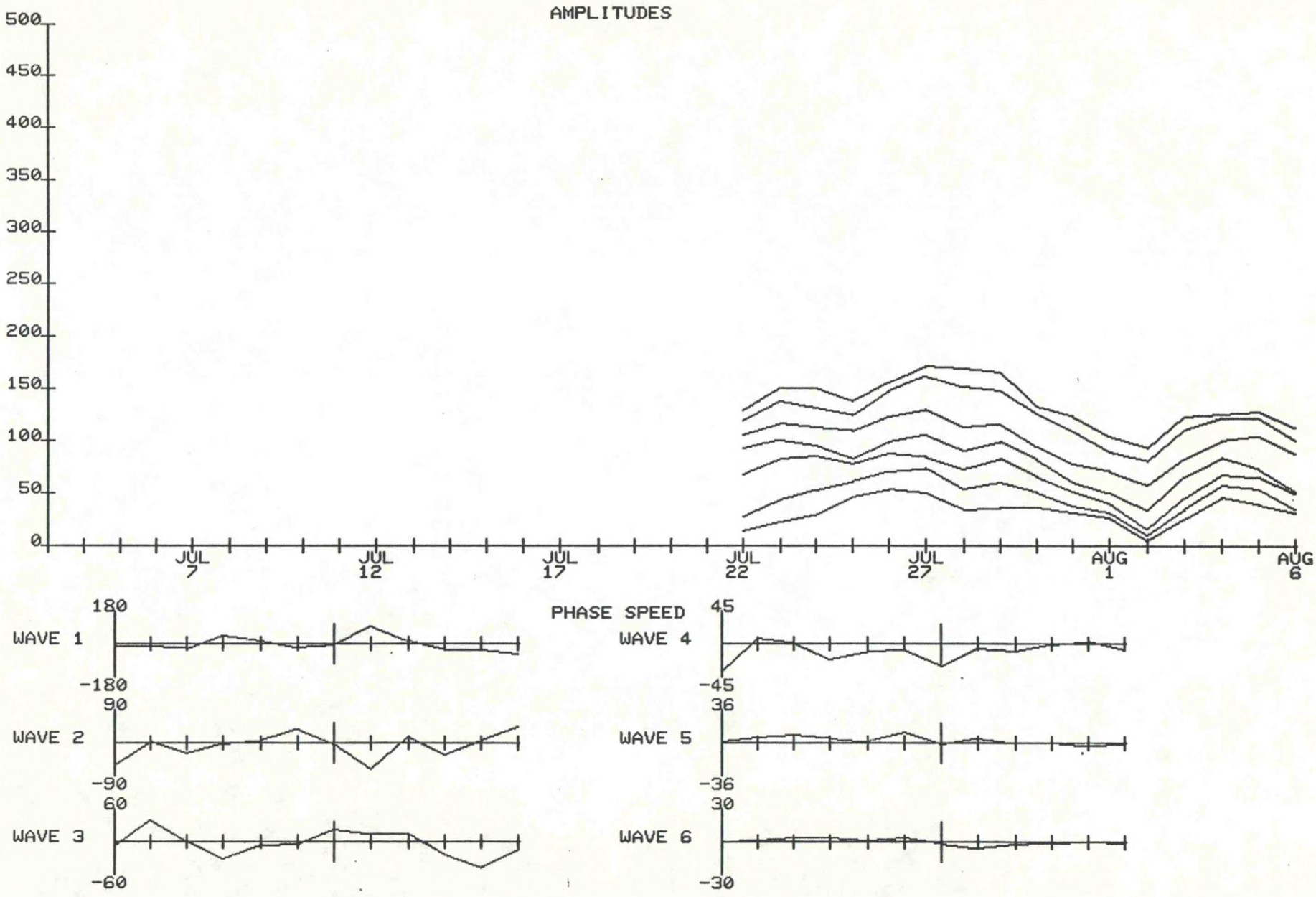

Figure 4: Spectral Wave Analysis chart (AFOS graphic)

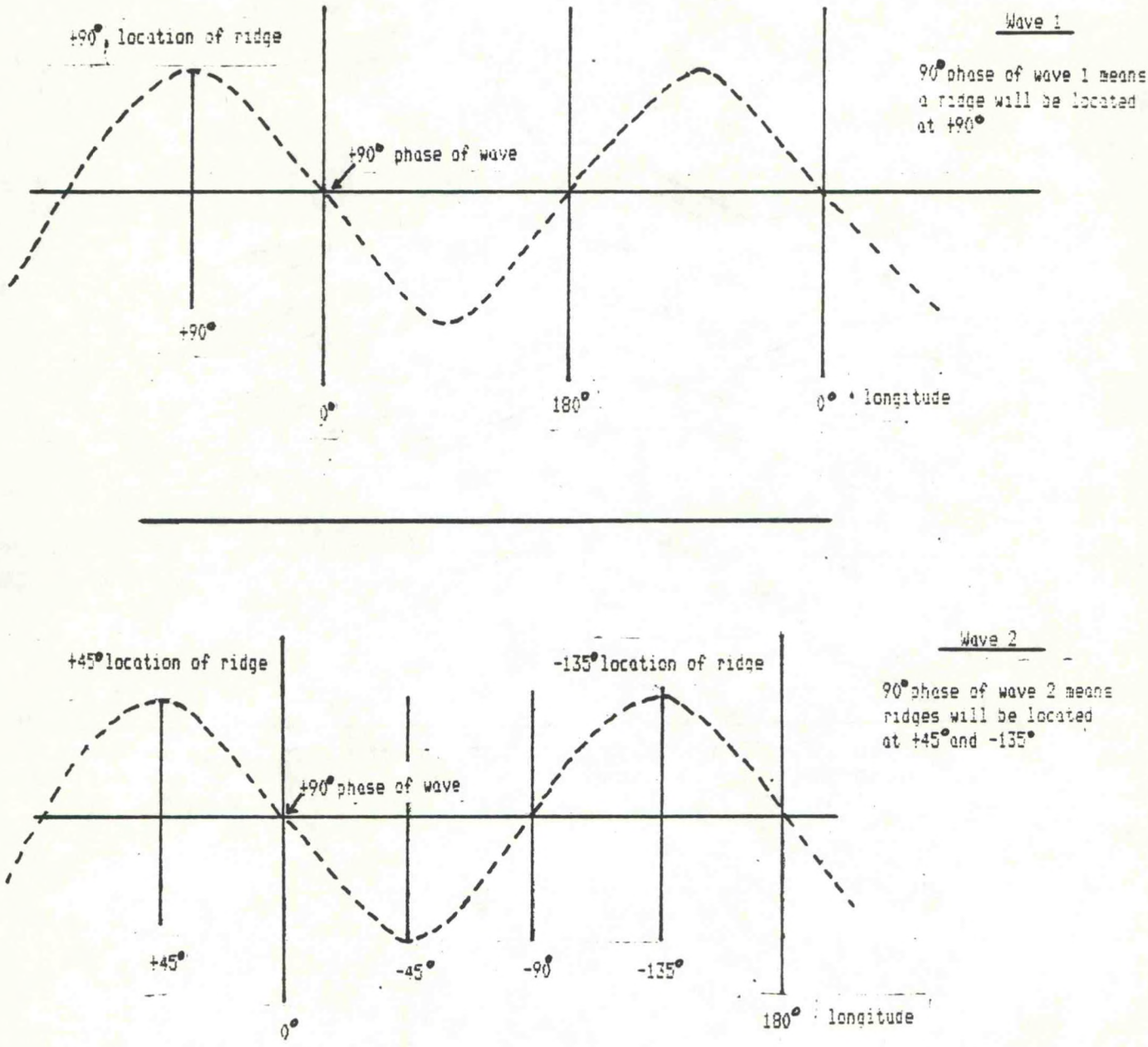

Figure 5: Calculated phase to global wave position conversion

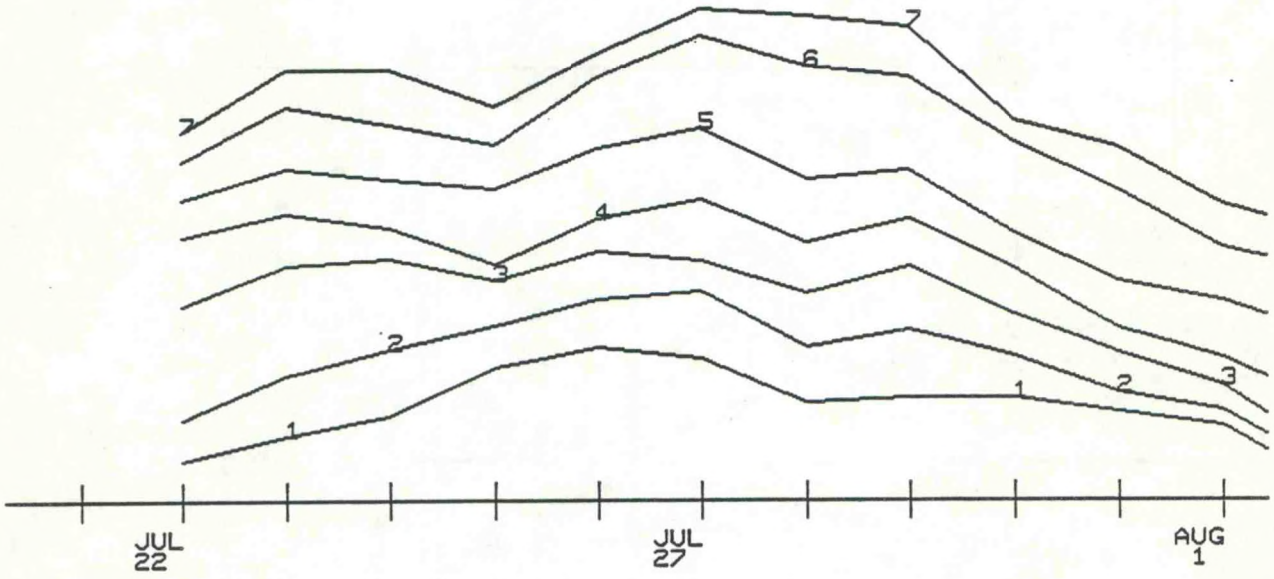

Figure 6: Spectral Wave Analysis chart showing amplitude wave numbers (at 4:1 zoom)

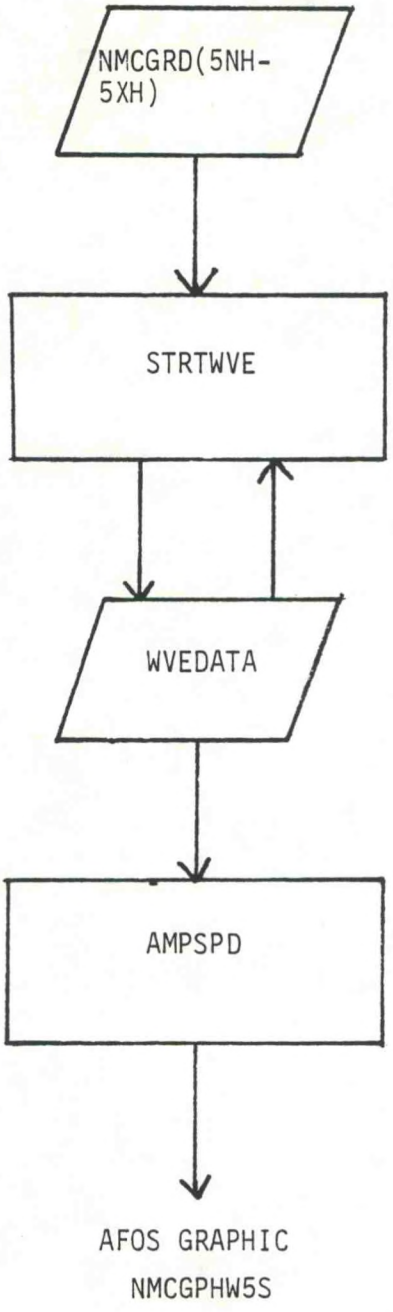

Figure 7: Program and Data File Interactions

NOAA Computer Programs and Problems NWS WR (continued)

36 Soaring Forecast Program. David S. Toronto, July 1982. (PB85 112274)
37 Program to Work Up Climatic Summary Weather Service Forms (F-6, F-52). Peter G. Mueller, August 1982. (PB85 109866)
38 The Hovmoller Diagram. Pamela A. Hudadoff, September 1982. (PB85 112159)
39 850-Millibar Charts Derived from Surface Data. Jeffrey L. Anderson, December 1982. (PB85 112175)
40 AFOS Vector Graphic to Grid Point Program. James R. Fors, December 1982. (PB85 109544)
41 A Pilot Briefing Program for the Background Partition. Kenneth B. Mielke and Joe L. Johnston, March 1983. (PB85 109551)
42 AEV Local Verification for Aviation, Precipitation, and Temperature Programs: AV, REl, TEM. Lawrence B. Dunn, Revised May 1985. (PB85 210342/AS)
43 OBLOG. Nancy Larsen, December 1983. (PB85 109528)
44 Communications Software for Olympics Micromation Computer System. Glen Sampson, June 1984. (PB85109510)
45 PLOTFILE Appender. Wendy L. Wolf, July 1984. (PB85 109502)
46 Spectral Wave Data Analysis (Non-directional). Lawrence Dunn, August 1984. (PB85 109577)
47 Isentropic Objective Analysis. Jeffrey L. Anderson, August 1984. (PB85 112167)
48 Hurricane Plotting Program. Paul D. Tolleson, October 1984. (PB85 121432)
49 Hemispheric Spectral Wave Analysis (Waves 0 to 7). Mary F. Milkovich, August 1985.
50 AOS Graphic to Grid Point Conversion and Departure from Normal Programs. Jeffrey L. Anderson and Mark A. Mathewson, August 1985.
51 Sunrise/Sunset. Glenn R. Lussky, August 1985.

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