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PSGRAPH - A Plotting Program for PC-HARPO, PROFILE, CONPLT, and EIGEN

J.A. Harlan
R.Michael Jones
T.M. Georges

NOAA/Wave Propagation Laboratory

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PSGRAPH - A Plotting Program for PC-HARPO, PROFILE, CONPLT and EIGEN.

J.A. Harlan, R.M. Jones and T.M. Georges

ABSTRACT. We describe a FORTRAN computer program, PSGRAPH, that generates PostScript graphics files and PC-compatible screen graphics. Input for the program is provided by files produced by the PROFILE, CONPLT, and EIGEN programs and the PC version of the HARPO program. The program provides for user-selectable PostScript plotting parameters including text font size, magnification factor and line width of the plots. In addition, a data editing factor allows the user to reduce the size of the output PostScript file while retaining the resolution of the plot. Included is a floppy disk with computer programs and sample cases. Instructions for retrieving PSGRAPH via Internet are also given.

1. INTRODUCTION

1.1. What PSGRAPH Does

The PC version of HARPO (Georges et al., 1990), PROFILE (Harlan et al., 1991a), EIGEN (Weickmann et al., 1987), and CONPLT (Harlan et al., 1991b) programs produce ASCII text files which contain plotting commands. These commands are interpreted by PSGRAPH to produce PostScript plots as well as screen graphics using MicroSoft Graphics Library commands.

PSGRAPH is specifically designed to process the outputs of only PC-HARPO, PROFILE, CONPLT and EIGEN. The PSGRAPH program's primary function is to create publication quality plots using PostScript graphics. An additional function is to simultaneously produce screen graphics on PC-compatible video monitors. However, the screen graphics are designed to provide a quick preview of the PostScript graphics and thus are not as detailed.

NOTE: When referring to PC-HARPO, this report refers to PC-HARPO versions dated December 1990, or later. Included in Appendix A is a listing of the source code changes for subroutines in PC-HARPO which will update older PC-HARPO versions to be compatible with PSGRAPH.

1.2. For Non-PC Users

The PSGRAPH program can be used by non-PC users after some modification. The program is designed so that the PostScript graphics modules are separate from the screen graphics modules. Thus, you can either

1) replace the screen graphics modules with ones that would work on your operating system and display monitor, or

2) remove all the screen graphics modules and use only the PostScript output files. While this option might, at first, seem inadequate, there is commercially available software which makes it possible to display standard PostScript files on a video monitor. Thus the PostScript file could also be used to produce the screen graphics output.

1.3. What PSGRAPH Does Not Do

The program is not compatible with any input data other than that produced by PROFILE, PC-HARPO, EIGEN and CONPLT. In particular, as noted above, it is not compatible with PC-HARPO version 7-1-90.

Also, the program will not process TXTOUT files that are combined by the user from different programs, e.g., the output from PC-HARPO and PROFILE combined into a single TXTOUT file.

2. INSTALLATION

2.1. Installing PSGRAPH via the Distribution Disk

Copy the entire contents of the distribution disk to your working directory. The distribution floppy disk (1.2 MB, 5-1/4" IBM-PC/AT format) contains ASCII files that include FORTRAN source code, batch files, the input and the output files for the sample cases. Also included on the disk is the executable file, PSGRAPH.EXE, and a copy of the document you are reading.

A complete description of the contents of the disk is given in Appendix B.

2.2. Installing PSGRAPH via Internet

The PSGRAPH program and its peripheral programs (i.e., the contents of the distribution disk) can be obtained via Internet and anonymous FTP. The "anonymous" account contains a public directory, "pub", which contains a subdirectory "raytracing", which is divided into several more subdirectories. The subdirectory to "raytracing" called "psgraph" contains the files you will need. To access these files via anonymous FTP through the Internet, proceed as follows:

1. Log on to a host at your site that has an Internet connection and also supports the FTP command.

2. Invoke FTP by entering the Internet address of the server at the NOAA Wave Propagation Laboratory site:

    ftp pooh.wpl.erl.gov

    or

    ftp 140.172.32.11

3. Log in as "anonymous"

4. For the password, enter your complete Internet address, e.g., jah@node.dee.dum.gov

5. General instructions and information about the anonymous FTP account at our site is available in a file named "README" in the "pub" subdirectory.
   To transfer this file to your local host, first change to the "pub" directory:

    cd pub

    and then enter:

    get README   (Note that the name of the file is in uppercase.)

6. Change your current directory to the "raytracing/psgraph" subdirectory by entering:

    cd raytracing/psgraph

7. To transfer information about the psgraph subdirectory to your local host, enter:

    get readme.psg

    This file also contains information about updates/corrections to PSGRAPH.

8. To transfer those files in the psgraph subdirectory that you are interested in, enter:

    get filename

where filename is the name of a file that you want to transfer. You may also retrieve multiple files using "mget".

9. To return to your local host, enter:

    quit

3. SAMPLE CASES

The sample cases were produced by the PROFILE, PC-HARPO, CONPLT and EIGEN programs. The data files that were input to these programs are listed in Appendixes C1 through C5.

The distribution disk contains the data file which is input to PSGRAPH for each sample case, named "TXTOUTx". Also,included are the associated output PostScript files for sample case 1 and sample case 2.

3.1. Sample Case 1: Profile Plots

Sample case 1 for PSGRAPH is the same as that used by the companion report (Harlan et al.,1991a) for the PROFILE program. The input file is TXTOUT.

This sample results in six separate PostScript plots with the first plot having two sets of discrete data points superimposed on the plot curve. The fifth plot has a single set of data points superimposed on it. The PostScript plots are shown in Figs. 1 through 6.

Run the sample case as follows:

Type: RUNPS

You will be prompted for several input parameters. Type a carriage return for each (i.e., use the defaults).

The output PostScript file, PS.OUT, can then be sent to a PostScript printer. It should be identical to PS.SAM from the distribution disk.

3.2. Sample Case 2: PC-HARPO Ray Plots

Sample case 2 provides four rayplot examples. The input file is TXTOUT2. It was produced by the PC version of HARPO.

Type: RUNPS

For Input File Name, enter: TXTOUT2.

Enter defaults for all the other parameters.

The output file, PS.OUT, should be identical to PS2.SAM from the distribution disk.

The plots produced by the PostScript file are shown in Figs. 7 through 10.

3.3. Sample Case 3: Contour Plots

Sample case 3 provides seven contour plots. The input file is TXTOUT3. It was produced by the CONPLT program. This is the same sample case as that used by the companion report (Harlan et al., 1991b)

Type: RUNPS

For Input File Name, enter: TXTOUT3

Enter defaults for all the other parameters.

The plots produced by the PostScript file are shown in Figs. 11 through 17.

3.4. Sample Case 4: Plots from EIGEN

Sample Case 4 provides 2 plots. The two plots were produced by the EIGEN program. The input file is TXTOUT4.

Type: RUNPS

For Input File Name, enter: TXTOUT4

Enter defaults for all the other parameters.

The plots produced by the PostScript file are shown in Figs. 18 and 19.

3.5. Sample Case 5: Eigenray Plot from PC-HARPO

Sample Case 5 provides 1 plot. The plot was produced by the PC-HARPO program. The input file is for PSGRAPH is TXTOUT5. (The input to PC-HARPO was created by the EIGEN program for sample case 4.)

Type: RUNPS

For Input File Name, enter: TXTOUT5

Enter defaults for all the other parameters.

The plot produced by the PostScript file is shown in Fig. 20.

4. HOW TO USE PSGRAPH

4.1. Input and Output

There is only one input file to PSGRAPH: an ASCII file created by PROFILE, PC-HARPO, CONPLT or EIGEN programs. There is also interactive input, discussed in Section 4.2.1.

The output from PSGRAPH are a PostScript file and the screen graphics.

4.2. The Two Modes for Running PSGRAPH

The batch file RUNPS.BAT can be used to run PSGRAPH interactively or using redirection of standard input from a user-selected file that contains responses to the prompts for input parameters.

4.2.1. Interactive Mode

The interactive mode is the default mode. To use this mode, either:

Type: PSGRAPH

or

Type: RUNPS

You are then prompted for each input parameter.

4.2.1.1. Interactive Mode: User Responses to Prompts

4.2.1.1.1. Input File Name

The input file name can be any valid DOS file name with or without path (up to 80 characters).

Default: TXTOUT

4.2.1.1.2. Output PostScript File Name

The output PostScript file name can be any valid DOS file name with or without path (up to 80 characters).

Default: PS.OUT

4.2.1.1.3. Advanced Features

Type a "y" or "Y" to see the advanced features choices. A new screen will appear which will enable you to choose your own PostScript scale factor, PostScript font size, PostScript line width, rayplot-editing factor and slow motion factor. If the default, "n" or "N", is chosen, PSGRAPH will use the defaults for all of the following plotting features.

Default: N (= Use defaults for the advanced features)

4.2.1.1.3.1. PostScript Scale Factor

The PostScript scale factor controls both the horizontal and vertical scales in the PostScript output file. If the scale factor is less than 1, the resulting plot is smaller than the default. If it is greater than 1, the plot is larger. For 8.5" x 11" paper, a factor of 1 results in a plot that uses about three-quarters of the page.

Default: 1.0

4.2.1.1.3.2. PostScript Font Size

The PostScript font size controls the size of the text for the axes labels. The font for the title of the plot is 1.5 times larger than the input font size. The font type, which is not user-selectable, is Helvetica.

Default: 12

4.2.1.1.3.3. PostScript Line Width

The PostScript line width is entered in inches. It controls the width of the lines (curves) drawn inside the frame. The frame is always drawn with a line width of .01 inches. The frame line width is not user-selectable.

Default: .01

4.2.1.1.3.4. Ray-Editing Factor for PostScript Files

When plotting output from PC-HARPO, this parameter allows you to reduce the size of the PostScript file and reduce the execution time of PSGRAPH by reducing the number of points that are written to the output PostScript file. This can be done without loss of resolution in the plot because the ray plot resolution is much higher than that of PostScript for an 8.5" x 11" page. The units of this parameter are HARPO plotting units, which divide the plotting area into 10240 by 10240. Essentially, without any editing factor, there would be line segment "draw" commands that would result in lines smaller than would be resolved by PostScript. Since the PostScript files can be very large when no editing is done, e.g., hundreds of Kbytes, editing provides a means of reducing the size of the file without loss of information. An added bonus is that execution time of PSGRAPH is decreased because of the decrease in WRITEs to the disk.

If the size of the PostScript file is of primary concern, the editing factor can be increased to the maximum. There may be an acceptable loss in resolution. This must be tested on a plot-by-plot basis.

The editing factor does not apply to profiles, contour plots or plots produced by the EIGEN program.

Default: 10.0

4.2.1.1.3.5. Slow Motion Factor

The slow motion factor enables the user to slow the plotting on the screen for raypath plots, that is, plots produced by PC-HARPO. The larger the value selected, the slower the plotting will be. This feature can be especially helpful when viewing vertical projections which are transverse to the raypath e.g., Fig. 10.

Default: 1.0 (no slow motion)

4.2.2. Standard Input Redirection Mode

The standard input redirection mode uses the RUNPS batch file to redirect standard input from the keyboard to a file chosen by the user. This frees the user from having to enter responses from the keyboard. The file must consist of at least 3 lines of text, one per each PSGRAPH prompt on the main screen. If advanced features other than the defaults are to be used, then at least 8 lines are necessary.

In addition, there must be a response for each plot to be displayed on the screen. The response consists of an "n" or a "y": "y" instructs the program to pause after the plot, "n" indicates no pause. These responses are necessary because the program is waiting for user response after each plot is made. If a pause has been directed, the program will pause for 20 seconds after the plot. A timer is visible in the upper right corner of the screen plot. See the file REDIRECT.SAM for a sample file of responses. (NOTE: The REDIRECT.SAM file could be used to run the sample case using redirected input.) This provides the user with a means to produce PostScript plots in a "mass production" manner. Also, this method may be useful when the screen graphics are not of interest.

To use this mode,

Type: RUNPS fname

where fname is the file containing the responses to the prompts (e.g., REDIRECT.SAM).

TIP FOR REDIRECTED INPUT FILES: If you are unsure of the number of plots that will be created from the input data, simply enter many more rows of "n" or "y" than you think there are plots. There is no problem if there are too many responses, but too few responses will result in a FORTRAN run-time READ error.

4.3. Troubleshooting

4.3.1. CLRS - Resetting the Terminal to Text Mode

If a run-time error occurs while running PSGRAPH or if the user interrupts the program via CTRL-C, the user must reset the terminal to text mode. An executable file, CLRS.EXE, is provided to do this. Type:

```
CLRS
```

4.3.2. Integer Overflow Errors

Most of the screen graphics use integer*2 variables. If the user encounters an integer overflow error, it usually indicates that there are one or more invalid values in the input (TXTOUT) file.
These values would typically be one of the maximum, minimum or interval values for a

particular plot. Check the input to the program e.g., PROFILE, which produced the TXTOUT file and the TXTOUT file itself for any invalid values.

4.3.3. READ Errors while Reading TXTOUT

These errors can occur if the TXTOUT file contains one or more invalid values. Look at the TXTOUT file for asterisks in place of a value, which indicates that the value's magnitude exceeded the FORTRAN format given to it.

4.3.4. SHOWMODE - Determining Your Monitor's Video Mode

This program is provided to help the user troubleshoot problems with video setup. Enter: SHOWMODE and compare the values returned from the program with the values given in the MicroSoft FGRAPH.FD file. Each value indicates a particular type of video monitor e.g., 16 = EGA 16 color with 640 by 350 pixels.

5. HOW PSGRAPH WORKS

5.1. Basic Overview

The input file to the PSGRAPH program must have been created by PROFILE, PC-HARPO, EIGEN, or CONPLT. PSGRAPH reads the file and interprets each line as either a plotting command or as data associated with a plotting command. Then, an appropriate PostScript command is written to the output PostScript file and an appropriate MicroSoft graphics library function/subroutine is called.

5.2. Program File Structure

The source code has been divided into two files: PSGRAPH1.FOR and PSGRAPH2.FOR

PSGRAPH1.FOR contains the main program module and all the subroutines that write to the PostScript file.

PSGRAPH2.FOR contains all the subroutines with Microsoft Graphics Library references.

This structure allows users to replace the MicroSoft Graphics Library references with their own graphics routines or to eliminate the screen graphics entirely.

5.3. Program Functional Structure

In addition to the division between subroutines for PostScript plotting and screen plotting, there is a division between subroutines that perform functions for PROFILE input and those that are for PC-HARPO input. This division was necessary because of the very different structure of the two types of input. (CONPLT is similar in most ways to PC-HARPO but has important differences. Likewise, EIGEN is closely related to PROFILE but also has distinct features of its own.) The difference is primarily due to the use of different plotting commands. For the user who is interested in these command details, the source files contain explicit comments about all commands.

Also, the screen graphics routines have been divided into very specific functional modules, e.g., clearing the screen, labelling axes etc. This will make it easier for the user to convert to another graphics system.

Although the files produced by PROFILE/PC-HARPO/CONPLT/EIGEN (e.g., TXTOUT) contain a combination of DISSPLA plotting commands and "meta-plotting-commands" (Tables 1 and 2), many of the DISSPLA commands are not applicable or are unnecessary for PostScript. These commands are ignored by PSGRAPH (see Table 2). The "meta-commands" were created specifically for use by PSGRAPH. Appendix D contains the FORTRAN format specifications for all the plotting commands produced by the four raytracing programs mentioned above.

5.4. Some Features of PSGRAPH

5.4.1. Color Contour Lines

PSGRAPH will determine whether the user's video monitor has color capability. If it does, each contour level will be drawn with a separate color, starting with blue for the lowest contour level. The program will continue changing the color for each level until all the available colors have been used, at which time it will return to blue and cycle through the colors again. Color contour lines are not currently implemented for the PostScript file. Note that for a typical 16-color monitor, only 14 colors are used; black and light white are not used.

5.4.2. Multiple Data Sets Superimposed on Plots

If the input data file to a program (e.g., PROFILE) contains tabular data, the points in the tabular data are represented by a small circle centered about the point. If there is more than one tabular data set, they are represented by symbols in the following order:

1. Small circle
2. Small square
3. Large circle
4. Large square

If the user requires more than four data sets on a single plot, the PSGRAPH program can be easily modified. See subroutine INIT_PS_FILE in the source code file PSGRAPH1.FOR.

5.4.3. Noninteger Intervals between Tick Marks

This feature provides the ability to plot an axis with different intervals between tick marks. For example, the user may choose, in the input file to the PROFILE program, a depth range of -3.0 km to +0.1 km.

5.4.4. Auto-Varying Formats for Axis Labels

The maximum, minimum and increments for an axis can vary widely from plot to plot. For example, sound speeds may typically be on the order of 1 km/sec whereas current speeds may be on the order of 10-5 km/sec. PSGRAPH will change the label format to handle the entire range of an axis depending on the minimum, maximum, and increment values.

6. References

Georges, T.M., R.M. Jones, and R.S. Lawrence, 1990, A PC version of the HARPO ocean acoustic ray-tracing program, NOAA Tech. Memo. ERL WPL-780, NOAA Environmental Research Laboratories, Boulder, Colorado, 18 pp. + disk.

Harlan, J.A., T.M. Georges, and R.M. Jones, 1991a, PROFILE--A program to generate profiles from HARPO/HARPA environmental models, NOAA Tech. Memo. ERL WPL-198, NOAA Environmental Research Laboratories, Boulder, Colorado, 46 pp. + disk.

Harlan, J.A., R.M. Jones, and T.M. Georges, 1991b, CONPLT--A program to generate contour maps from HARPO/HARPA environmental models, NOAA Tech. Memo. in preparation.

Weickmann, A.M., J.P. Riley, T.M. Georges, and R.M. Jones, 1989, EIGEN--A program to compute eigenrays from HARPA/HARPO raysets, NOAA Tech. Memo. ERL WPL-160, NOAA Environmental Research Laboratories, Boulder, Colorado, 91 pp.

Appendix A. Source Code Changes to PC-HARPO Necessary for PSGRAPH Compatibility

Note: Because of the extensive changes to Subroutine Plot, the entire subroutine is listed. The lower case code is new.

```
C*********************************************************************
      SUBROUTINE PLOT (X,Y,NEW)
C*********************************************************************
C     PLOTS ONE VECTOR FROM CURRENT PLOT POSITION TO POINT(X,Y)
C     TAKING BORDER CROSSINGS INTO ACCOUNT.
C%    NEW = 0 means draw a line to X,Y;
C%    NEW .ne. 0 means move to X,Y without drawing a line.

      implicit double precision (a-h,o-z)

      COMMON /PLT/ XMIN0,XMAX0,YMIN0,YMAX0,RESET
      COMMON/PLT/RMIN,RMAX,ALPHA,APLT
      INTEGER REZFLG
      PARAMETER (REZFLG=2001)
      COMMON/DDREZ/DDHIX,DDHIY
      COMMON/RAYDEV/NRYIND,NDEVTMP,NFRMAT,NDEVGRP,NDEVBIN
      COMMON /DD/ INT,IOR,IT,IS,IC,ICC,IX,IY

C**** The following variables were added to handle the "buffering" of all
C     the "lineto" data i.e. calls to DDVC_ACUM.
C     After each "moveto", the x and y values for the "lineto"s
C     will be stored in IXTMP and IYTMP.  Then, a single write to NDEVGRP
c     is performed which writes all NUMPTS values.  NUMPTS is then reset
C     and the process starts over.

      integer*2 numpts, ixtmp(3000), iytmp(3000)

      character*12 lastcmd

C.....OUTRANGE handles cases when the moveto is off the plotting area.
C     This may be followed by a lineto which is on the plotting area, so
C     we want to be sure that the part of the line that falls in the
C     plotting area will show up on the plot.

      logical outrange

      data lastcmd/'            '/

C DEFINE NOMINAL PLOTTING AREA(ZERO SUFFIXES) AND AN
C OUTER CLIPPING BOUNDARY BEYOND WHICH NO VECTORS EXTEND.
      DATA XOLD,YOLD/0.0,0.0/
C 90% FOR Y RANGE
C
C          COMPUTE SCALE FACTORS

    1 IF (RESET.EQ.0.d0) GO TO 5
      RESET=0.d0
      IF(APLT.EQ.2.d0) THEN
         MRNGE=723
```

```
            MINX0=165
            MINY0=140
         ELSE
            MRNGE=813
            MINX0=165
            MINY0=140
         ENDIF
         if(aplt.eq.4.d0) miny0=80
C
         MAXX0=MINX0+MRNGE
         MAXY0=MINY0+MRNGE
C
         XSCALE=(MAXX0-MINX0)/(XMAX0-XMIN0)
         YSCALE=(MAXY0-MINY0)/(YMAX0-YMIN0)
         XMIN=XMIN0
         YMIN=YMIN0
         XMAX=XMAX0
         YMAX=YMAX0
         IF(APLT.EQ.2.d0) GO TO 5
C
         XMIN=-ALPHA
         XMAX=ALPHA
         YMIN=RMIN
         YMAX=RMAX
         IF(APLT.NE.4.d0) GO TO 5
         YSCALE=.85d0*YSCALE
         MINY0=MINY0+60
C
C             START A NEW LINE
C             HORIZONTAL DISPLACEMENT
5        XS=X-XOLD
         YS=Y-YOLD
         S=1.d0
         IF(NEW.EQ.0) GO TO 10

         IF(X.GE.XMIN.AND.X.LE.XMAX.AND.Y.GE.YMIN.AND.Y.LE.YMAX) then
              GO TO 48
         else
              outrange=.true.
              GO TO 50
         endif
C
10       IF (XS) 11,12,16
C             NEGATIVE
      11 X1=XMAX
         X2=XMIN
         GO TO 20
C             ZERO
      12 IF (YS) 13,50,14
      13 S1=(YMAX-YOLD)/YS
         S2=(YMIN-YOLD)/YS
         GO TO 40
      14 S1=(YMIN-YOLD)/YS
         S2=(YMAX-YOLD)/YS
         GO TO 40
```

```
C           POSITIVE
   16 X1=XMIN
      X2=XMAX
C
C           VERTICAL DISPLACEMENT
   20 IF (YS) 21,22,26
C           NEGATIVE
   21 Y1=YMAX
      Y2=YMIN
      GO TO 30
C           ZERO
   22 S1=(X1-XOLD)/XS
      S2=(X2-XOLD)/XS
      GO TO 40
C           POSITIVE
   26 Y1=YMIN
      Y2=YMAX
C
   30 S1=DMAX1((X1-XOLD)/XS,(Y1-YOLD)/YS)
      S2=DMIN1((X2-XOLD)/XS,(Y2-YOLD)/YS)
C
C           PLOT LINE -- CHECKING FOR BORDER CROSSINGS
40    IF (S2.LT.0.d0.OR.S1.GT.1.d0) then
           GO TO 50
      endif
      IF (S1.LT.0.d0) GO TO 42
C           PREVIOUS POINT OFF GRAPH
      XP=XOLD+XS*S1
      YP=YOLD+YS*S1
      IF(APLT.EQ.2.d0.OR.APLT.EQ.4.d0) GO TO 41
      T=XP
      XP=YP*dSIN(T)
      YP=YP*dCOS(T)
C
41    DDHIX=MINX0+(XP-XMIN0)*XSCALE+0.5d0
      DDHIY=MINY0+(YP-YMIN0)*YSCALE+0.5d0
C     USE SPECIAL HI-REZ MODE
      IX=REZFLG

      if (outrange .and. lastcmd.eq.'            ') then
           WRITE (lastcmd,333) 1,idint(1.d1*ddhix),
     &                          idint(1.d1*ddhiy)
      endif
      GO TO 48
C
42    IF (S2.GT.1.d0) GO TO 48
C           CURRENT POINT OFF GRAPH
      S=S2
C           CURRENT POINT ON GRAPH
48    XP=XOLD+XS*S
      YP=YOLD+YS*S
      IF(APLT.EQ.2.d0.OR.APLT.EQ.4.d0) GO TO 49
      T=XP
      XP=YP*dSIN(T)
      YP=YP*dCOS(T)
```

```
49    DDHIX=MINX0+(XP-XMIN0)*XSCALE+0.5d0
      DDHIY=MINY0+(YP-YMIN0)*YSCALE+0.5d0
C     USE SPECIAL HI-REZ MODE
      IX=REZFLG
ccccc    IF(NEW.EQ.0) CALL DDVC

C The basic idea here is that when NEW = 0,
C the program accumulates "lineto" (i.e. DDVC) commands in IXTMP,IYTMP.
C Then, when NEW is not equal to 0, we are beginning a new line.  This
C requires a "moveto" (i.e."1 ix iy") command.  It is necessary, when a new
C "moveto" occurs that all "lineto"s that have been accumulated be
C "flushed".
C Occasionally, the plotting routines write some redundant "moveto"s, i.e.
C a "moveto" followed immediately by another "moveto" (sometimes to the
C same location!) with NO intervening "lineto"s.  This results in NUMPTS=
0.
C We ignore these movetos and do not flush.
C

C.....Handle very large plots. The IXTMP, IYTMP arrays are only dimensioned
C     to 3000.    This reduces the size of the executable file, decreases
C     the amount of memory used and increases execution speed.
C     Therefore, when 3000 is reached and the line is not yet finished,
C     write the 3000 pairs that have been accumulated.

      if (new.eq.0 ) then
       call DDVC_ACUM (numpts,ixtmp,iytmp)
           if (numpts .eq. 3000) then
                WRITE (ndevgrp,444) lastcmd
                  WRITE (ndevgrp,99) 3000
                do ii = 1, 3000-7,8               !  3000/8 pairs per row =
                                                   !  375 rows
                   WRITE (ndevgrp,111) (ixtmp(j),iytmp(j),j=ii,ii+7)
               enddo

C...............Save the last point as a moveto command in LASTCMD so we
can
C               pick up where we left off.
                WRITE (lastcmd,333) 1,ixtmp(3000),iytmp(3000)
            numpts = 0
          endif
      endif

C
C.....The call to DDBP only sets values of DDHIX,DDHIY, IX, IY.
C     It does not write to NDEVGRP.

      IF(NEW.NE.0) then
          call DDBP

C.........If we have accumulated any points, flush IXTMP, IYTMP.

          if (numpts .gt.0) then
              WRITE (ndevgrp,444) lastcmd    ! the moveto command
             WRITE (ndevgrp,99) numpts
```

```
             nremain = MOD(numpts,8)
             if (numpts .ge. 8) then
                 do ii = 1, numpts-7, 8
                    WRITE (ndevgrp,111)(ixtmp(j),iytmp(j),j=ii,ii+7)
                 enddo
             endif

C............if NUMPTS was not evenly divisible by 8, then the
C............remaining points are written to the file one per line.

            if (nremain.gt.0) then
                 WRITE (ndevgrp,222)
     &                (ixtmp(k),iytmp(k),k=numpts-nremain+1,numpts)
            endif
         endif

C.........Store the moveto command whenever NUMPTS = 0, or
C         whenever NEW is not 0 (i.e. a moveto occurs).  Either way, reset
C         NUMPTS.
C.........We write the moveto to a character string which is later written
C         to NDEVGRP.

          WRITE (lastcmd,333) 1,idint(1.d1*ddhix), idint(1.d1*ddhiy)

          numpts = 0   ! reset for DDVC_ACUM

      endif  !    new .ne. 0

99    FORMAT (I5)
111   FORMAT (8(2I5))
222   FORMAT (2I5)
333   FORMAT (I2,2I5)
444   format (a)
555   format (1x,a)

C          EXIT ROUTINE
   50 XOLD=X
      YOLD=Y
C.....Handle a moveto that is off the plotting area.

      if (outrange .and.new.ne.0)then
           if (numpts.gt.0) then
               WRITE (ndevgrp,444) lastcmd
               WRITE (ndevgrp,99) numpts
               nremain = MOD(numpts,8)
               if (numpts .ge. 8) then
               do ii = 1, numpts-7, 8
                  WRITE (ndevgrp,111)(ixtmp(j),iytmp(j),j=ii,ii+7)
               enddo
           endif

C..........if NUMPTS was not evenly divisible by 8, then the
C..........remaining points are written to the file one per line.

           if (nremain.gt.0) then
```

```
                 WRITE (ndevgrp,222)
     &                      (ixtmp(k),iytmp(k),k=numpts-nremain+1,numpts)
             endif
              numpts = 0
              lastcmd = '            '
            endif
        endif
        RETURN
C
C            TERMINATE THE CURRENT PLOT
C**********************************************************************
        entry pltend
C**********************************************************************
C        ENTRY PLTEND(X,Y,NEW)
        CALL DDFR
C
        RETURN
           END
```

Appendix B. Contents of the Distribution Disk

PSGRAPH1.FOR PSGRAPH2.FOR	- These two source code files comprise the entire source code for the PSGRAPH program.
PSGRAPH.EXE	- The executable file
RUNPS.BAT	- A DOS batch file for running PSGRAPH with either interactive input or redirected input.
TXTOUT	- Input data file for sample case 1, Profile Plots.
TXTOUT2	- Input data file for sample case 2, Ray Plots.
TXTOUT3	- Input data file for sample case 3, Contour Plots.
TXTOUT4	- Input data file for sample case 4, Eigen Plots.
TXTOUT5	- Input data file for sample case 5, Eigenray Plot.
PS.SAM	- Output PostScript file for sample case 1.
PS2.SAM	- Output PostScript file for sample case 2.
REDIRECT.SAM	- Example file for redirection of standard input
PSGRAPH.DOC	- The document you are reading.
CLRS.EXE CLRS.FOR	- Source code and executable file for the program that returns the video screen to text mode.
SHOWMODE.EXE SHOWMODE.FOR	- Source code and executable file for a program that displays the current video mode.

Appendix C1. Input Data File Listing for Sample Case 1

```
MIKE=JONES=RL3=X6464
0T6  MUNK'S 1974 UNIFORM SOUND CHANNEL WITH VVORTEX CURRENT MODEL 3
 29 1.                  1=PROCESS PROFILE RUNSET, 0=SKIP RUNSET
 83 0.           AN KM  LEFT LATITUDE OF PLOT, KM
 84 0.           AN KM  LEFT LONGITUDE OF PLOT, KM
 88-5.00000000000       HEIGHT ABOVE SEA LEVEL OF BOTTOM OF GRAPH, KM
 89 0.                  HEIGHT ABOVE SEA LEVEL OF THE TOP OF THE GRAPH
 90 1.00000000000       SELECT SOUND SPEED
 92 1.49000000000       HORIZONTAL AXIS MINIMUM
 93 1.54000000000       HORIZONTAL AXIS MAXIMUM
 94 .010000000000LN KM  HORIZONTAL AXIS TICK MARK INTERVAL
 96 1.00000000000       DISTANCE BETWEEN VERTICAL TICK MARKS, KM
100       9.            VVORTX3 MODEL CHECK NUMBER
 -1                     DATA SUBSET FOR BACKGROUND CURRENT MODEL
  A  VORTEX AT LONGITUDE 150 KM E, UMAX= 1.02 M/S, R= 50 KM
  0       RETURN TO W-ARRAY DATA SET
102       3.             VVORTX3 BACKGROUND CURRENT DATA SET ID
103     1.02     LN  M   MAXIMUM TANGENTIAL CURRENT, M/S
104      50.             RADIUS OF VORTEX CORE, KM
105       0.     AN KM   LATITUDE OF VORTEX CENTER, KM
106     150.     AN KM   LONGITUDE OF VORTEX CENTER, KM
107       1.             VERTICAL HALF-WIDTH OF VORTEX, KM
108      -1.             HEIGHT OF VORTEX CENTER ABOVE MSL, KM
125       0.            NPCURR MODEL CHECK NUMBER
 -2                     DATA SUBSET FOR PERTURBATION CURRENT MODEL
  A  NO CURRENT PERTURBATION
  0       RETURN TO W-ARRAY DATA SET
150 5.00000000000       CSMUNK1 SOUND SPEED MODEL
152 2.00000000000       INPUT DATA SET ID NUMBER
153 1.00000000000       REFERENCE SOUND SPEED
154 0.           AN KM  PH1 LONGITUDE 1
155 1.49200000000       CA1 SOUND SPEED ON AXIS
156-1.30000000000       ZA1 DEPTH OF AXIS
157 1.30000000000       H1 SCALE DEPTH
158 .007400000000       EP1 FRACTIONAL INCREASE OF C WITH DEPTH
159 1000.00000000AN KM  PH2 LONGITUDE 2
160 1.49200000000       CA2 SOUND SPEED ON AXIS
161-1.30000000000       ZA2 DEPTH OF AXIS
162 1.30000000000       H2 SCALE DEPTH
163 .007400000000       EP2 FRACTIONAL INCREASEE OF C WITH DEPTH
175 0.0                 NPSPEED - DO NOTHING SPEED PERTURBATION MODEL
200 1.0                 TLINEAR MODEL CHECK NUMBER
201 1.                  DATA FORMAT CODE
202 1.                  DATA SET ID NUMBER
203 293.                BOTTOM TEMPERATURE, DEGREES KELVIN
204 2.3                 TEMPERATURE GRADIENT, DEGREES KELVIN/KM
225 0.                  NPTEMP, DO-NOTHING TEMPERATURE PERTURBATION
275 1.00000000000       RHORIZ RECEIVER MODEL CHECK NUMBER
300       4.            GLORENZ BOTTOM MODEL CHECK NUMBER
302       3.             GLORENZ BOTTOM MODEL DATA SET ID
303       .5             HEIGHT OF RIDGE, KM ABOVE BASE
```

```
304        10.    AN KM   N. LATITUDE OF RIDGE CENTER, KM
305         2.    AN KM   HALF-WIDTH OF THE RIDGE, KM
306        -3.            HEIGHT ABOVE MSL OF BASE OF RIDGE, KM
325         0.            DO-NOTHING BOTTOM PERTURBATION
  0
0T6    SAMPLE SOUND SPEED DATA POINTS
 90-42.0000000000       NEGATIVE VALUE = SUPERIMPOSE DATA POINTS
-42                     ENTERING DATA SUBSET
  2      999.0
   LN KM        LN KM
 -.568240E-01  1.53400
 -.710503E-01  1.53282
 -.853171E-01  1.53165
 -.995969E-01  1.53048
 -.113850      1.52931
 -.128006      1.52814
 -.141939      1.52697
 -.155372      1.52581
 -.167350      1.52464
 -.177608      1.52348
 -.195094      1.52232
 -.212698      1.52117
 -.230376      1.52001
 -.248050      1.51886
 -.265561      1.51770
 -.282521      1.51655
 -.297255      1.51540
 -.313064      1.51426
 -.335598      1.51311
 -.358481      1.51197
 -.381655      1.51082
 -.404971      1.50968
 -.428009      1.50854
 -.448662      1.50741
 -.471800      1.50627
 -.503609      1.50514
 -.536853      1.50401
 -.571848      1.50288
 -.609165      1.50175
 -.650365      1.50062
 -.698865      1.49950
 -.733760      1.49837
 -.770014      1.49725
 -.806911      1.49613
 -.841016      1.49501
 -.843638      1.49390
 -.941190      1.49278
 -4.32248      1.53400
 -4.26850      1.53282
 -4.21328      1.53165
 -4.15665      1.53048
 -4.09840      1.52931
 -4.03821      1.52814
 -3.97557      1.52697
 -3.90943      1.52581
```

```
 -3.83637      1.52464
 -3.75539      1.52348
 -3.69719      1.52232
 -3.63710      1.52117
 -3.57480      1.52001
 -3.50979      1.51886
 -3.44119      1.51770
 -3.36717      1.51655
 -3.28030      1.51540
 -3.19451      1.51426
 -3.13375      1.51311
 -3.07037      1.51197
 -3.00377      1.51082
 -2.93298      1.50968
 -2.85600      1.50854
 -2.76490      1.50742
 -2.67538      1.50627
 -2.45335      1.50288
 -2.36103      1.50175
 -2.24327      1.50062
 -2.06858      1.49950
 -2.03932      1.49837
 -2.01206      1.49725
 -1.99054      1.49613
 -1.98684      1.49501
 -2.08138      1.49390
 -1.97047      1.49278
  999.000
  0                      RETURNING TO W ARRAY DATA SET
  0
0T6    SAMPLE SOUND SPEED DATA POINTS
 90-41.0000000000        NEGATIVE VALUE = SUPERIMPOSE ON PREVIOUS PLOT
-41                      NEGATIVE VALUE = TABULAR DATA SET FOLLOWS
  2      999.0
   LN KM        LN KM
 -2.66103      1.51175
 -2.54327      1.51062
 -2.40858      1.50950
 -2.40932      1.50837
 -2.40206      1.50725
 -2.38054      1.50613
 -2.28684      1.50501
 -2.30138      1.50390
 -2.27047      1.50278
  999.000
  0                      RETURNING TO W ARRAY DATA SET
  0
0T6  MUNK'S 1974 UNIFORM SOUND CHANNEL WITH VVORTEX CURRENT MODEL 3
 29 1.0000               1 = PROFILE, 0 = SKIP THIS RUNSET
 83 5.           AN KM  Latitude of the profile
 84 145.         AN KM  Longitude of the profile
 88-5.00000000000        Height above sea level of bottom of graph km
 89 0.                   HEIGHT ABOVE SEA LEVEL OF TOP OF GRAPH
 90 2.00000000000        CURRENT SPEED
 92 0.00000000000        Minimum speed km/s, m/s
```

```
 93 0.00000000000       Maximum speed km/s, m/s
 94 0.00000000000       Horizontal tick mark interval km/s, m/s
 96 1.00000000000       Vertical tick mark interval km
  0
0T6  MUNK'S 1974 UNIFORM SOUND CHANNEL WITH VVORTEX CURRENT MODEL 3
 29 1.0000              1 = PROFILE, 0 = SKIP THIS RUNSET
 83 5.           AN KM  Latitude of the profile   (rad, deg, km) north
 84 145.         AN KM  Longitude of the profile   (rad, deg, km) east
 88-5.00000000000       Height above sea level of bottom of graph   km
 89    0.               Height above sea level of top of graph  km
 90 4.00000000000       SOUTHWARD component of current velocity
 92 0.00000000000       Minimum speed km/s, m/s
 93 0.00000000000       Maximum speed km/s, m/s
 94 0.00000000000       Horizontal tick mark interval km/s, m/s
 96 0.00000000000       Vertical tick mark interval km
  0
0T6  MUNK'S 1974 UNIFORM SOUND CHANNEL WITH VVORTEX CURRENT MODEL 3
 29 1.0000              1 = PROFILE, 0 = SKIP THIS RUNSET
 83 5.           AN KM  Latitude of the profile  (rad, deg, km) north
 84 145.         AN KM  Longitude of the profile  (rad, deg, km) east
 88-5.00000000000       Height above sea level of bottom of graph  km
 89 0.                  Height above sea level of top of graph  km
 90 5.00000000000EASTWARD component of current velocity
 92 0.00000000000       Minimum speed  km/s, m/s
 93 0.00000000000       Maximum speed  km/s, m/s
 94 0.00000000000       Horizontal tick mark interval km/s, m/s
 96 1.00000000000Vertical tick mark interval km
  0
0T6    TLINEAR TEMPERATURE PROFILE
 29 1.0000              1 = PROFILE, 0 = SKIP THIS RUNSET
 83 5.           AN KM  Latitude of the profile   (rad, deg, km) north
 84 145.         AN KM  Longitude of the profile   (rad, deg, km) east
 88 0.00000000000       Height above sea level of bottom of graph   km
 89    3.               Height above sea level of top of graph  km
 90 7.00000000000       TEMPERATURE PROFILE
 92 290.000000000       Minimum temperature deg K
 93 300.000000000       Maximum temperature deg K
 94 0.00000000000       Horizontal tick mark interval deg K
 96 0.00000000000       Vertical tick mark interval km
   0
0T6    SAMPLE TEMPERATURE DATA POINTS
 90-45.0000000000       NEGATIVE VALUE = SUPERIMPOSE ON PREVIOUS PLOT
-45                     NEGATIVE VALUE = TABULAR DATA SET FOLLOWS
  2      999.0
 1.06103      295.1175
 1.04327      295.1062
 1.00858      295.0950
 1.10932      295.0837
 1.20206      295.0725
 1.38054      296.0613
 1.28684      296.0501
 1.40138      296.0390
 1.47047      296.0278
  999.000
  0                     RETURNING TO W ARRAY DATA SET
```

```
  0
0T6    GLORENZ TOPOGRAPHY PROFILE
 29 1.0000              1 = PROFILE, 0 = SKIP THIS RUNSET
 83 0.          AN KM  Left Latitude of plot   (rad, deg, km) north
 84 0.          AN KM  Longitude of plot  (rad, deg, km) east
 85 20.         AN KM  Right Latitude of plot  (rad, deg, km) north
 90 6.00000000000       TOPOGRAPHY PROFILE
  0
```

Appendix C2. Input Data File Listing for Sample Case 2

```
GEORGES   RB3    X6437
N01-Sample Case 2, Plot 1:  PSGRAPH Documentation
  1     6370.            EARTH RADIUS TO MSL, KM (6370.)
  3        2.           TTRANSMITTER HEIGHT ABOVE MSL (T=ABOVE BOTM),KM
  4        0.    AN KM  N. TRANSMITTER LATITUDE, KM
  5        0.    AN KM  E. TRANSMITTER LONGITUDE, KM
  7      400.    FQ HZ  INITIAL FREQUENCY, HZ
 11       80.    AN DG  INITIAL AZIMUTH ANGLE, DEG
 15        2.    AN DG  INITIAL ELEVATION ANGLE, DEG
 16        4.    AN DG  FINAL   ELEVATION ANGLE, DEG
 17        2.    AN DG  STEP IN ELEVATION ANGLE, DEG
 19        0.           STOP RAYS THAT STRIKE BOTTOM (1=YES; 0=NO)
 20       -1.           RECEIVER HEIGHT ABOVE MSL, KM
 22       50.           MAXIMUM NUMBER OF HOPS (1.)
 23     1000.           MAXIMUM NUMBER OF STEPS PER HOP (1000.)
 26        5.           MAXIMUM RAY HEIGHT ABOVE MSL, KM
 27       -5.           MINIMUM RAY HEIGHT ABOVE MSL, KM
 28      210.           MAXIMUM RANGE AT MSL, KM
 29        0.           DO:RAYTRC
 33       20.           MAXIMUM ABSORPTION, DB (999.999)
 42       1.0E-03       MAXIMUM SINGLE-STEP INTEGRATION ERROR (1.0E-4)
 44        .1           INITIAL INTEGRATION STEP SIZE, KM (1.0)
 57        2.           PHASE PATH  (0=NO;1=INTEGRATE;2=INTEGR/PRINT)
 58        2.           ABSORPTION  (0=NO;1=INTEGRATE;2=INTEGR/PRINT)
 60        2.           PATH LENGTH (0=NO;1=INTEGRATE;2=INTEGR/PRINT)
 71       50.           NUMBER OF INTEGRATION STEPS PER PRINT [1.E9]
 72        1.           OUTPUT RAYSETS (1=YES; 0=NO)
 73        0.           DIAGNOSTIC PRINTOUT (1=YES; 0=NO)
 74        0.           PRINT EVERY W(71) RAY STEPS (0=YES; 1=N0)
 76        1.           BINARY RAY OUTPUT (1=YES; 0=NO)
 77       76.           LINES PER PAGE OF PRINTOUT= 76. FOR HPLJ (57.)
 81        4.           RAYPLOT PROJECTION PLANE (2 = HORIZONTAL)
 82       40.           PLOT-ORDINATE EXPANSION FACTOR [1.]
 83        0.    AN KM  N. LATITUDE OF LEFT PLOT EDGE, KM
 84        0.    AN KM  E. LONGITUDE OF LEFT PLOT EDGE, KM
 85  35.265396   AN KM  N. LATITUDE OF RIGHT PLOT EDGE, KM
 86      200.    AN KM  E. LONGITUDE OF RIGHT PLOT EDGE, KM
 87       50.    AN KM  DISTANCE BETWEEN RANGE TICKS, KM
 88       -3.           HEIGHT ABOVE MSL OF BOTTOM OF GRAPH, KM
 89        0.           HEIGHT ABOVE MSL OF TOP OF GRAPH, KM
 96        1.           DISTANCE BETWEEN DEPTH TICKS, KM
100        9.           VVORTX3 MODEL CHECK NUMBER
102        3.           VVORTX3 BACKGROUND CURRENT DATA SET ID
103      1.02    LN  M  MAXIMUM TANGENTIAL CURRENT, M/S
104       50.           RADIUS OF VORTEX CORE, KM
105        0.    AN KM  LATITUDE OF VORTEX CENTER, KM
106      150.    AN KM  LONGITUDE OF VORTEX CENTER, KM
107        1.           VERTICAL HALF-WIDTH OF VORTEX, KM
108       -1.           HEIGHT OF VORTEX CENTER ABOVE MSL, KM
125        0.           NPCURR MODEL CHECK NUMBER
150        7.           CTANH SOUND SPEED MODEL CHECK NUMBER
152        1.           CTANH BACKGROUND SOUND SPEED DATA SET ID
```

```
175        2.           CBLOB2 SOUND SPEED PERTURB MODEL CHECK NUM
177        7.           CBLOB2 PERTURBATION SOUND SPEED DATA SET ID
178       .02           MAXIMUM FRACTIONAL INCREASE IN C SQUARED
179       -1.           HEIGHT OF MAX EFFECT ABOVE MSL, KM
180        0.    AN KM  LATITUDE OF MAX EFFECT, KM
181      150.    AN KM  LONGITUDE OF MAX EFFECT, KM
182        1.           VERTICAL HALF-WIDTH, KM
183       50.    AN KM  N-S  HALF-WIDTH, KM
184       50.    AN KM  E-W  HALF-WIDTH, KM
275        1.           RHORIZ RECEIVER MODEL CHECK NUMBER
300        4.           GLORENZ BOTTOM MODEL CHECK NUMBER
302        3.            GLORENZ BOTTOM MODEL DATA SET ID
303        .5            HEIGHT OF RIDGE, KM ABOVE BASE
304       10.    AN KM   N. LATITUDE OF RIDGE CENTER, KM
305        2.    AN KM   HALF-WIDTH OF THE RIDGE, KM
306       -3.            HEIGHT ABOVE MSL OF BASE OF RIDGE, KM
325        0.           NPBOTM MODEL CHECK NUMBER
350        1.           SHORIZ MODEL CHECK NUMBER
352        1.            SHORIZ OCEAN SURFACE DATA SET ID
353        0.            HEIGHT OF OCEAN SURFACE ABOVE MSL, KM
375        0.           NPSURF MODEL CHECK NUMBER
500        1.           SLLOSS ABSORPTION MODEL CHECK NUMBER
502        1.            SLLOSS ABSORPTION DATA SET ID
503     0.006    AM DB   A COEFFICIENT, DB
504    0.2635    AM DB   B COEFFICIENT, DB
505     1000.    FQ HZ   OMEGA1, HZ
506     1700.    FQ HZ   OMEGA2, HZ
525        0.           NPABSRP MODEL CHECK NUMBER
 -1                     DATA SUBSET FOR BACKGROUND CURRENT MODEL
  A  VORTEX AT LONGITUDE 150 KM E, UMAX= 1.02 M/S, R= 50 KM
  0        RETURN TO W-ARRAY DATA SET
 -2                     DATA SUBSET FOR PERTURBATION CURRENT MODEL
  A  NO CURRENT PERTURBATION
  0        RETURN TO W-ARRAY DATA SET
 -3                     DATA SUBSET FOR BACKGROUND SOUND-SPEED MODEL
  A  EL NINO BACKGROUND SOUND-SPEED PROFILE
  3     999.0
   LN  M       LN  M       LN  M
   0.          1532.       0.
   -20.        1531.5      -7.
   -50.        1509.       -20.
   -250.       1503.       -40.
   -450.       1485.       -300.
   -1500.      1485.       -400.
   -3000.      1508.       0.
   999.0
  0       RETURN TO W-ARRAY DATA SET
 -4                     DATA SUBSET FOR SOUND-SPEED PERTURBATION MODEL
  A  2% INCREASE IN C-SQUARED AT 150 KM LON., 1 KM DEPTH, 50 KM WIDE
  0       RETURN TO W-ARRAY DATA SET
 -8                     DATA SUBSET FOR RECEIVER-SURFACE MODEL
  A  RECEIVER SURFACE = SPHERE 1 KM BELOW MSL
  0       RETURN TO W-ARRAY DATA SET
 -9                     DATA SUBSET FOR BACKGROUND BOTTOM MODEL
  A  RIDGE .5 KM HIGH, 2 KM WIDE AT 10 KM N LATITUDE; BASE= -3 KM
```

```
  0       RETURN TO W-ARRAY DATA SET
-10                     DATA SUBSET FOR BOTTOM PERTURBATION MODEL
  A  NO BOTTOM PERTURBATION
  0       RETURN TO W-ARRAY DATA SET
-11                     DATA SUBSET FOR OCEAN SURFACE MODEL
  A  OCEAN SURFACE = SPHERE AT MSL
  0       RETURN TO W-ARRAY DATA SET
-12                     DATA SUBSET FOR OCEAN SURFACE PERTURBA MODEL
  A  NO OCEAN SURFACE PERTURBATION
  0       RETURN TO W-ARRAY DATA SET
-17                     DATA SUBSET FOR OCEAN ABSORPTION MODEL
  A  SKRETTING-LEROY ABSORPTION FORMULA
  0       RETURN TO W-ARRAY DATA SET
-18                     DATA SUBSET FOR PERTURBATION ABSORPTION MODEL
  A  NO ABSORPTION PERTURBATION
  0       RETURN TO W-ARRAY DATA SET
  0                     **********  END OF RUN SET NUMBER 1  *********
N01-Sample Case 2, Plot 2: PSGRAPH Documentation
 29      0.             DO: RAYTRC
 81      2.             HORIZONTAL PLOT PROJECTION
 82      80.            PLOT-ORDINATE EXPANSION FACTOR [1.]
 88     -1.             DEPTH OF HORIZONTAL PLANE, KM
 0                      ***********  END OF RUN SET NUMBER 2  ********
N01-Sample Case 2, Plot 3: PSGRAPH Documentation
 29       0.            DO: RAYTRC
 81        4.           RAYPLOT PROJECT. PLANE (4 = VERT. RECTANGULAR)
 82      180.           PLOT-ORDINATE EXPANSION FACTOR [1.]
 83    1.00000   AN KM  N. LATITUDE OF LEFT PLOT EDGE, KM
 84  -.1763269   AN KM  E. LONGITUDE OF LEFT PLOT EDGE, KM
 85   -1.00000   AN KM  N. LATITUDE OF RIGHT PLOT EDGE, KM
 86   .1763269   AN KM  E. LONGITUDE OF RIGHT PLOT EDGE, KM
 87       1.     AN KM  DISTANCE BETWEEN RANGE TICKS, KM
 88       -3.           HEIGHT ABOVE MSL OF BOTTOM OF GRAPH, KM
 0                      ***********  END OF RUN SET NUMBER 3  ********
N01-Sample Case 2, Plot 4: PSGRAPH Documentation
 29        0.           DO: RAYTRC
 81        3.           RAYPLOT PROJECT. PLANE (4 = VERT. RECTANGULAR)
 82      200.           PLOT-ORDINATE EXPANSION FACTOR [1.]
 83        0.    AN KM  N. LATITUDE OF LEFT PLOT EDGE, KM
 84        0.    AN KM  E. LONGITUDE OF LEFT PLOT EDGE, KM
 85 141.0615846  AN KM  N. LATITUDE OF RIGHT PLOT EDGE, KM
 86      800.    AN KM  E. LONGITUDE OF RIGHT PLOT EDGE, KM
 87      200.    AN KM  DISTANCE BETWEEN RANGE TICKS, KM
 88       -3.            HEIGHT ABOVE MSL OF BOTTOM OF GRAPH, KM
 89        0.            HEIGHT ABOVE MSL OF TOP OF GRAPH, KM
 96        1.            DISTANCE BETWEEN DEPTH TICKS, KM
 28      800.           MAXIMUM RANGE AT MSL, KM
 0                      ***********  END OF RUN SET NUMBER 4  ********
```

Appendix C3. Input Data File Listing for Sample Case 3

```
MIKE JONES RL3 X6464
N01-1     Sample Case for CONPLT Documentation
  1 6370.00000000       EARTH RADIUS TO MSL, KM (6370.)
  3 2.00000000000      TTRANSMITTER HEIGHT ABOVE MSL (T=ABOVE BOTM),KM
  4 0.           AN KM  N. TRANSMITTER LATITUDE, KM
  5 0.           AN KM  E. TRANSMITTER LONGITUDE, KM
  7 400.000000000FQ HZ  INITIAL FREQUENCY, HZ
 11 80.0000000000AN DG  INITIAL AZIMUTH ANGLE, DEG
 15 2.00000000000AN DG  INITIAL ELEVATION ANGLE, DEG
 16 16.0000000000AN DG  FINAL   ELEVATION ANGLE, DEG
 17 2.00000000000AN DG  STEP IN ELEVATION ANGLE, DEG
 19 0.                  STOP RAYS THAT STRIKE BOTTOM (1=YES; 0=NO)
 20-1.00000000000       RECEIVER HEIGHT ABOVE MSL, KM
 22 50.0000000000       MAXIMUM NUMBER OF HOPS (1.)
 23 1000.00000000       MAXIMUM NUMBER OF STEPS PER HOP (1000.)
 26 5.00000000000       MAXIMUM RAY HEIGHT ABOVE MSL, KM
 27-5.00000000000       MINIMUM RAY HEIGHT ABOVE MSL, KM
 28 210.000000000       MAXIMUM RANGE AT MSL, KM
 29 1.                  1=PROCESS RUNSET, 0=SKIP RUNSET
 33 20.0000000000       MAXIMUM ABSORPTION, DB (999.999)
 42  .1000000E-05       MAXIMUM SINGLE-STEP INTEGRATION ERROR (1.0E-4)
 44 .100000000000       INITIAL INTEGRATION STEP SIZE, KM (1.0)
 57 2.00000000000       PHASE PATH  (0=NO;1=INTEGRATE; 2=INTEGR/PRINT)
 58 2.00000000000       ABSORPTION  (0=NO;1=INTEGRATE; 2=INTEGR/PRINT)
 60 2.00000000000       PATH LENGTH (0=NO;1=INTEGRATE; 2=INTEGR/PRINT)
 71 50.0000000000       NUMBER OF INTEGRATION STEPS PER PRINT [1.E9]
 72 1.00000000000       OUTPUT RAYSETS (1=YES; 0=NO)
 73 0.                  DIAGNOSTIC PRINTOUT (1=YES; 0=NO)
 74 0.                  PRINT EVERY W(71) RAY STEPS (0=YES; 1=N0)
 76 0.                  BINARY RAY OUTPUT (1=YES; 0=NO)
 77 76.0000000000       LINES PER PAGE OF PRINTOUT= 76. FOR HPLJ (57.)
 81 4.00000000000       RAYPLOT PROJECT. PLANE (4 = VERT. RECTANGULAR)
 82 40.00000000000      PLOT-ORDINATE EXPANSION FACTOR [1.]
 83 0.           AN KM  N. LATITUDE OF LEFT PLOT EDGE, KM
 84 0.           AN KM  E. LONGITUDE OF LEFT PLOT EDGE, KM
 85  35.265396   AN KM  N. LATITUDE OF RIGHT PLOT EDGE, KM
 86 200.000000000AN KM  E. LONGITUDE OF RIGHT PLOT EDGE, KM
 87 50.0000000000AN KM  DISTANCE BETWEEN RANGE TICKS, KM
 88-3.00000000000       HEIGHT ABOVE MSL OF BOTTOM OF GRAPH, KM
 89 0.00                HEIGHT ABOVE MSL OF TOP OF GRAPH, KM
 90 1.00000000000       SOUND SPEED CONTOURS
 92 1486.00000000LN  M  MINIMUM CONTOUR LEVEL
 93 1540.00000000LN  M  MAXIMUM CONTOUR LEVEL
 94 4.00000000000LN  M  CONTOUR INTERVAL
 96 1.00000000000       DISTANCE BETWEEN DEPTH TICKS, KM
100 9.00000000000       VVORTX3 MODEL CHECK NUMBER
102 3.00000000000       VVORTX3 BACKGROUND CURRENT DATA SET ID
103 1.02000000000LN  M  MAXIMUM TANGENTIAL CURRENT, M/S
104 50.0000000000       RADIUS OF VORTEX CORE, KM
105 0.           AN KM  LATITUDE OF VORTEX CENTER, KM
106 150.000000000AN KM  LONGITUDE OF VORTEX CENTER, KM
107 1.00000000000       VERTICAL HALF-WIDTH OF VORTEX, KM
108-1.00000000000       HEIGHT OF VORTEX CENTER ABOVE MSL, KM
```

```
125 0.                   NPCURR MODEL CHECK NUMBER
150 7.00000000000        CTANH SOUND SPEED MODEL CHECK NUMBER
152 1.00000000000        CTANH BACKGROUND SOUND SPEED DATA SET ID
175 2.00000000000        CBLOB2 SOUND SPEED PERTURB MODEL CHECK NUM
177 7.00000000000        CBLOB2 PERTURBATION SOUND SPEED DATA SET ID
178 .020000000000        MAXIMUM FRACTIONAL INCREASE IN C SQUARED
179-1.00000000000        HEIGHT OF MAX EFFECT ABOVE MSL, KM
180 0.            AN KM  LATITUDE OF MAX EFFECT, KM
181 150.000000000AN KM   LONGITUDE OF MAX EFFECT, KM
182 1.00000000000        VERTICAL HALF-WIDTH, KM
183 50.0000000000AN KM   N-S  HALF-WIDTH, KM
184 50.0000000000AN KM   E-W  HALF-WIDTH, KM
275 1.00000000000        RHORIZ RECEIVER MODEL CHECK NUMBER
300 4.0                  GLORENZ BOTTOM MODEL CHECK NUMBER
301 0.                   DATA INPUT FORMAT CODE NUMBER
302 0.                   DATA SET IDENTIFICATION NUMBER
303 1.00                 HEIGHT OF RIDGE (KM)
304 10.0          AN KM  LATITUDE OF THE RIDGE CENTER
305 2.0           AN KM  WIDTH OF RIDGE (KM)
306-3.0                  BASE OF RIDGE  (KM MSL)
325 0.0                  NPBOTM MODEL CHECK NUMBER
350 1.00000000000        SHORIZ MODEL CHECK NUMBER
352 1.00000000000        SHORIZ OCEAN SURFACE DATA SET ID
353 0.                   HEIGHT OF OCEAN SURFACE ABOVE MSL, KM
375 0.                   NPSURF MODEL CHECK NUMBER
500 1.00000000000        SLLOSS ABSORPTION MODEL CHECK NUMBER
502 1.00000000000        SLLOSS ABSORPTION DATA SET ID
503 .006000000000AM DB   A COEFFICIENT, DB
504 .263500000000AM DB   B COEFFICIENT, DB
505 1000.00000000FQ HZ   OMEGA1, HZ
506 1700.00000000FQ HZ   OMEGA2, HZ
525 0.                   NPABSRP MODEL CHECK NUMBER
 -1                      DATA SUBSET FOR BACKGROUND CURRENT MODEL
  A  VORTEX AT LONGITUDE 150 KM E, UMAX= 1.02 M/S, R= 50 KM
  0        RETURN TO W-ARRAY DATA SET
 -2                      DATA SUBSET FOR PERTURBATION CURRENT MODEL
  A  NO CURRENT PERTURBATION
  0        RETURN TO W-ARRAY DATA SET
 -3                      DATA SUBSET FOR BACKGROUND SOUND-SPEED MODEL
  A  EL NINO BACKGROUND SOUND-SPEED PROFILE
  3      999.0
   LN  M       LN  M       LN  M
 0.            1532.00     0.
 -20.0000      1531.50     -7.00000
 -50.0000      1509.00     -20.0000
 -250.000      1503.00     -40.0000
 -450.000      1485.00     -300.000
 -1500.00      1485.00     -400.000
 -3000.00      1508.00     0.
  999.000
  0       RETURN TO W-ARRAY DATA SET
 -4                      DATA SUBSET FOR SOUND-SPEED PERTURBATION MODEL
  A  2% INCREASE IN C-SQUARED AT 150 KM LON., 1 KM DEPTH, 50 KM WIDE
  0       RETURN TO W-ARRAY DATA SET
 -8                      DATA SUBSET FOR RECEIVER-SURFACE MODEL
```

```
  A  RECEIVER SURFACE = SPHERE 1 KM BELOW MSL
  0       RETURN TO W-ARRAY DATA SET
 -9                      DATA SUBSET FOR BACKGROUND BOTTOM MODEL
  A  RIDGE .5 KM HIGH, 2 KM WIDE AT 10 KM N LATITUDE; BASE= -3 KM
  0       RETURN TO W-ARRAY DATA SET
-10                      DATA SUBSET FOR BOTTOM PERTURBATION MODEL
  A  NO BOTTOM PERTURBATION
  0       RETURN TO W-ARRAY DATA SET
-11                      DATA SUBSET FOR OCEAN SURFACE MODEL
  A  OCEAN SURFACE = SPHERE AT MSL
  0       RETURN TO W-ARRAY DATA SET
-12                      DATA SUBSET FOR OCEAN SURFACE PERTURB MODEL
  A  NO OCEAN SURFACE PERTURBATION
  0       RETURN TO W-ARRAY DATA SET
-17                      DATA SUBSET FOR OCEAN ABSORPTION MODEL
  A  SKRETTING-LEROY ABSORPTION FORMULA
  0       RETURN TO W-ARRAY DATA SET
-18                      DATA SUBSET FOR PERTURBATION ABSORPTION MODEL
  A  NO ABSORPTION PERTURBATION
  0       RETURN TO W-ARRAY DATA SET
  0                      **********  END OF RUN SET NUMBER 1  *********
N01-2     Sample Case for CONPLT Documentation
 29 1.                   1=PROCESS RUNSET, 0=SKIP RUNSET
 81 4.00000000000        RAYPLOT PROJECTION PLANE (2 = HORIZONTAL)
 82 40.0000000000         PLOT-ORDINATE EXPANSION FACTOR [1.]
 85  35.265396   AN KM    N. LATITUDE OF RIGHT PLOT EDGE, KM
 86 200.000000000AN KM    E. LONGITUDE OF RIGHT PLOT EDGE, KM
 87 50.0000000000AN KM    DISTANCE BETWEEN RANGE TICKS, KM
 88-3.00000000000         HEIGHT ABOVE MSL OF BOTTOM OF GRAPH, KM
 89 0.0                   HEIGHT ABOVE MSL OF TOP OF GRAPH, KM
 90 2.00000000000         CURRENT SPEED CONTOURS
 92 0.10000000000LN  M    MINIMUM CONTOUR LEVEL
 93 1.00000000000LN  M    MAXIMUM CONTOUR LEVEL
 94 0.10000000000LN  M    CONTOUR INTERVAL
 96 1.00000000000         DISTANCE BETWEEN DEPTH TICKS, KM
  0                      **********  END OF RUN SET NUMBER 2  *********
N01-3     Sample Case for CONPLT Documentation
 29 1.                   1=PROCESS RUNSET, 0=SKIP RUNSET
 81 3.00000000000        RAYPLOT PROJECTION PLANE (2 = HORIZONTAL)
 82 200.00000000         PLOT-ORDINATE EXPANSION FACTOR [1.]
 85 141.0615846  AN KM   N. LATITUDE OF RIGHT PLOT EDGE, KM
 86 800.000000000AN KM    E. LONGITUDE OF RIGHT PLOT EDGE, KM
 87 100.000000000AN KM    DISTANCE BETWEEN RANGE TICKS, KM
 88-3.00000000000         HEIGHT ABOVE MSL OF BOTTOM OF GRAPH, KM
 90 1.0                  SOUND SPEED CONTOURS
 92 1486.00000000LN  M   MINIMUM CONTOUR LEVEL
 93 1540.00000000LN  M   MAXIMUM CONTOUR LEVEL
 94 6.00000000000LN  M   CONTOUR INTERVAL
 96 1.00000000000         DISTANCE BETWEEN DEPTH TICKS, KM
  0                      **********  END OF RUN SET NUMBER 3  *********
N01-4     Sample Case for CONPLT Documentation
 29 1.                   1=PROCESS RUNSET, 0=SKIP RUNSET
 81 2.00000000000        RAYPLOT PROJECTION PLANE (2 = HORIZONTAL)
 82 1.00000000000        PLOT-ORDINATE EXPANSION FACTOR [1.]
 85  35.265396   AN KM   N. LATITUDE OF RIGHT PLOT EDGE, KM
```

```
 86 200.000000000AN KM  E. LONGITUDE OF RIGHT PLOT EDGE, KM
 87 50.0000000000AN KM  DISTANCE BETWEEN RANGE TICKS, KM
 88-1.00000000000       HEIGHT OF HORIZONTAL PLOT SECTION ABOVE MSL,KM
 90 2.0                 CURRENT SPEED CONTOURS
 92 0.10000000000LN  M  MINIMUM CONTOUR LEVEL
 93 1.00000000000LN  M  MAXIMUM CONTOUR LEVEL
 94 0.10000000000LN  M  CONTOUR INTERVAL
 96 100.000000000       DISTANCE BETWEEN DEPTH TICKS, KM
  0                     **********  END OF RUN SET NUMBER 4  *********
N01-5     Sample Case for CONPLT Documentation
 29 1.                  1=PROCESS RUNSET, 0=SKIP RUNSET
 81 4.00000000000       RAYPLOT PROJECTION PLANE (2 = HORIZONTAL)
 82 40.0000000000       PLOT-ORDINATE EXPANSION FACTOR [1.]
 85  35.265396   AN KM  N. LATITUDE OF RIGHT PLOT EDGE, KM
 86 200.000000000AN KM  E. LONGITUDE OF RIGHT PLOT EDGE, KM
 87 50.0000000000AN KM  DISTANCE BETWEEN RANGE TICKS, KM
 88-3.00000000000       HEIGHT ABOVE MSL OF BOTTOM OF GRAPH, KM
 89 0.0                 HEIGHT ABOVE MSL OF TOP OF GRAPH, KM
 90 4.00000000000       CURRENT SPEED CONTOURS
 92-1.00000000000LN  M  MINIMUM CONTOUR LEVEL
 93 1.00000000000LN  M  MAXIMUM CONTOUR LEVEL
 94 0.10000000000LN  M  CONTOUR INTERVAL
 96 1.00000000000       DISTANCE BETWEEN DEPTH TICKS, KM
  0                     **********  END OF RUN SET NUMBER 5  *********
N01-6     Sample Case for CONPLT Documentation
 29 1.                  1=PROCESS RUNSET, 0=SKIP RUNSET
 81 2.00000000000       RAYPLOT PROJECTION PLANE (2 = HORIZONTAL)
 82 5.00000000000       PLOT-ORDINATE EXPANSION FACTOR [1.]
 85  35.265396   AN KM  N. LATITUDE OF RIGHT PLOT EDGE, KM
 86 200.000000000AN KM  E. LONGITUDE OF RIGHT PLOT EDGE, KM
 87 50.0000000000AN KM  DISTANCE BETWEEN RANGE TICKS, KM
 88-2.50000000000       HEIGHT OF HORIZONTAL PLOT SECTION ABOVE MSL,KM
 90 6.00000000000       TOPOGRAPHY CONTOURS
 92 -3.0000000000LN KM  INITIAL CONTOUR VALUE
 93 -1.5000000000LN KM  FINAL CONTOUR VALUE
 94 0.10000000000LN KM  STEP IN CONTOUR VALUE
 96 10.0000000000       DISTANCE BETWEEN CROSS-RANGE TICKS, KM
  0                     **********  END OF RUN SET NUMBER 6  *********
N01-7     Sample Case for CONPLT Documentation
 29 1.                  1=PROCESS RUNSET, 0=SKIP RUNSET
 81 4.00000000000       RAYPLOT PROJECTION PLANE (2 = HORIZONTAL)
 82 40.0000000000       PLOT-ORDINATE EXPANSION FACTOR [1.]
 85  35.265396   AN KM  N. LATITUDE OF RIGHT PLOT EDGE, KM
 86 200.000000000AN KM  E. LONGITUDE OF RIGHT PLOT EDGE, KM
 87 50.0000000000AN KM  DISTANCE BETWEEN RANGE TICKS, KM
 88-3.00000000000       HEIGHT ABOVE MSL OF BOTTOM OF GRAPH, KM
 89 0.0                 HEIGHT ABOVE MSL OF TOP OF GRAPH, KM
 90 5.00000000000       CURRENT SPEED CONTOURS
 92-1.00000000000LN  M  MINIMUM CONTOUR LEVEL
 93 1.00000000000LN  M  MAXIMUM CONTOUR LEVEL
 94 0.10000000000LN  M  CONTOUR INTERVAL
 96 1.00000000000       DISTANCE BETWEEN DEPTH TICKS, KM
  0                     **********  END OF RUN SET NUMBER 7  *********
```

Appendix C4. Input Data File Listing for Sample Case 4

```
GEORGES  RL-3    X6437
EL1              EL NINO MODEL FOR EIGEN PROGRAM - GAP SPECIFIED.
 29      0.             DO EIGENRAYS AND BOTH PLOTS
403    -15.0     AN DG  MINIMUM ELEVATION ANGLE
404     15.0     AN DG  MAXIMUM ELEVATION ANGLE
405      2.      AN DG  TICK INTERVAL FOR ELEVATION ANGLE
406     50.             TICK INTERVAL FOR RANGE
407     50.             MAXIMUM HOPS FOR RANGE-ELEV PLOT
408    160.             MAXIMUM NUMBER OF RAYSETS TO PROCESS
409     -0.2     AN DG  BEGIN ELEVATION ANGLE GAP
410      0.2     AN DG  END ELEVATION ANGLE GAP
428     -3.             MINIMUM TRAVEL TIME, SECONDS
429      0.1            MAXIMUM TRAVEL TIME, SECONDS
430      0.5            TICK INTERVAL FOR TRAVEL TIME, SECONDS
432     50.             MAXIMUM HOPS FOR RANGE-TIME PLOT
433    160.             MAXIMUM NUMBER OF RAYSETS TO PROCESS
434      1.485          REFERENCE SOUND SPEED FOR RANGE-TIME PLOT
435      1.             PLOTTING UNITS FOR TIME SCALE (1=SEC)
436    300.             MAXIMUM RANGE FOR BOTH PLOTS
437    100.             MINIMUM RANGE FOR BOTH PLOTS
453    290.             RANGE FOR WHICH EIGENRAYS ARE DESIRED
454      0.001          ELEVATION/RANGE SLOPE CUTOFF
456     50.             MAXIMUM HOPS FOR EIGENRAY INTERPOLATION
457    160.             MAXIMUM NUMBER OF RAYSETS TO PROCESS
458      2.             RUNSET TO USE FROM TAPE1
000
```

Appendix C5. Input Data File Listing for Sample Case 5

```
MIKE=JONES=RL3=X6464
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
  3-1.20000000000       TRANSMITTER HEIGHT, KM
  4 0.           AN KM  TRANSMITTER POSITION, LATITUDE, KM
  5 00.          AN KM  TRANSMITTER LONGITUDE, KM
  7 400.000000000FQ HZ  INITIAL FREQUENCY, HZ
 11 90.0000000000AN DG  AZIMUTH ANGLE
 15-14.0000000000AN DG  INITIAL ELEVATION ANGLE, DEG
 16 14.0000000000AN DG  FINAL   ELEVATION ANGLE, DEG
 17 .200000000000AN DG  STEP IN ELEVATION ANGLE, DEG
 20-1.10000000000       RECEIVER HEIGHT
 21 0.                  PENETRATING RAYS NOT WANTED(=0)
 22 50.0000000000       NUMBER OF HOPS
 26 0.                  MAXIMUM RAY HEIGHT
 27-5.00000000000       MINIMUM RAY HEIGHT
 28 1000.00000000       MAXIMUM RANGE
 28 1100.00000000       MAXIMUM RANGE
 29 1111111.00000       ENABLE FUNCTIONS DESIRED
 42  .1000000E-07       SINGLE STEP ERROR
 44 .100000000000       INITIAL INTEGRATION STEP SIZE
150 5.00000000000       CSMUNK1 SOUND SPEED MODEL
152 2.00000000000       INPUT DATA SET ID NUMBER
153 1.00000000000       REFERENCE SOUND SPEED
154 0.           AN KM  PH1 LONGITUDE 1
155 1.49200000000       CA1 SOUND SPEED ON AXIS
156-1.30000000000       ZA1 DEPTH OF AXIS
157 1.30000000000       H1 SCALE DEPTH
158 .007400000000       EP1 FRACTIONAL INCREASE OF C WITH DEPTH
159 1000.00000000AN KM  PH2 LONGITUDE 2
160 1.49200000000       CA2 SOUND SPEED ON AXIS
161-1.30000000000       ZA2 DEPTH OF AXIS
162 1.30000000000       H2 SCALE DEPTH
163 .007400000000       EP2 FRACTIONAL INCREASEE OF C WITH DEPTH
275 1.00000000000       RHORIZ RECEIVER MODEL CHECK NUMBER
300 1.00000000000       GHORIZ TERRAIN MODEL CHECK NUMBER
302 2.00000000000       INPUT DATA SET ID NUMBER
303-5.00000000000       CONSTANT TERRAIN HEIGHT
350 1.                  SHORIZ OCEAN SURFACE MODEL CHECK NUMBER
375 0.                  NPSURF OCEAN SURFACE PERTURB MODEL CHECK NUM
 57 0.                  INTEGRATE AND PRINT PHASE PATH
 60 0.                  INTEGRATE AND PRINT GEOMETRICAL PATH LENGTH
 71 100.000000000       PERIODIC PRINTING INTERVAL
 72 1.00000000000       OUTPUT RAYSETS
 73 1.                  TURN ON DIAGNOSTIC PRINTOUT
 74 0.00000000000       SUPPRESS ALL PRINTOUT FROM SUBROUTINE PRINTR
 75 .100000000000       FULANN HEIGHT OF LETTERING IN INCHES
 80 0.0                 NORMAL RAYPATH PLOTS
 81 -3.                 PLOT PROJECTION OF RAY (1=VERT.,2=HORIZ) PLANE
 82 10.0000000000       PLOT EXPANSION FACTOR
 83 0.0          AN KM  LEFT LATITUDE OF PLOT, KM
 84 900.         AN KM  LEFT LONGITUDE OF PLOT, KM
 85 0.           AN KM  RIGHT LATITUDE OF PLOT, KM
```

```
 86 1000.00000000AN KM  RIGHT LONGITUDE OF PLOT, KM
 87 10.0000000000AN KM  DISTANCE BETWEEN TIC MARKS, KM
 88-5.00000000000       HEIGHT ABOVE GROUND OF BOTTOM OF GRAPH, KM
 89 0.                  HEIGHT ABOVE SEA LEVEL OF THE TOP OF THE GRAPH
 17 0.           AN DG  STEP IN ELEVATION ANGLE
 29 0.                  PICK DESIRED FUNCTIONS
 15 -13.867      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15 -13.503      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15 -12.167      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15  13.480      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15 -11.770      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15  13.101      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15 -10.455      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15  11.741      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15 -10.005      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15  11.322      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15  -8.650      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15   9.968      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15  -8.110      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15   9.483      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15  -6.600      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15   8.056      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15  -5.885      AN DG  ELEVATION ANGLE
```

```
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15   7.456      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15  -3.802      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15   5.784      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15  -2.558      AN DG  ELEVATION ANGLE
  0
0T5    MUNK'S 1974 UNIFORM SOUND CHANNEL
 15   4.933      AN DG  ELEVATION ANGLE
  0
```

Appendix D. FORTRAN Format Specification for Plotting Commands

Part I. Commands Used by PSGRAPH

Command

0 - User Identifier Number of Lines: 2

Contents of Line 1: "0"
Contents of Line 2: Text

Format of Line 1: I2
Format of Line 2: A

1 - Moveto with "pen up" to IX, IY

Number of Lines: Variable (up to 377)

Contents of Line 1: "1" IX IY
Contents of Line 2: Number of pairs of points to follow
Contents of Lines 3 to 377: 8 pairs of X,Y plot coordinates

Format of Line 1: I2 2I5
Format of Line 2: I5
Format of Lines 3 to 377: 8(2I5)

NOTE: If number of points on line 2 is not evenly divisible by 8, then the remaining pairs of points are each written to a separate line (1 pair per line).

3 - Text for Ray Plots or Text for Profile Subtitles

Number of Lines: 3

Contents of Line 1: "3" IX IY location for characters
Contents of Line 2: Orientation, number of characters
Contents of Line 3: Text

Format of Line 1: I2 2I4
Format of Line 2: 2I3
Format of Line 3: A

4 - Sequence of Moveto and Lineto Commands

Number of Lines: Variable

Contents of Line 1: "4"
Contents of Line 2: Number of Pairs of Points to be Plotted (there are actually twice this number of pairs of points since there is one pair for the moveto and one pair for the lineto.)

Contents of Lines 3 to N: 8 pairs of X,Y plot coordinates

Format of Line 1: I2
Format of Line 2: I4
Format of Line 3: 8(2I5)

NOTE: If number of points on line 2 is not evenly divisible by 8, then the remaining pairs of points are each written to a separate line (2 pairs per line, one moveto pair and one lineto pair).

-2 - Frame Advance for Ray Plots

Number of Lines: 1

Contents of Line 1: "-2"

Format of Line 1: I2

-1 - End of Plotting for Ray Plots

Number of Lines: 1

Contents of Line 1: "-1"

Format of Line 1: I2

22 - Lower Left Origin (in inches from lower left corner)

Number of lines: 1

Contents of Line 1: "22" X Y

Format of Line 1: I2 2(F5.2)

25 - Text for Title and Axis Labels

Number of Lines: 4

Contents of Line 1: "25" X-axis length, Y-axis length (inches)

Contents of Line 2: Title length, title

Contents of Line 3: X-axis label length, X-axis label

Contents of Line 4: Y-axis label length, Y-axis label

Format of Line 1: I2 2(F6.2)
Format of Line 2: I5 1X A40
Format of Line 3: I5 1X A40
Format of Line 4: I5 1X A40

29 - Points to be Plotted for a Curve

Number of Lines: Variable

Contents of Line 1: "29", Number of points, Symbol Marker

Contents of Line 2 to N: x(i), y(i), x(i+1), y(i+1) where i = 1 to Number of points

Format of Line 1: I2, 2(I5)

Format of Line 2 to N: 4(E14.6)

NOTE: If the number of points is odd, then the last line has only one x,y pair. Thus, the Nth line would have format 2(E14.6).

30 - Frame Advance for Profiles

Number of Lines: 1

Contents of Line 1: "30 1"

Format of Line 1: I2, I3

31 - End of Plotting

Number of Lines: 1

Contents of Line 1: "31"

Format of Line 1: I2

39 - Maximum, minimum and interval values for both axes in real units

Number of Lines: 1

Contents of Line 1: "39", X-axis minimum, X-axis interval, X-axis maximum, Y-axis minimum, Y-axis interval, Y-axis maximum

Format of Line 1: I2, 6(E13.7)

40 - Indicates Eigen plot is being produced

Number of Lines: 1

Contents of Line 1: "40"

Format of Line 1: I2

Appendix D. FORTRAN Format Specification for Plotting Commands

PART II. Commands Used by DISSPLA (Ignored by PSGRAPH)

10 - Font indicator

Number of Lines: 1

Contents of Line 1: "10"

Format of Line 1: I2

11 - Case indicator

Number of Lines: 1

Contents of Line 1: "11 STAND   !"

Format of Line 1: I2,trl,a,1x,al

12 - Case indicator

Number of Lines; 1

Contents of Line 1: "12 L/CSTD   #"

Format of Line 1: I2,trl,a,lx,al

13 - Text Height

Number of Lines: 1

Contents of Line 1: "13" number

Format of Line 1: I2,F4.2

20 - Initializes DISSPLA to create an intermediate compressed output file

Number of Lines: 1

Contents of Line 1: "20"

Format of Line 1: I2

21 - Clipping Indicator

Number of Lines: 1

Contents of Line 1: "21" number

Format of Line 1: I2,F4.2

23 - Page Limits

Number of Lines: 1

Contents of Line 1: "23" number, number

Format of Line 1: I2, 2F6.2

24 - Scale Factor for plot symbols

Number of Lines: 1

Contents of Line 1: "24" number

Format of Line 1: I2,F5.2

32 - Number of X axis ticks

Number of Lines: 1

Contents of Line 1: "32" number

Format of Line 1: I2,I3

33 - Number of Y axis ticks

Number of Lines: 1

Contents of Line 1: "33" number

Format of Line 1: I2,I3

35 - For converting negatively valued labels to positive numbers. Begin converting at the "mth" number and continuing for "n" numbers.

Number of Lines: 1

Contents of Line 1: "35" m,n

Format of Line 1: I2,2I3

36 - Suppress border

Number of Lines: 1

Contents of Line 1: "36"

Format of Line 1: I2

TABLE 1. - Plotting Commands in TXTOUT Files Used by PSGRAPH

RAYPLOTS

0	Frame start
1	Moveto with linetos
3	Text location + text
-2	Frame advance
-1	End of plotting

CONTOURS

0	Frame start
1	Moveto with linetos
3	Text location + text
4	Alternating moveto,linetos
-2	Frame advance
-1	End of plotting

PROFILES

22	Lower left origin (in inches from corner)
25	Title Text and Axis Labels
29	Points to be plotted
30	Frame advance
31	End of plotting
39	Coordinates for plot (in plotting units)

EIGEN PLOTS

3	Text location + text
22	Lower left origin (in inches from corner)
25	Title Text and Axis Labels
29	Points to be plotted
30	Frame advance
31	End of plotting
39	Coordinates for plot (in plotting units)
40	Indicates Eigen plot

TABLE 2. Plotting Commands in TXTOUT Used by DISSPLA Software (Ignored by PSGRAPH)

10	Font indicator
11	Case indicator
12	Case indicator
13	Text Height
20	Initializes DISSPLA to create an intermediate compressed output file
21	Clipping Indicator
23	Page Limits
24	Scale Factor for plot symbols
32	Number of X axis ticks
33	Number of Y axis ticks
35	For Converting Negative Labels to Positive Numbers
36	Suppress border