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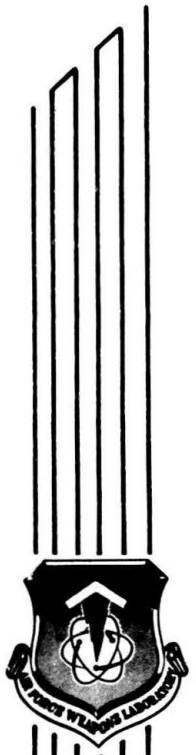

WORLD, A SUBROUTINE FOR DIGITAL PLOTTING OF CONTINENTAL OUTLINES AND GEOGRAPHICAL DATA

Robert E. Wiley
Capt USAF

TECHNICAL REPORT NO. AFWL-TR-69-126

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AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base
New Mexico

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FOREWORD

This research was performed under Program Element 61102H, Project 5710, Subtask PA051, and was funded by the Defense Atomic Support Agency (DASA).

Inclusive dates of research were July 1968 to December 1968. The report was submitted 6 October 1969 by the Air Force Weapons Laboratory Project Officer, Captain Robert E. Wiley (WLTH).

The latitude-longitude data defining the continental outlines was obtained from the National Center for Atmospheric Research along with a sample program for plotting the modified mercator map. Subroutine ELIM is the only routine which remains essentially unchanged from the NCAR version.

This report has been reviewed and is approved.

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ABSTRACT

(Distribution Limitation Statement No. 2)

WORLD is a general-use computer subroutine which draws maps containing continental outlines and overlays data on the map. Projection of maps may be modified mercator, equidistant polar, or hemispherical.

CONTENTS

SECTION I

INTRODUCTION

Frequently one generates or obtains data which readily lends itself to plots that emphasize the positional relationship between the data and the earth. Generally this means that one must plot the data on a standard map of the earth (e.g., Calcomp paper W2), and be limited by the fixed scale, or draw a simple grid labeling the latitudes and longitudes and neglect the geographical features of continents, etc. Use of subroutine WORLD allows one to draw a map of reasonable size of any section of the earch (excluding the polar regions) and plot data on this map. The projection of the plot may be either modified mercator, equidistant polar, or hemispherical. Hemisphere projections may be done as if viewed from any point above the earth.

SECTION II

HOW TO USE THE ROUTINE

The calling statement for WORLD is as follows:

CALL WORLD (XLONG, YLAT, N, XSIZE, YSIZE, XEAST, XWEST, YNORTH, YSOUTH, MAP, IPLOT, IEND, IXAX, IX, IYAX, IY, ITLE, IT, LABEL, IL) where

XLONG — The array containing the logitude data. The data must be in degrees, but may be in the range 0° to 360° or -180° to +180° (- indicates west longitude and + east)

YLAT — The array containing the latitude data. The data must be in degrees and in the range -90° to +90° (- indicates south latitudes and + north)

N — The number of data points in the arrays XLONG and YLAT. If N = 0 no data will be plotted, although any operations specified by other parameters will be performed.

XSIZE — The length of the longitude axis in inches.

YSIZE — The length of the latitude axis in inches. For polar or hemispherical projection YSIZE is the diameter of the map.

XEAST — The longitude of the eastern boundary of the map. Units must be consistent with definition of XLONG. Not used for polar map. For MAP=5, longitude of viewing position.

XWEST — The longitude of the western boundary of the map. Units must be consistent with definition of XLONG. Not used for polar map. For MAP=5, latitude of viewing position.

YNORTH — The northern boundary of the map. Units must be consistent with the definition of YLAT. Boundary of north polar map.

YSOUTH — The southern boundary of the map. Units must be consistent with the definition of YLAT. Boundary of south polar map.

MAP — Indicates the type of projection. The values which MAP may have and what each indicates are

1. Modified mercator projection
2. Hemisphere viewed from above the equator
3. North polar projection
4. South polar projection
5. Hemisphere but viewed from some point other than the equator. Viewing position specified by XEAST and XWEST.

IPLOT — An indicator which allows the user to reuse the mapping region defined in the previous call to the subroutine. IPLOT = 0 indicates that a new mapping region and/or a new scale is being defined with this call; therefore a new map is needed. IPLOT = 1 indicates that the same region as the previous call is being used, but that a new map of the region is desired. (This value of IPLOT should be used only after a call defining IEND = 0. See below.) Any other definition of IPLOT indicates that this call defines new data which is to be plotted over the data plotted in the previous call.

IEND — The plot advance control. IEND = 0 will plot the data for this call and advance the plotter to the origin of the next plot. Distance between plots = 4.0 inches. Any other definition of IEND will not terminate the plot and subsequent calls to the subroutine will cause the new data to be plotted over the older data.

IXAX — Contains the longitude axis label in Hollerith format. Unused if no label desired.

IX — Number of characters in IXAX. Must = 0 is no longitude label is desired or for polar projection.

IYAX — Contains the latitude axis label in Hollerith format. Unused if no label desired.

IY — Number of characters in IYAX. Must = 0 if no latitude label is desired for polar projection.

ITLE — Contains the plot title in Hollerith format. Unused if no label desired.

IT — Number of characters in ITLE. Must = 0 if no plot title is desired.

LABEL — Contains any identification which the user wishes to apply to this set of data. The identifier must be in Hollerith format. It will be positioned above and along the line beginning with the first point inside the mapping region.

IL — The number of characters in LABEL. Must = 0 if no data identification is desired.

NOTE 1: The user must make provision for a physical TAPE3, EF20, 1/2 inch, 556 BPI.

NOTE 2: For the special case of using WORLD with Calcomp W2 paper, use the following parameters: XSIZE = 9.0, YSIZE = 18.0, XEAST = 360.0, XWEST = 0, YNORTH = 90.0, MAP = 1, IPLOT = 2. Other parameters may be set as appropriate.

Considerable effort has been expended to make subroutine WORLD as general as the average programmer may need. If problems do occur or if help is needed on very specific problems, contact Captain Wiley, WLTH, AFWL.

SECTION III

GENERAL COMMENTS TO THE USER

The WORLD package consists of a main routine, WORLD, and 11 supporting routines. All control of the supporting routines is determined by the calling parameters of WORLD. WORLD has the following capabilities:

1. To draw a map of any specified region and label it as desired.
2. To draw a map and overlay data.
3. To overlay several sets of data on same map.
4. To ignore all data falling outside the specified map region.
5. To do any of above in mercator, polar, or hemispherical projection.

There are some limitations on the use of this routine. Although the calling sequence specifies both XSIZE and YSIZE, one or the other is always ignored. If YSIZE is 10.0 inches or less, then XSIZE will be adjusted to ensure that the latitude and longitude scaling factors are equal. If YSIZE is greater than 10.0 inches, but XSIZE is 10.0 inches or less, then YSIZE will be adjusted to ensure that the scaling factors remain equal. (This will result in a reorientation of the axes and the values of XSIZE and YSIZE will be switched, which may cause problems in the calling program.) If both XSIZE and YSIZE are greater than 10.0 inches, the size is incompatible with the Calcomp plotter; therefore WORLD will print an error message and stop execution. Even though the range of all longitudes can be -180 to +180 when calling WORLD, the returned values will be between 0 and 360, as will be all longitude labels on the plot. In addition, the YLAT array will be altered when doing polar projections. When MAP = 5, XWEST, XEAST, XLONG, and YLAT are all changed to the new, rotated coordinate system.

Features of mercator maps include a boundary around the map with tick marks every inch on all four sides, latitude values defined at each tick mark along the left edge with longitude values defined along the bottom, and any labels which the user provides. Polar projections will have the diameter of YSIZE. Quadrant longitudes will be drawn and labeled. North polar maps have 0° longitude at the bottom while south polar maps have 0° longitude at the top. Latitude circles will be drawn and labeled every inch from pole to boundary.

It must be pointed out to the user that each call to the routine which specifies that a new region is to be mapped involves rewinding a tape, reading that tape, and sorting the data. Therefore, one should use care in defining the calling parameters so that unnecessary tape handling can be avoided. Remember that one can change the scaling (i.e., the size) without doing any tape handling as long as the map region remains constant. (HINT: Copying the physical tape to a disk TAPE3 will reduce the tape handling problem.)

Each of the major subroutines is briefly described below:

SCALE	Uses the calling parameters XEAST, XWEST, YNORTH, YSOUTH and MAP to fit the map into the area specified by YSIZE and/or XSIZE and set scaling factors for other subroutines.
DRAW	Plots the continental outlines in the desired projection.
ELIM	Eliminates all continental areas outside of map region.
WPLOT2	Scales and plots the user's data over the world map.
TITLE	Draws boundaries and labels plots.
VIEW	Transforms the continental outline and plot data to the proper viewing angle.

The normal starting point for all plots except Calcomp W2 is 1/2 inch from the right edge of the Calcomp paper. For W2, the zero point is -90° latitude and 0° longitude (i.e., the crosshairs must be at -90° latitude and 20° longitude).

Subroutine WORLD is used in conjunction with any of the Calcomp plot packages or simulation routines.

ERROR MESSAGES

SIZE IS INCOMPATIBLE WITH CALCOMP PAPER SIZE.

XSIZE = XX.XX YSIZE = XX.XX

occurs whenever both XSIZE and YSIZE are greater than 10.0 inches.

SAMPLE PLOTS

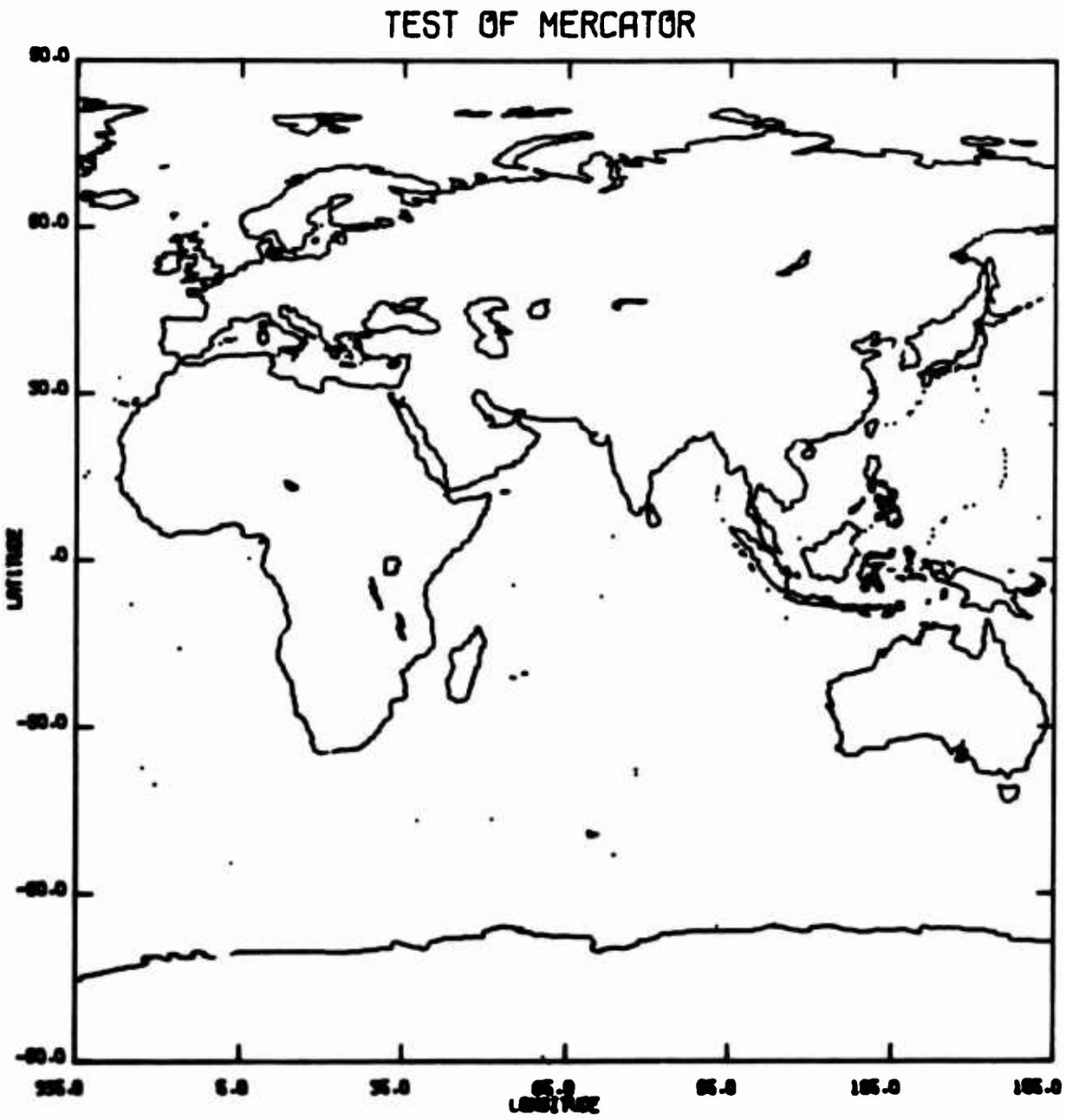

Figure 1. Modified Mercator

```
CALL WORLD (DUM, DUM, 0., 6., 155., 355., 90., -90., 1, 0, 0,
9HLONGITUDE, 9, 8HLATITUDE, 8, 16HTEST OF MERCATOR, 16, DUM, 0)
```

Figure 2. Hemisphere

```
CALL WORLD (DUM, DUM, 0, 6., 6., 155., 355., 90., -90., 2, 0, 0,
DUM, 0, DUM, 0, 18HTEST OF HEMISPHERE, 18, DUM, 0)
```

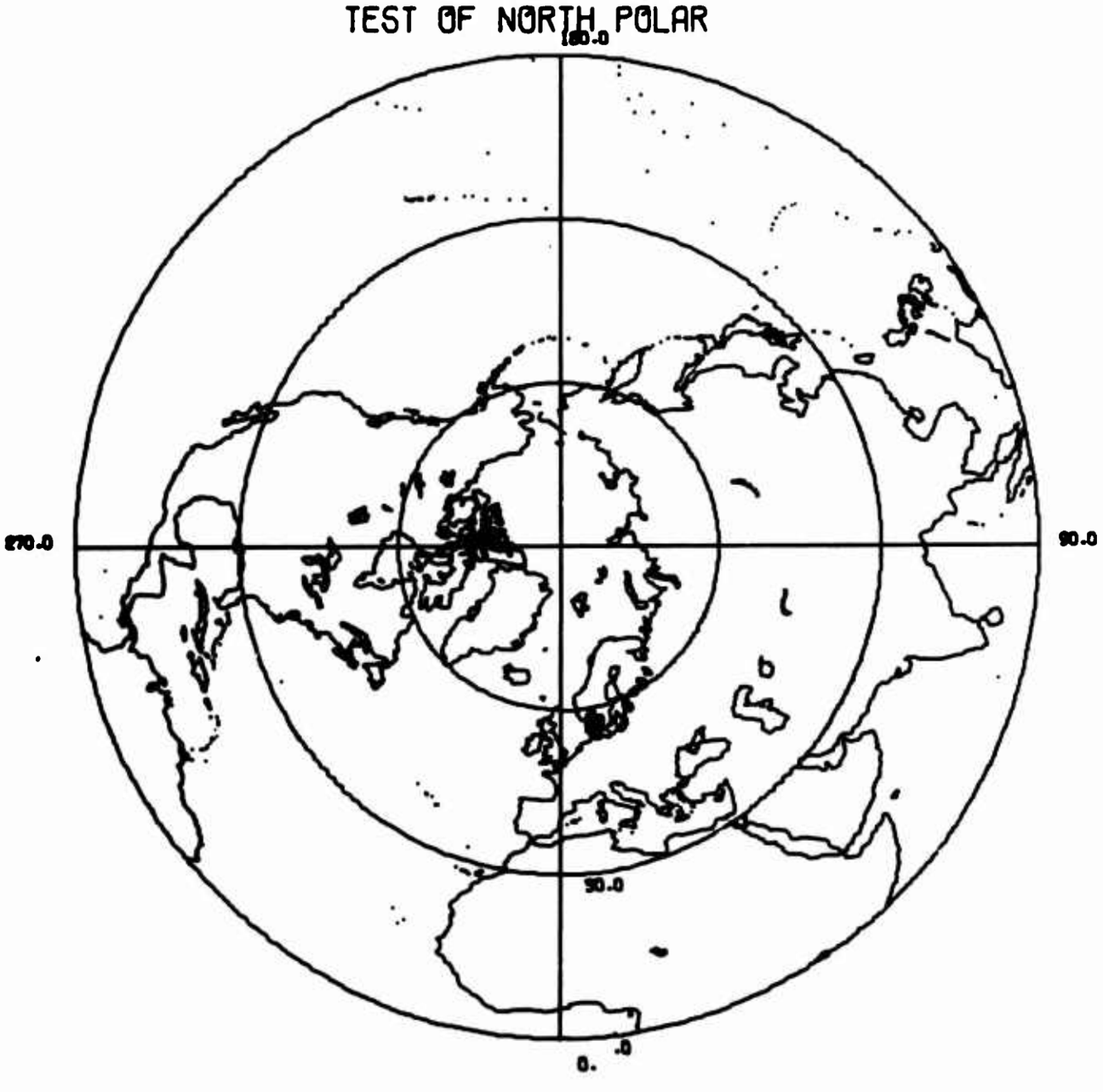

Figure 3. North Polar

```
CALL WORLD (DUM, DUM, 0, 6., 6., DUM, DUM, 0., DUM, 3, 0, 0, DUM,
0, DUM, 0, 19HTEST OF NORTH POLAR, 19, DUM, 0)
```

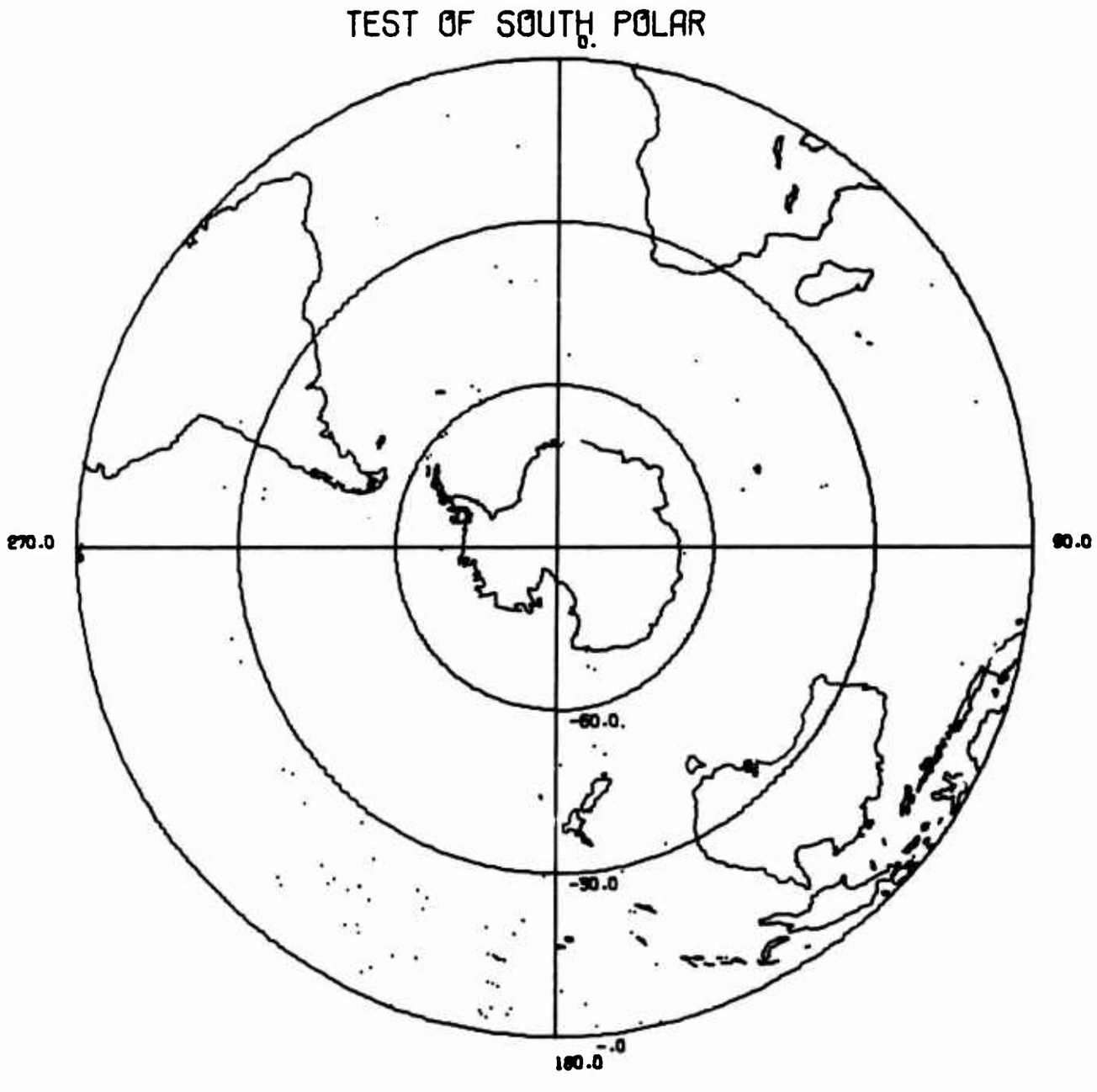

Figure 4. South Polar

CALL WORLD (DUM, DUM, 0, 6., 6., DUM, DUM, DUM, 0., 4, 0, 0, DUM, 0, DUM, 0, 19HTEST OF SOUTH POLAR, 19, DUM, 0)

Figure 5. Hemisphere (Off-Equator View)

```
CALL WORLD (DUM, DUM, 0, 6., 6., 250., 45., 90., -90., 5, 0, 0,
DUM, 0, DUM, 0, 24HTEST OF OFF-EQUATOR VIEW, 24, DUM, 0)
```

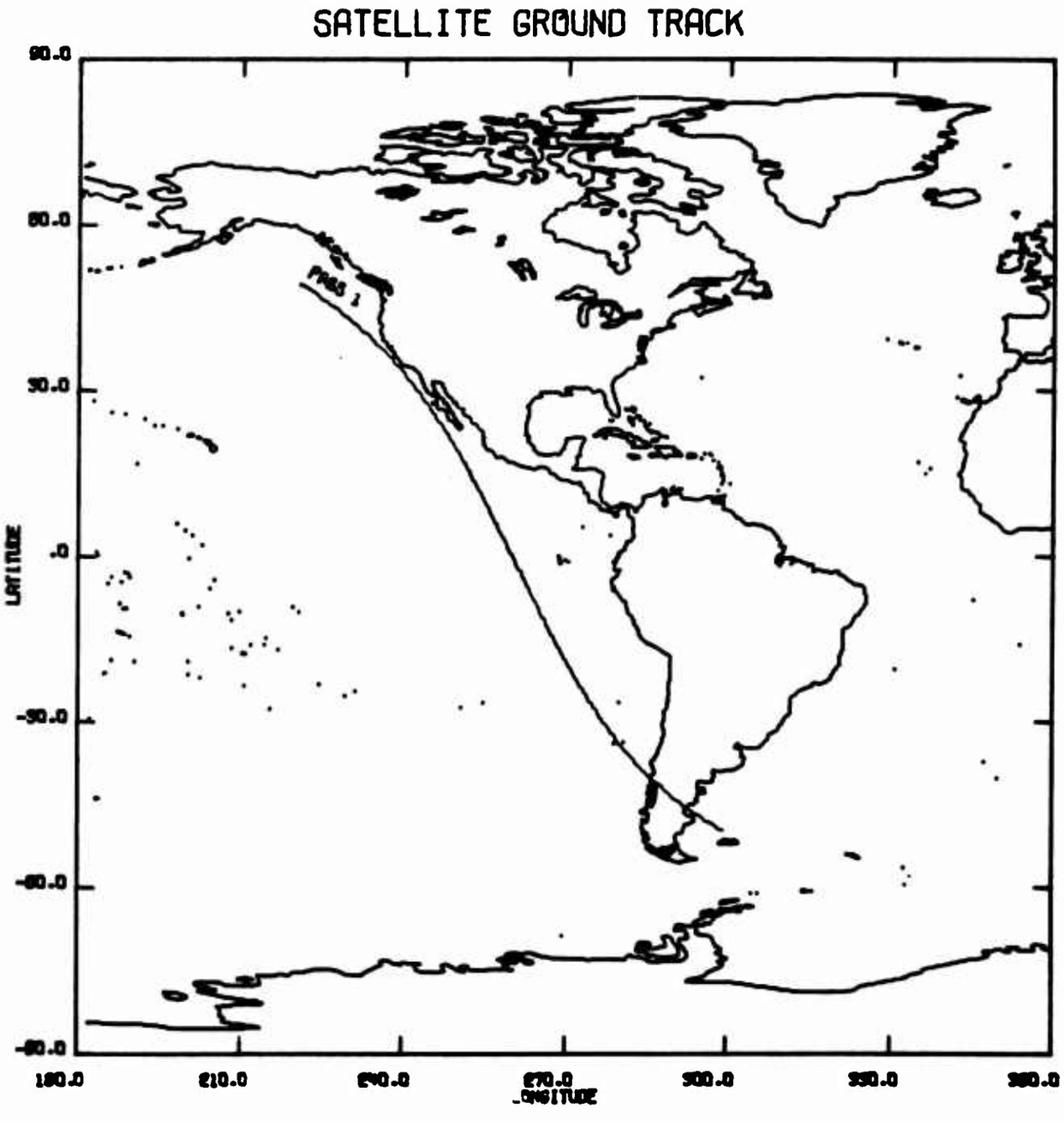

Figure 6. Data Plot

```
CALL WORLD (XLONG, YLAT, N, 6., 6., 360., 180, 90., -90., 1, 0, 0,
9HLONGITUDE, 9, 8HLATITUDE, 8, 22HSATELLITE GROUND TRACK, 22,
6HPASS 1, 6)
```

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LISTING

```
      SUBROUTINE WORLD (XLONG,YLAT,N,XSIZE,YSIZE,XEAST,XWEST,YNORTH,YSOUWRL    1
     1TH,MAP,IPLOT,IEND,IXAX,IX,IYAX,IY,ITLE,IT,LABEL,IL)                WRL    2
      COMMON /FACTOR/ XFAC,YFAC,XZERO,YZERO,XDIS,YSZ,XSZ                 WRL    3
      COMMON /SPLMAP/ SPLIT,MAPP,DEV,POT                                 WRL    4
      DIMENSION XLONG(1), YLAT(1)                                        WRL    5
      XSZ=XSIZE                                                          WRL    6
      MAPP=MAP                                                           WRL    7
      IF (IPLOT.NE.0) GO TO 1                                            WRL    8
      CALL SCALE (YLONG,YLAT,N,YSIZE,XSIZE,XEAST,XWEST,YNORTH,YSOUTH,MAPWRL    9
     1,IPLOT)                                                            WRL   10
1     CALL TITLE (IXAX,IYAX,ITLE,IX,IY,IT)                               WRL   11
      IF (IPLOT.GT.1) GO TO 2                                            WRL   12
      CALL DRAW (IPLOT)                                                  WRL   13
2     IF (N.EQ.0) GO TO 3                                                WRL   14
      CALL WPLOT2 (XLONG,YLAT,N,LABEL,IL)                                WRL   15
3     IF (IEND.NE.0) RETURN                                              WRL   16
      CALL PLOT (XSIZE+4.0,0.0,-3)                                       WRL   17
      RETURN                                                             WRL   18
      END                                                                WRL   19-
```

```
      SUBROUTINE SCALE (X,Y,N,XSIZE,XSIZE,XEAST,XWEST,YNORTH,YSOUTH,MAP,SCL   1
     1IPLOT)                                                                 SCL   2
      COMMON /SPLMAP/ SPLIT,MAPP,REVERSE,DOT                                 SCL   3
      COMMON /EDGE/ XE,XW,YN,YS,XEASTS                                       SCL   4
      COMMON /FACTOR/ XFAC,YFAC,XZERO,YZERO,XDIS,YSZ,YSZ                     SCL   5
C                                                                            SCL   6
C     XSIZE IS IN INCHES, REFERS TO THE LATITUDE DIRECTION IF LESS THAN      SCL   7
C     10. INCHES.  IF MORE THAN 10 INCHES AND YSIZE LESS THAN 10 INCHES,     SCL   8
C     THEN XSIZE DETERMINES THE SIZE OF THE MAP.   IF BOTH  XSIZE AND       SCL   9
C     YSIZE ARE CREATER THAN 10 INCHES THEN THE ERROR EXIT IS TAKEN.         SCL  10
C     ALSO DIAMETER OF MAP FOR POLAR PROJECTION.                             SCL  11
C     XSIZE IS IN INCHES, REFERS TO THE LONGITUDE DIRECTION NORMALLY.        SCL  12
C     SEE YSIZE FOR SPECIAL CASES.                                           SCL  13
C     XWEST,XEAST,YNORTH,YSOUTH ARE IN DEGREES AND DEFINE BOUNDARIES         SCL  14
C       OF MAP                                                               SCL  15
C                                                                            SCL  16
      LOGICAL REVERSE                                                        SCL  17
      LOGICAL SPLIT                                                          SCL  18
      INTEGER DOT                                                            SCL  19
      REVERSE=.FALSE.                                                        SCL  20
      IF (YSIZE.GT.10.0) GO TO 1                                             SCL  21
      GO TO 2                                                                SCL  22
1     IF (XSIZE.GT.10.0) GO TO 13                                            SCL  23
      REVERSE=.TRUE.                                                         SCL  24
      TEMP=XSIZE                                                             SCL  25
      XSIZE=YSIZE                                                            SCL  26
      YSIZE=TEMP                                                             SCL  27
2     YN=YNORTH                                                              SCL  28
      YS=YSOUTH                                                              SCL  29
      YSZ=YSIZE                                                              SCL  30
      DOT=0                                                                  SCL  31
      IF (MAP.EQ.5) CALL VIEW (XEAST,YWEST,IPLOT)                            SCL  32
      MAP=MAPP                                                               SCL  33
      SPLIT=.FALSE.                                                          SCL  34
      GO TO (3,3,9,10), MAP                                                  SCL  35
3     IF (XEAST.LT.0.) XEAST=XEAST+360.                                      SCL  36
      IF (XWEST.LT.0.) XWEST=XWEST+360.                                      SCL  37
      XEASTS=XEAST                                                           SCL  38
      XE=XEAST                                                               SCL  39
      XW=XWEST                                                               SCL  40
      IF ((XEAST-XWEST).GT.1.E-5) GO TO 4                                    SCL  41
      XEASTS=XEASTS+360.                                                     SCL  42
      SPLIT=.TRUE.                                                           SCL  43
4     CONTINUE                                                               SCL  44
      XDIS=XEASTS-XWEST                                                      SCL  45
      YDIS=YNORTH-YSOUTH                                                     SCL  46
      IF (REVERSE) 5,6                                                       SCL  47
5     YDIS=YNORTH-YSOUTH                                                     SCL  48
      YDIS=XEASTS-XWEST                                                      SCL  49
6     CONTINUE                                                               SCL  50
      XFAC=XSIZE/XDIS                                                        SCL  51
      XSIZE=XSIZE*(XDIS/XDIS)                                                SCL  52
      XSZ=XSIZE                                                              SCL  53
      XFAC=XFAC                                                              SCL  54
      XZERO=XWEST*XFAC                                                       SCL  55
```

```
      XPROD=YSCALE*XFAC                                                 SCL  56
      IF (DEVPROG) 7,8                                                  SCL  57
7     TEMP=XPROD                                                        SCL  58
      XPROD=YPROD                                                       SCL  59
      YPROD=TEMP                                                        SCL  60
8     CONTINUE                                                          SCL  61
      RETURN                                                            SCL  62
C     YOLD=OLD-YNORTH                                                   SCL  63
      GO TO 11                                                          SCL  64
10    YOLD=YSCALE*OLD                                                   SCL  65
11    XFAC=.8*YSIZE/YOLD                                                SCL  66
      YFAC=YFAC                                                         SCL  67
      XPROD=-.8*YSIZE                                                   SCL  68
      YPROD=XPROD                                                       SCL  69
      YSZ=YSIZE                                                         SCL  70
      RETURN                                                            SCL  71
12    PRINT 13, XSIZE,YSIZE                                             SCL  72
      STOP 0000                                                         SCL  73
C                                                                       SCL  74
C                                                                       SCL  75
C                                                                       SCL  76
13    FORMAT (24H       ++++ ++       SIZE IS INCOMPATIBLE WITH CALCOMP SCL  77
     1  PAPER SIZE,   ++++++++     /14H       XSIZE= ,F5.2,15H  AND YSIZESCL  78
     2E =  ,F5.2)                                                       SCL  79
      END                                                               SCL  80
```

```
      SUBROUTINE [illegible] (SPLIT)
C
C     SUBROUTINE [illegible] WILL DRAW A MAP OF ANY PART OF THE WORLD,
C     [illegible] THE POLAR REGIONS.   THIS ROUTINE REQUIRES THE DATA
C     STORED [illegible]
C     SPLIT [illegible] OLD MAP
C
      LOGICAL SPLIT
      LOGICAL REVERSE
      COMMON /[illegible]/ XFIRST,XLAST,[illegible]
      COMMON /SPLMAP/ SPLIT,[illegible],REVERSE
      C[illegible] /[illegible]/ [illegible]
      COMMON /[illegible]/ X([illegible]),Y([illegible]),KCHECK
      DATA [illegible]
      IF ([illegible]) GO TO 3
      [illegible]
      [illegible]
    1 IF ([illegible]) 1,2
    2 [illegible]
    3 IF ([illegible])
C
C       IF SPLIT IS TRUE, [illegible] EVERY POINT TO THE LEFT OF THE OLD EASTERN
C       [illegible]
C
    3 DO 4 J=1,[illegible]
      IF (X(J).EQ.0.0.AND.Y(J).EQ.0.0) GO TO 4
      IF (X(J).LT.0.) X(J)=X(J)+360.
      IF ([illegible].XFIRST) X(J)=X(J)+360.
    4 CONTINUE
    5 CALL FLIP ([illegible])
C
C       ELIMINATE THE POINTS OUTSIDE THE MAP.
C
      IF (KCHECK.EQ.1) RETURN
      IF (REVERSE) 6,8
    6 [illegible]
      DO 7 I=1,KCHECK
      IF (X(I).EQ.0.0.AND.Y(I).EQ.0.0) GO TO 7
      TEMP=X(I)
      X(I)=Y(I)
      Y(I)=-TEMP+[illegible]
    7 CONTINUE
    8 [illegible]
      GO TO ([illegible]), MAP
    9 ZERO=[illegible]
   10 JCH=0
      DO 15 I=1,KCHECK
      IF (X(I).EQ.0.0.AND.Y(I).EQ.0.0) GO TO 14
      GO TO (11,12), MAP
   11 XX=X(I)*XFAC-XZERO
      YY=Y(I)*YFAC-YZERO
      IF (I.EQ.1) GO TO 13
      IF ((ABS(X(I)-X(I-1)).GT.340.).AND.(X(I-1).NE.0.0)) JCH=0
      GO TO 13
   12 XX=ZERO+([illegible]COS(([illegible]-Y(I))[illegible])[illegible](X(I)[illegible])*[illegible]
```

```
      [illegible]                                             DRW  56
13    IF (JPW.EQ.0) CALL PLOT (XX,YY,3)                       DRW  57
      CALL PLOT (XX,YY,2)                                     DRW  58
      JPW=1                                                   DRW  59
      GO TO 15                                                DRW  60
14    JPW=0                                                   DRW  61
      CALL PLOT (XX,YY,3)                                     DRW  62
15    CONTINUE                                                DRW  63
      CALL PLOT (XX,YY,3)                                     DRW  64
      IF (IPLT.NE.0) RETURN                                   DRW  65
      IF ([illegible]) 16,19                                  DRW  66
16    DO 17 [illegible]                                       DRW  67
      IF ([illegible]) GO TO 17                               DRW  68
      TEMP=Y(I)                                               DRW  69
      Y(I)=Y(I1)                                              DRW  70
      Y(I1)=[illegible]                                       DRW  71
17    CONTINUE                                                DRW  72
18    CONTINUE                                                DRW  73
      RETURN                                                  DRW  74
19    CALL [illegible]                                        DRW  75
      FACT=1.0                                                DRW  76
      IF ([illegible]) FACT=-1.0                              DRW  77
      JPW=0                                                   DRW  78
      DO 21 [illegible]                                       DRW  79
      IF ([illegible]) GO TO 20                               DRW  80
      XX=[illegible]                                          DRW  81
      YY=[illegible]                                          DRW  82
      IF (JPW.EQ.0) CALL PLOT (XX,YY,3)                       DRW  83
      CALL PLOT (XX,YY,2)                                     DRW  84
      JPW=1                                                   DRW  85
      GO TO 21                                                DRW  86
20    JPW=0                                                   DRW  87
21    CONTINUE                                                DRW  88
      CALL PLOT (XX,YY,3)                                     DRW  89
      RETURN                                                  DRW  90
C                                                             DRW  91
      END                                                     DRW  92
```

```
      SUBROUTINE FLIM (AVE,AMN,AMX,AVR,VCHECK)                          FLM   1
C                                                                       FLM   2
C     SUBROUTINE FLIM SHOULD TAKE EACH STRING OF POINTS AND SUBSTITUTE  FLM   3
C     ZEROS FOR THE FIRST POINT OUTSIDE THE DESIRED MAP AREA.  IT WILL  FLM   4
C     THEN IGNORE SUCCESSIVE POINTS UNTIL THEY OPENTER THE MAP AREA.    FLM   5
C                                                                       FLM   6
      COMMON /FACTOR/ VEFF,VEFF,VZERO,VZERO,VDIS,VST                    FLM   7
      COMMON /FLIMAR/ FFLIT,MAP,REVERSE                                 FLM   8
      COMMON /DATA/ V(8000),V(8000)                                     FLM   9
      VCHECK=1                                                          FLM  10
      GO TO (1,1,6,6), MAP                                              FLM  11
1     DO 5 I=1,8000                                                     FLM  12
      IF (V(I).LT.0.0) V(I)=V(I)+360.                                   FLM  13
      IF (V(I).GT.AMN.OR.V(I).LT.AMX) GO TO 3                           FLM  14
      IF (V(I).GT.AMN.OR.V(I).LT.AVE) GO TO 3                           FLM  15
      IF (V(I).EQ.0.0.AND.V(I).NE.0.0) GO TO 2                          FLM  16
      IF (VCHECK.EQ.1) GO TO 5                                          FLM  17
2     V(VCHECK)=V(I)                                                    FLM  18
      V(VCHECK)=V(I)                                                    FLM  19
      GO TO 4                                                           FLM  20
3     IF (VCHECK.EQ.1) GO TO 5                                          FLM  21
      V(VCHECK)=0.0                                                     FLM  22
      IF (V(L-1).EQ.0.0.AND.V(L-1).EQ.0.0) GO TO 5                      FLM  23
      V(VCHECK)=0.0                                                     FLM  24
      V(VCHECK)=0.0                                                     FLM  25
4     VCHECK=VCHECK+1                                                   FLM  26
5     CONTINUE                                                          FLM  27
      IF (VCHECK.EQ.1) RETURN                                           FLM  28
      VCHECK=VCHECK-1                                                   FLM  29
      IF (V(VCHECK).EQ.0.0.AND.V(VCHECK).EQ.0.0) RETURN                 FLM  30
      VCHECK=VCHECK-1                                                   FLM  31
      V(VCHECK)=0.0                                                     FLM  32
      V(VCHECK)=0.0                                                     FLM  33
      RETURN                                                            FLM  34
C     CHECK FOR POLAR MAP REGION                                        FLM  35
6     DO 12 I=1,8000                                                    FLM  36
      IF (V(I).EQ.0.0.AND.V(I).EQ.0.0) GO TO 8                          FLM  37
      IF (V(I).LT.0.0) V(I)=V(I)+360.                                   FLM  38
      IF (MAP.EQ.4) GO TO 7                                             FLM  39
      IF (V(I).LT.AMN) GO TO 11                                         FLM  40
      V(I)=90.-V(I)                                                     FLM  41
      GO TO 8                                                           FLM  42
7     IF (V(I).GT.AVE) GO TO 11                                         FLM  43
      V(I)=V(I)+90.                                                     FLM  44
8     IF (V(I).NE.0.0.OR.V(I).NE.0.0) GO TO 10                          FLM  45
9     IF (VCHECK.EQ.1) GO TO 12                                         FLM  46
10    V(VCHECK)=V(I)                                                    FLM  47
      V(VCHECK)=V(I)                                                    FLM  48
      GO TO 12                                                          FLM  49
11    IF (VCHECK.EQ.1) GO TO 12                                         FLM  50
      VCHECK=VCHECK-1                                                   FLM  51
      IF (V(VCHECK).EQ.0.0.AND.V(VCHECK).EQ.0.0) GO TO 12               FLM  52
      V(VCHECK)=0.0                                                     FLM  53
      V(VCHECK)=0.0                                                     FLM  54
12    VCHECK=VCHECK+1                                                   FLM  55
C                                                                       FLM  56
13    CONTINUE                                                          FLM  57
      IF (VCHECK.EQ.1) RETURN                                           FLM  58
      VCHECK=VCHECK-1                                                   FLM  59
      IF (V(VCHECK).EQ.0.0.AND.V(VCHECK).EQ.0.0) RETURN                 FLM  60
      VCHECK=VCHECK+1                                                   FLM  61
      V(VCHECK)=0.0                                                     FLM  62
      V(VCHECK)=0.0                                                     FLM  63
      RETURN                                                            FLM  64
C                                                                       FLM  65
      END
```

```
      SUBROUTINE POLEPOC                                                PLG    1
C                                                                       PLG    2
C     THIS ROUTINE PLOTS EDGE OF POLAR MAP                              PLG    3
C                                                                       PLG    4
      COMMON /SPLMAP/ SPLIT,MAP                                         PLG    5
      COMMON /FACTOR/ XFAC,YFAC,YZERO,YZERO,XDIS,YSIZE                  PLG    6
      DATA PAD/57.295779513/,PADI/.017453/                              PLG    7
      GO TO (1,12,1,1), MAP                                             PLG    8
1     JUMP=0                                                            PLG    9
      IXD=XDIS*XFAC+.001                                                PLG   10
      IF ((XDIS*XFAC-IXD).LT..001) IXD=IXD-1                            PLG   11
      DO 6 ID=1,IXD                                                     PLG   12
      XDI=ID                                                            PLG   13
      PHI=0.                                                            PLG   14
2     CONTINUE                                                          PLG   15
      DO 3 I=1,360                                                      PLG   16
      XX=SIN(PHI)*XDI-YZERO                                             PLG   17
      YY=-COS(PHI)*XDI-YZERO                                            PLG   18
      IF (I.EQ.1) CALL PLOT (XX,YY,3)                                   PLG   19
      CALL PLOT (XX,YY,2)                                               PLG   20
      PHI=PHI+PADI                                                      PLG   21
3     CONTINUE                                                          PLG   22
      CALL PLOT (XX,YY,3)                                               PLG   23
      IF (MAP.EQ.4) GO TO 4                                             PLG   24
      CALL NUMBER (XX+.1,YY-.1,.07,90.-XDI/XFAC,0.,4HES,1)              PLG   25
      GO TO 5                                                           PLG   26
4     CALL NUMBER (XX+.1,YY-.1,.07,XDI/YFAC-90.,0.,4HES,1)              PLG   27
5     IF (JUMP.EQ.1) GO TO 7                                            PLG   28
6     CONTINUE                                                          PLG   29
      JUMP=1                                                            PLG   30
      XDI=XDIS*XFAC                                                     PLG   31
      GO TO 2                                                           PLG   32
7     IF (MAP.EQ.4) GO TO 8                                             PLG   33
      CALL NUMBER (-XZERO,-.2,.07,0.,0.,4HES,1)                         PLG   34
      GO TO 9                                                           PLG   35
8     CALL NUMBER (-XZERO,-.2,.07,180.,0.,4HES,1)                       PLG   36
9     CALL PLOT (-XZERO,0.,3)                                           PLG   37
      CALL PLOT (-XZERO,-2.*YZERO,2)                                    PLG   38
      IF (MAP.EQ.4) GO TO 10                                            PLG   39
      CALL NUMBER (-XZERO,-2.*YZERO+.07,.07,180.,0.0,4HES,1)            PLG   40
      GO TO 11                                                          PLG   41
10    CALL NUMBER (-XZERO,-2.*YZERO+.07,.07,0.,0.,4HES,1)               PLG   42
11    CALL NUMBER (-.45,-YZERO,.07,270.,0.0,4HES,1)                     PLG   43
      CALL PLOT (0.,-YZERO,3)                                           PLG   44
      CALL PLOT (-2.*XZERO,-YZERO,2)                                    PLG   45
      CALL NUMBER (-2.*XZERO+.07,-YZERO,.07,90.,0.0,4HES,1)             PLG   46
      RETURN                                                            PLG   47
12    ZERO=YSIZE*.5                                                     PLG   48
      PHI=0.                                                            PLG   49
      DO 13 I=1,360                                                     PLG   50
      XX=SIN(PHI)*ZERO+ZERO                                             PLG   51
      YY=COS(PHI)*ZERO+ZERO                                             PLG   52
      IF (I.EQ.1) CALL PLOT (XX,YY,3)                                   PLG   53
      CALL PLOT (XX,YY,2)                                               PLG   54
      PHI=PHI+PADI                                                      PLG   55
13    CONTINUE                                                          PLG   56
      CALL PLOT (XX,YY,3)                                               PLG   57
      RETURN                                                            PLG   58
      END                                                               PLG   59-
```

```
      SUBROUTINE WPLOT2 (X,Y,N,LABEL,IL)                                WPT   1
C                                                                       WPT   2
C     THIS ROUTINE TAKES ARRAYS OF LATITUDE AND LONGITUDE AND PLOTS THE WPT   3
C     DATA ON MAP DRAWN BY WORLD                                        WPT   4
C     X=LONGITUDE(DEGREES,0 TO 360, OR -180 TO 180)                     WPT   5
C     Y=LATITUDE(DEGREES, +=NORTH, -=SOUTH)                             WPT   6
C     N=NUMBER OF DATA POINTS                                           WPT   7
C                                                                       WPT   8
      COMMON /EDGE/ XEAST,XWEST,YNORTH,YSOUTH,XEASTS                    WPT   9
      COMMON /FACTOR/ XFAC,YFAC,XZERO,YZERO,YDIS,YSZ                    WPT  10
      COMMON /SPLMAP/ SPLIT,MAP,REVERSE,ROT                             WPT  11
      LOGICAL REVERSE                                                   WPT  12
      LOGICAL SPLIT                                                     WPT  13
      INTEGER ROT                                                       WPT  14
      DIMENSION X(1), Y(1)                                              WPT  15
      DATA RAD/.0174533/                                                WPT  16
      YH(HY)=(90.+90.*SIN(HY*RAD))*YFAC                                 WPT  17
      XH(HX,HY)=ZERO+90.*COS((XEASTS-HX)*RAD)*COS(HY*RAD)*XFAC          WPT  18
      YMAY=.9*YDIS                                                      WPT  19
      IF (X(1).LT.0.) X(1)=X(1)+360.                                    WPT  20
      IF (ROT.EQ.0) GO TO 3                                             WPT  21
      DO 1 J=1,N                                                        WPT  22
      XX=COS(X(J)*RAD)*COS(Y(J)*RAD)                                    WPT  23
      YY=COS(X(J)*RAD)*SIN(X(J)*RAD)                                    WPT  24
      ZZ=SIN(Y(J)*RAD)                                                  WPT  25
      CALL EULER (XEAST,XWEST,RS,XP,YP,ZP,1,XX,YY,ZZ,2)                 WPT  26
      XX=SQRT(YP*YP+ZP*ZP)                                              WPT  27
      Y(J)=ACOS(YP/XX)*57.29577795                                      WPT  28
      IF (ZP.LT.0.) X(J)=360.-X(J)                                      WPT  29
      Y(J)=90.-ACOS(ZP/SQRT(XX*XX+ZP*ZP))*57.29577795                   WPT  30
1     CONTINUE                                                          WPT  31
3     GO TO (4,3,36,36), MAP                                            WPT  32
3     ZERO=YSZ*.5                                                       WPT  33
4     DO 12 J=1,N                                                       WPT  34
      IF (Y(J).LT.0.) Y(J)=Y(J)+360.                                    WPT  35
      IF (SPLIT) 5,6                                                    WPT  36
5     IF (X(J).LT.XEAST) X(J)=X(J)+360.                                 WPT  37
6     IF (X(J).LT.XWEST.OR.X(J).GT.XEASTS) GO TO 13                     WPT  38
      IF (X(J).GT.YNORTH.OR.X(J).LT.YSOUTH) GO TO 13                    WPT  39
      GO TO (7,10), MAP                                                 WPT  40
7     XX=X(J)*XFAC-XZERO                                                WPT  41
      YY=Y(J)*YFAC-YZERO                                                WPT  42
      XXX=X(J+1)*XFAC-XZERO                                             WPT  43
      YYY=Y(J+1)*YFAC-YZERO                                             WPT  44
      IF (REVERSE) 8,9                                                  WPT  45
8     TEMP=XX                                                           WPT  46
      XX=-YY+2*YZERO+YSIZE                                              WPT  47
      YY=TEMP                                                           WPT  48
      TEMP=XXX                                                          WPT  49
      XXX=-YYY+2.*YZERO+YSIZE                                           WPT  50
      YYY=TEMP                                                          WPT  51
9     CONTINUE                                                          WPT  52
      GO TO 11                                                          WPT  53
10    XX=XH(X(J),Y(J))                                                  WPT  54
      YY=YH(Y(J))                                                       WPT  55
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      XXX=XH(X(J+1),Y(J+1))                                          WPT  86
      YYY=YH(Y(J+1))                                                 WPT  87
11    XXX=ATAN((YYY-YY)/(XXX-XX))*57.3                               WPT  88
      IF (IL.EQ.0) GO TO 12                                          WPT  89
      CALL SYMBOL (XX+.05,YY+.05,.07,LABEL,XXX,IL)                   WPT  90
12    CALL PLOT (XX,YY,3)                                            WPT  91
      JPLOT=1                                                        WPT  92
      IF (J.EQ.1) JPLOT=0                                            WPT  93
      GO TO 14                                                       WPT  94
13    JPLOT=1                                                        WPT  95
      RETURN                                                         WPT  96
14    CONTINUE                                                       WPT  97
      JP2=J+2                                                        WPT  98
      DO 25 I=J,N                                                    WPT  99
      IF (X(I).LT.0.) X(I)=X(I)+360.                                 WPT 100
      IF (SPLIT) 15,16                                               WPT 101
15    IF (X(I).LT.XEAST) X(I)=X(I)+360.                              WPT 102
16    CONTINUE                                                       WPT 103
      IF (X(I).LT.XWEST.OR.X(I).GT.XEASTS) GO TO 24                  WPT 104
      IF (Y(I).LT.YSOUTH.OR.Y(I).GT.YNORTH) GO TO 24                 WPT 105
      IF (I.LT.JP2) GO TO 17                                         WPT 106
      IF (ABS(X(I)-X(I-1)).GT.XMAX) GO TO 23                         WPT 107
17    CONTINUE                                                       WPT 108
      IF (JPLOT.NE.0) CALL EDGPLOT (X,Y,I,JPLOT,J)                   WPT 109
18    CONTINUE                                                       WPT 110
      GO TO (19,21), MAP                                             WPT 111
19    YY=Y(I)*YFAC-YZERO                                             WPT 112
      XX=X(I)*XFAC-XZERO                                             WPT 113
      IF (REVERSE) 20,22                                             WPT 114
20    TEMP=XX                                                        WPT 115
      XX=-YY+2*YZERO+YSIZE                                           WPT 116
      YY=TEMP                                                        WPT 117
      GO TO 22                                                       WPT 118
21    XX=XH(X(I),Y(I))                                               WPT 119
      YY=YH(Y(I))                                                    WPT 120
22    CALL PLOT (XX,YY,2)                                            WPT 121
      NUM=0                                                          WPT 122
      JPLOT=0                                                        WPT 123
      GO TO 25                                                       WPT 124
23    JPLOT=3                                                        WPT 125
      CALL EDGPLOT (X,Y,I,JPLOT,J)                                   WPT 126
      JPLOT=0                                                        WPT 127
      GO TO 18                                                       WPT 128
24    JPLOT=2                                                        WPT 129
      IF (NUM.EQ.0) CALL EDGPLOT (X,Y,I,JPLOT,J)                     WPT 130
      NUM=NUM+1                                                      WPT 131
      JPLOT=1                                                        WPT 132
25    CONTINUE                                                       WPT 133
      CALL PLOT (XX,YY,3)                                            WPT 134
      RETURN                                                         WPT 135
26    CONTINUE                                                       WPT 136
      JPLOT=1                                                        WPT 137
      FACT=1.0                                                       WPT 138
      DO 30 J=1,N                                                    WPT 139
      IF (MAP.EQ.4) GO TO 27                                         WPT 140
```

```
      IF (Y(J).LT.YNORTH) GO TO 30                                      WPT 111
      Y(J)=90.-Y(J)                                                     WPT 112
      GO TO 28                                                          WPT 113
27    FACT=-1.0                                                         WPT 114
      IF (Y(J).GT.YSOUTH) GO TO 30                                      WPT 115
      Y(J)=Y(J)+90.                                                     WPT 116
28    XX=SIN(X(J)*RAD)*Y(J)*XFAC-XZERO                                  WPT 117
      YY=-COS(X(J)*RAD)*Y(J)*YFAC*FACT-YZERO                            WPT 11
      XXX=SIN(X(J+1)*RAD)*Y(J+1)*XFAC-XZERO                             WPT 119
      YYY=-COS(X(J+1)*RAD)*Y(J+1)*YFAC*FACT-YZERO                       WPT 120
C     XXX=ATAN((YYY-YY)/(XXX-XX))*57.3                                  WPT 121
      IF (IL.EQ.0) GO TO 29                                             WPT 122
      CALL SYMBOL (XX+.05,YY+.05,.07,LABEL,XXX,IL)                      WPT 123
29    CALL PLOT (XX,YY,3)                                               WPT 124
      JPLOT=0                                                           WPT 125
      GO TO 31                                                          WPT 126
30    CONTINUE                                                          WPT 127
      RETURN                                                            WPT 128
31    CONTINUE                                                          WPT 129
      J=J+1                                                             WPT 130
      IF (J.GT.N) RETURN                                                WPT 131
      DO 35 I=J,N                                                       WPT 132
      IF (MAP.EQ.4) GO TO 32                                            WPT 133
      Y(I)=90.-Y(I)                                                     WPT 134
      GO TO 33                                                          WPT 135
32    Y(I)=Y(I)+90.                                                     WPT 136
33    IF (Y(I).GT.XDIS) GO TO 34                                        WPT 137
      IF (X(I).LT.0.) X(I)=X(I)+360.                                    WPT 138
      YY=-COS(X(I)*RAD)*Y(I)*YFAC*FACT-YZERO                            WPT 139
      XX=SIN(Y(I)*RAD)*Y(I)*XFAC-XZERO                                  WPT 140
      IF (JPLOT.NE.0) CALL PLOT (XX,YY,3)                               WPT 141
      CALL PLOT (XX,YY,2)                                               WPT 142
      JPLOT=0                                                           WPT 143
      GO TO 35                                                          WPT 144
34    JPLOT=1                                                           WPT 145
35    CONTINUE                                                          WPT 146
      CALL PLOT (XX,YY,3)                                               WPT 147
      RETURN                                                            WPT 148
      END                                                               WPT 149-
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      SUBROUTINE EDGPLOT (X,Y,I,JPLOT,JJ)                                EDG   1
C                                                                        EDG   2
C     THIS ROUTINE DRAWS LINE FROM EDGE OF MAP TO FIRST DATA POINT INSIDEDG   3
C       MAP                                                              EDG   4
C     NOT USED FOR POLAR PLOTS                                           EDG   5
C     JPLOT=1 MEANS OUTSIDE COMING IN                                    EDG   6
C     JPLOT=2 MEANS INSIDE GOING OUT                                     EDG   7
C     JPLOT=3 MEANS LINE CROSSES BREAK IN MAP                            EDG   8
C                                                                        EDG   9
      DIMENSION X(1), Y(1)                                               EDG  10
      COMMON /FACTOR/ XFAC,YFAC,XZERO,YZERO,XDIS,YSZ                     EDG  11
      COMMON /EDGE/ XEAST,XWEST,YNORTH,YSOUTH,XEASTS                     EDG  12
      COMMON /SPLMAP/ SPLIT,MAP,REVERSE                                  EDG  13
      LOGICAL REVERSE                                                    EDG  14
      DATA RAD/.0174533/                                                 EDG  15
      XH(HX,HY)=ZERO+90.*COS((XEASTS-HX)*RAD)*COS(HY*RAD)*XFAC           EDG  16
      YH(HY)=(90.+90.*SIN(HY*RAD))*YFAC                                  EDG  17
      GO TO (2,1), MAP                                                   EDG  18
1     ZERO=YSZ*.5                                                        EDG  19
2     K=I-1                                                              EDG  20
      J=I                                                                EDG  21
      GO TO (4,3,31), JPLOT                                              EDG  22
3     CONTINUE                                                           EDG  23
      IT=J                                                               EDG  24
      J=K                                                                EDG  25
      K=IT                                                               EDG  26
      IF (JJ.NE.1) GO TO 4                                               EDG  27
      J=J+1                                                              EDG  28
      K=K+1                                                              EDG  29
4     IF (X(K).LT.XWEST) GO TO 10                                        EDG  30
      IF (X(K).GT.XEASTS) GO TO 16                                       EDG  31
      IF (Y(K).LT.YSOUTH) GO TO 22                                       EDG  32
C     Y(K) MUST BE GT YNORTH                                             EDG  33
      XIN=X(J)+(YNORTH-Y(J))*((X(K)-X(J))/(Y(K)-Y(J)))                   EDG  34
      GO TO (5,8), MAP                                                   EDG  35
5     YY=YNORTH*YFAC-YZERO                                               EDG  36
      XX=XIN*XFAC-XZERO                                                  EDG  37
      IF (REVERSE) 6,7                                                   EDG  38
6     TEMP=YY                                                            EDG  39
      XX=-YY+2*YZERO+YSIZE                                               EDG  40
      YY=TEMP                                                            EDG  41
7     CONTINUE                                                           EDG  42
      GO TO 9                                                            EDG  43
8     XX=XH(XIN,YNORTH)                                                  EDG  44
      YY=YH(YNORTH)                                                      EDG  45
9     CALL PLOT (XX,YY,3)                                                EDG  46
      XX=X(J)*XFAC-XZERO                                                 EDG  47
      YY=Y(J)*YFAC-YZERO                                                 EDG  48
      IF (MAP.LT.2) GO TO 27                                             EDG  49
      XX=XH(Y(J),Y(J))                                                   EDG  50
      YY=YH(Y(J))                                                        EDG  51
      GO TO 27                                                           EDG  52
10    YIN=Y(J)+(XWEST-X(J))*((Y(K)-Y(J))/(X(K)-X(J)))                    EDG  53
      GO TO (11,14), MAP                                                 EDG  54
11    XX=XWEST*XFAC-XZERO                                                EDG  55
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      YY=YIN*YFAC-YZERO                                                 EDG  56
      IF (REVERSE) 12,13                                                EDG  57
12    TEMP=YY                                                           EDG  58
      YY=-YY+3*YZERO+YSIZE                                              EDG  59
      YY=TEMP                                                           EDG  60
13    CONTINUE                                                          EDG  61
      GO TO 15                                                          EDG  62
14    YY=YW(YWEST,YIN)                                                  EDG  63
      YY=YW(YIN)                                                        EDG  64
15    CALL PLOT (XX,YY,3)                                               EDG  65
      YY=Y(J)*YFAC-YZERO                                                EDG  66
      YY=Y(J)*YFAC-YZERO                                                EDG  67
      IF (MAP.LT.2) GO TO 27                                            EDG  68
      XX=XW(X(J),Y(J))                                                  EDG  69
      YY=YW(Y(J))                                                       EDG  70
      GO TO 27                                                          EDG  71
16    YIN=Y(J)+(XEASTS-X(J))*((Y(K)-Y(J))/(X(K)-X(J)))                  EDG  72
      GO TO (17,20), MAP                                                EDG  73
17    XX=XEASTS*XFAC-XZERO                                              EDG  74
      YY=YIN*YFAC-YZERO                                                 EDG  75
      IF (REVERSE) 18,19                                                EDG  76
18    TEMP=YY                                                           EDG  77
      YY=-YY+3*YZERO+YSIZE                                              EDG  78
      YY=TEMP                                                           EDG  79
19    CONTINUE                                                          EDG  80
      GO TO 21                                                          EDG  81
20    YY=YW(XEASTS,YIN)                                                 EDG  82
      YY=YW(YIN)                                                        EDG  83
21    CALL PLOT (XX,YY,3)                                               EDG  84
      YY=Y(J)*YFAC-YZERO                                                EDG  85
      XX=X(J)*XFAC-XZERO                                                EDG  86
      IF (MAP.LT.2) GO TO 27                                            EDG  87
      XX=XW(X(J),Y(J))                                                  EDG  88
      YY=YW(Y(J))                                                       EDG  89
      GO TO 27                                                          EDG  90
22    XIN=X(J)+(YSOUTH-Y(J))*((X(K)-X(J))/(Y(K)-Y(J)))                  EDG  91
      GO TO (23,25), MAP                                                EDG  92
23    YY=YSOUTH*YFAC-YZERO                                              EDG  93
      XX=XIN*XFAC-XZERO                                                 EDG  94
      IF (REVERSE) 24,26                                                EDG  95
24    TEMP=YY                                                           EDG  96
      YY=-YY+3.*YZERO+YSIZE                                             EDG  97
      YY=TEMP                                                           EDG  98
      GO TO 26                                                          EDG  99
25    XX=XW(XIN,YSOUTH)                                                 EDG 100
      YY=YW(YSOUTH)                                                     EDG 101
26    CALL PLOT (XX,YY,3)                                               EDG 102
      YY=Y(J)*YFAC-YZERO                                                EDG 103
      XX=X(J)*XFAC-XZERO                                                EDG 104
      IF (MAP.LT.2) GO TO 27                                            EDG 105
      XX=XW(X(J),Y(J))                                                  EDG 106
      YY=YW(Y(J))                                                       EDG 107
27    GO TO (28,30), MAP                                                EDG 108
28    IF (REVERSE) 29,30                                                EDG 109
29    TEMP=YY                                                           EDG 110
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```
      XX=-YY+2*YZERO+YSIZE                                          EDG 111
      YY=TEMP                                                       EDG 112
30    CONTINUE                                                      EDG 113
      CALL PLOT (XX,YY,2)                                           EDG 114
      CALL PLOT (XX,YY,3)                                           EDG 115
      RETURN                                                        EDG 116
31    KK=K-1                                                        EDG 117
      SIGN=1.0                                                      EDG 118
      IF (ABS(X(K)-XEAST),LT.,2*XDIS) GO TO 40                      EDG 119
      YIN=Y(K)+(XWEST-X(K))*((Y(KK)-Y(K))/(X(KK)-X(K)))             EDG 120
      GO TO (32,33), MAP                                            EDG 121
32    XX=XH(XWEST,YIN)                                              EDG 122
      YY=YH(YIN)                                                    EDG 123
      GO TO 34                                                      EDG 124
33    YY=YWEST*XFAC-YZERO                                           EDG 125
      YY=YIN*XFAC-YZERO                                             EDG 126
34    CALL PLOT (XX,YY,2)                                           EDG 127
      GO TO 35                                                      EDG 128
35    CONTINUE                                                      EDG 129
      CALL PLOT (XX+XDIS*XFAC*SIGN,YY,3)                            EDG 130
      GO TO 36                                                      EDG 131
      XX=XH(XEASTS,YIN)                                             EDG 132
      YY=YH(YIN)                                                    EDG 133
      CALL PLOT (XX,YY,3)                                           EDG 134
36    GO TO (38,37), MAP                                            EDG 135
37    XX=YH(X(J),Y(J))                                              EDG 136
      YY=YH(Y(J))                                                   EDG 137
      GO TO 39                                                      EDG 138
38    YY=X(J)*XFAC-YZERO                                            EDG 139
      YY=Y(J)*XFAC-YZERO                                            EDG 140
39    CONTINUE                                                      EDG 141
      CALL PLOT (YY,YY,2)                                           EDG 142
      RETURN                                                        EDG 143
40    YIN=Y(K)+(XEASTS-X(K))*((Y(KK)-Y(K))/(X(KK)-X(K)))            EDG 144
      GO TO (42,41), MAP                                            EDG 145
41    XX=XH(XEASTS,YIN)                                             EDG 146
      YY=YH(YIN)                                                    EDG 147
      GO TO 34                                                      EDG 148
42    CONTINUE                                                      EDG 149
      XX=XEASTS*XFAC-XZERO                                          EDG 150
      YY=YIN*XFAC-YZERO                                             EDG 151
      SIGN=-1.                                                      EDG 152
      GO TO 34                                                      EDG 153
      END                                                           EDG 154-
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```
      SUBROUTINE TITLE (XAXIS,YAXIS,PLTLE,NBY,NBY,NBT)                  TLE   1
C                                                                       TLE   2
C     THIS SUBROUTINE LABELS THE AXES AND TOP OF THE PLOT AS WELL AS    TLE   3
C     DRAWING THE BOUNDARIES.                                           TLE   4
C                                                                       TLE   5
      DIMENSION XAXIS(1), YAXIS(1), PLTLE(1)                            TLE   6
      COMMON /SPLMAP/ SPLIT,MAP,REVERSE                                 TLE   7
      COMMON /FACTOR/ XFAC,YFAC,XZERO,YZERO,YDIS,YSIZE,XSIZE            TLE   8
      LOGICAL REVERSE                                                   TLE   9
      INTEGER XAXIS,YAXIS,PLTLE                                         TLE  10
      SIZE=.07                                                          TLE  11
C     PLOT YAXIS LABLE                                                  TLE  12
      IF (NBY.EQ.0) GO TO 3                                             TLE  13
      CALL DOIT (NBX,DIF,XSIZE,SIZE)                                    TLE  14
      IF (REVERSE) 1,2                                                  TLE  15
1     CALL SYMBOL (-.36,DIF,SIZE,XAXIS,90.,NBY)                         TLE  16
      GO TO 3                                                           TLE  17
2     CONTINUE                                                          TLE  18
      CALL SYMBOL (DIF,-.3,SIZE,XAXIS,0.0,NBX)                          TLE  19
3     IF (NBY.EQ.0) GO TO 6                                             TLE  20
C     PLOT Y LABEL                                                      TLE  21
      CALL DOIT (NBY,DIF,YSIZE,SIZE)                                    TLE  22
      IF (REVERSE) 4,5                                                  TLE  23
4     CALL SYMBOL (DIF,-.3,SIZE,YAXIS,0.0,NBY)                          TLE  24
      GO TO 6                                                           TLE  25
5     CONTINUE                                                          TLE  26
      CALL SYMBOL (-.36,DIF,SIZE,YAXIS,90.0,NBY)                        TLE  27
6     IF (NBT.EQ.0) GO TO 8                                             TLE  28
      SIZE=.14                                                          TLE  29
      CALL DOIT (NBT,DIF,XSIZE,SIZE)                                    TLE  30
      IF (REVERSE) 7,8                                                  TLE  31
7     CALL SYMBOL (XSIZE+.15,YSIZE-DIF,SIZE,PLTLE,-30.,NBT)             TLE  32
      GO TO 9                                                           TLE  33
8     CONTINUE                                                          TLE  34
      CALL SYMBOL (DIF,YSIZE+.15,SIZE,PLTLE,0.0,NBT)                    TLE  35
9     CONTINUE                                                          TLE  36
      GO TO (12,10,11,11), MAP                                          TLE  37
10    CALL POLEFOG                                                      TLE  38
11    RETURN                                                            TLE  39
C     DRAW BORDER                                                       TLE  40
12    IXS=YSIZE+1.00001                                                 TLE  41
      CALL PLOT (0.,0.,3)                                               TLE  42
      IF (NBX.EQ.0.AND.NBY.EQ.0.AND.NBT.EQ.0) RETURN                    TLE  43
      XFP=1./XFAC                                                       TLE  44
      DO 15 I=1,IXS                                                     TLE  45
      X=I-1                                                             TLE  46
      XS=AMOD((X+XZERO)*XFP,360.)                                       TLE  47
      CALL PLOT (X,0.,2)                                                TLE  48
      CALL PLOT (X,.1,2)                                                TLE  49
      IF (REVERSE) 14,13                                                TLE  50
13    CONTINUE                                                          TLE  51
      CALL NUMBER (X-.24,-.2,.07,XS,0.,4HFE5.1)                         TLE  52
14    CONTINUE                                                          TLE  53
      CALL PLOT (X,0.,3)                                                TLE  54
15    CONTINUE                                                          TLE  55
```

```
      CALL PLOT (XSIZE,0.,2)                                          TLE  86
      IYS=YSIZE+1.0000001                                             TLE  87
      YFP=1.0/YFAC                                                    TLE  88
      DO 16 I=1,IYS                                                   TLE  89
      Y=I-1                                                           TLE  90
      CALL PLOT (XSIZE,Y,2)                                           TLE  91
      CALL PLOT (XSIZE-.1,Y,2)                                        TLE  92
      CALL PLOT (XSIZE,Y,2)                                           TLE  93
16    CONTINUE                                                        TLE  94
      CALL PLOT (YSIZE,YSIZE,2)                                       TLE  95
      XDIF=YSIZE-(IYS-1)                                              TLE  96
      DO 19 I=1,IYS                                                   TLE  97
      X=XSIZE-I+1-XDIF                                                TLE  98
      XS=AMOD((X+XZERO)*XFP,360.)                                     TLE  99
      CALL PLOT (X,YSIZE,2)                                           TLE 100
      CALL PLOT (X,YSIZE-.1,2)                                        TLE 101
      IF (REVERSE) 17,18                                              TLE 102
17    CALL NUMBER (X,YSIZE+.36,.07,XS,180.,4HEE.1)                    TLE 103
18    CALL PLOT (X,YSIZE,3)                                           TLE 104
      CALL PLOT (X,YSIZE,2)                                           TLE 105
19    CONTINUE                                                        TLE 106
      CALL PLOT (0.,YSIZE,2)                                          TLE 107
      YDIF=YSIZE-(IYS-1)                                              TLE 108
      DO 23 I=1,IYS                                                   TLE 109
      Y=YSIZE-I+1-YDIF                                                TLE 110
      CALL PLOT (0.,Y,2)                                              TLE 111
      CALL PLOT (.1,Y,2)                                              TLE 112
      YS=(Y+YZERO)*YFP                                                TLE 113
      IF (REVERSE) 20,21                                              TLE 114
20    YS=(I-1+YZERO)*YFP                                              TLE 115
      CALL NUMBER (-.25,Y-.07,YS,-90.,4HEE.1)                         TLE 116
      GO TO 22                                                        TLE 117
21    CONTINUE                                                        TLE 118
      CALL NUMBER (-.36,Y-.07,YS,0.0,4HEE.1)                          TLE 119
22    CALL PLOT (0.,Y,3)                                              TLE 120
23    CONTINUE                                                        TLE 121
      CALL PLOT (0.,0.,2)                                             TLE 122
      CALL PLOT (0.,0.,3)                                             TLE 123
      RETURN                                                          TLE 124
```

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```
      SUBROUTINE DOIT (NBX,DIF,XSIZE,SIZE)                            DOT   1
      IF (NBX*SIZE.GT.XSIZE) SIZE=.07                                 DOT   2
      XLENTH=NBX*SIZE                                                 DOT   3
      DIF=(XSIZE-XLENTH)*.5                                           DOT   4
      RETURN                                                          DOT   5
      END                                                             DOT   6
```

```
      SUBROUTINE VIEW (XLONG,XLAT,IPLOT)                                VEW   1
      COMMON /SPLVAR/ SPLIT,MAP,REVERSE,DOT                             VEW   2
*     COMMON /POINTS/ X(8883),Y(8883),KOMPCV                            VEW   3
      COMMON /EDGE/ XE,XW,YN,YS,YEASTS                                  VEW   4
      INTEGER DOT                                                       VEW   5
      REWIND 3                                                          VEW   6
*     BUFFER IN (3,1) (X(1),Y(8883))                                    VEW   7
1     IF (UNIT(3) ).2                                                   VEW   8
2     REWIND 3                                                          VEW   9
      XMLT=XLAT                                                         VEW  10
      XE=AMOD(XLONG+90.,360.)                                           VEW  11
      XEASTS=XE                                                         VEW  12
      XW=XE-180.                                                        VEW  13
      IF (XW.LT.0.) XW=XW+360.                                          VEW  14
      IF ((XEASTS-XW).LT.0.) XEASTS=XEASTS+360.                         VEW  15
      YN=90.                                                            VEW  16
      YS=-90.                                                           VEW  17
      D=0.                                                              VEW  18
      DS1=0                                                             VEW  19
      RAD=57.2957795131                                                 VEW  20
      RAD1=1./RAD                                                       VEW  21
      XX=COS(XLAT*RAD1)*COS(XLONG*RAD1)                                 VEW  22
      YY=COS(XLAT*RAD1)*SIN(XLONG*RAD1)                                 VEW  23
      ZZ=SIN(XLAT*RAD1)                                                 VEW  24
      CALL EULER (XE,XLAT,0.,XX,YY,ZZ,1,XD,YD,ZD,1)                     VEW  25
      XLO=ACOS(XD/SQRT(XD*XD+YD*YD))*RAD                                VEW  26
*     IF (YD.LT.0.) XLO=360.-XLO                                        VEW  27
      DS1=XLO-XLONG                                                     VEW  28
      CALL EULER (XE,XLAT,DS1,XX,YY,ZZ,1,XD,YD,ZD,1)                    VEW  29
      CALL EULER (XE,XLAT,DS1,XD,YD,ZD,1,XX,YY,ZZ,2)                    VEW  30
*     XLO=ACOS(XD/SQRT(XD*XD+YD*YD))*RAD                                VEW  31
      IF (YD.LT.0.) XLO=360.-XLO                                        VEW  32
      XLA=90.-ACOS(ZD)*RAD                                              VEW  33
      DO 3 I=1,8883                                                     VEW  34
      IF ((X(I).EQ.0.0).AND.(Y(I).EQ.0.0)) GO TO 3                      VEW  35
      XX=COS(Y(I)*RAD1)*COS(X(I)*RAD1)                                  VEW  36
      YY=COS(Y(I)*RAD1)*SIN(X(I)*RAD1)                                  VEW  37
      ZZ=SIN(Y(I)*RAD1)                                                 VEW  38
      CALL EULER (XE,XLAT,DS1,XX,YY,ZZ,2)                               VEW  39
      YY=SQRT(XD*XD+YD*YD)                                              VEW  40
      X(I)=ACOS(XD/YY)*RAD                                              VEW  41
      IF (YD.LT.0.) X(I)=360.-X(I)                                      VEW  42
      Y(I)=90.-ACOS(ZD)*RAD                                             VEW  43
3     CONTINUE                                                          VEW  44
      XED=2                                                             VEW  45
      XLONG=XE                                                          VEW  46
      XLAT=XW                                                           VEW  47
      CALL PLIT (XEASTS,XX,YN,YS,KOMPCV)                                VEW  48
      IPLOT=1                                                           VEW  49
      DOT=1                                                             VEW  50
      RETURN                                                            VEW  51
C                                                                       VEW  52
C                                                                       VEW  53
      END                                                               VEW  54-



*     SUBROUTINE EULER (PHI,THETA,PSI,X,Y,Z,N,XD,YD,ZD,IT)              EUL   1
      DIMENSION X(1),Y(1),Z(1),XD(1),YD(1),ZD(1)                        EUL   2
      GO TO (1,2),IT                                                    EUL   3
1     CALL TRANSFM (PHI,THETA,PSI,X,Y,Z,N,XD,YD,ZD)                     EUL   4
*     RETURN                                                            EUL   5
2     CALL INVERSE (XD,YD,ZD,N,X,Y,Z)                                   EUL   6
      RETURN                                                            EUL   7
      END                                                               EUL   8-
```

```
      SUBROUTINE TRANSFM (PHI1,THETA1,PSI1,XX,YY,ZZ,N,XXB,YYB,ZZB)        TFM   1
      DIMENSION X(3), XB(3), XX(1), YY(1), ZZ(1), XXB(1), YYB(1), ZZB(1)TFM   2
      COMMON /A/ A(3,3)                                                  TFM   3
      IF ((PSI.EQ.PHI1).AND.(THETA.EQ.THETA1).AND.(PSI.EQ.PSI1)) GO TO 1 TFM   4
      PSI=PHI1                                                           TFM   5
      THETA=THETA1                                                       TFM   6
      PSI=PSI1                                                           TFM   7
      CALL ANGLE                                                         TFM   8
      PHI=PHI1*ORAD                                                      TFM   9
      PSI=PSI1*ORAD                                                      TFM  10
      THETA=THETA1*ORAD                                                  TFM  11
      CPHI=COS(PHI)                                                      TFM  12
      CPSI=COS(PSI)                                                      TFM  13
      CTHETA=COS(THETA)                                                  TFM  14
      SPHI=SIN(PHI)                                                      TFM  15
      SPSI=SIN(PSI)                                                      TFM  16
      STHETA=SIN(THETA)                                                  TFM  17
      A(1,1)=CPSI*CPHI-CTHETA*SPHI*SPSI                                  TFM  18
      A(1,2)=CPSI*SPHI+CTHETA*CPHI*SPSI                                  TFM  19
      A(1,3)=SPSI*STHETA                                                 TFM  20
      A(2,1)=-SPSI*CPHI-CTHETA*SPHI*CPSI                                 TFM  21
      A(2,2)=-SPSI*SPHI+CTHETA*CPHI*CPSI                                 TFM  22
      A(2,3)=CPSI*STHETA                                                 TFM  23
      A(3,1)=STHETA*SPHI                                                 TFM  24
      A(3,2)=-STHETA*CPHI                                                TFM  25
      A(3,3)=CTHETA                                                      TFM  26
    1 DO 3 K=1,N                                                         TFM  27
      X(1)=XX(K)                                                         TFM  28
      X(2)=YY(K)                                                         TFM  29
      X(3)=ZZ(K)                                                         TFM  30
      DO 2 I=1,3                                                         TFM  31
      XB(I)=0.                                                           TFM  32
      DO 2 J=1,3                                                         TFM  33
      XB(I)=XB(I)+A(I,J)*X(J)                                            TFM  34
    2 CONTINUE                                                           TFM  35
      XXB(K)=XB(1)                                                       TFM  36
      YYB(K)=XB(2)                                                       TFM  37
      ZZB(K)=XB(3)                                                       TFM  38
    3 CONTINUE                                                           TFM  39
      RETURN                                                             TFM  40
      END                                                                TFM  41-
```

```
      SUBROUTINE INVERSE (XXB,YYB,ZZB,N,XX,YY,ZZ)                        INV   1
      COMMON /A/ A(3,3)                                                  INV   2
      DIMENSION XB(3), X(3), XXB(1), YYB(1), ZZB(1), XX(1), YY(1), ZZ(1)INV   3
      DO 2 K=1,N                                                         INV   4
      XB(1)=XXB(K)                                                       INV   5
      XB(2)=YYB(K)                                                       INV   6
      XB(3)=ZZB(K)                                                       INV   7
      DO 1 J=1,3                                                         INV   8
      X(J)=0.                                                            INV   9
      DO 1 I=1,3                                                         INV  10
      X(J)=X(J)+A(I,J)*XB(I)                                             INV  11
    1 CONTINUE                                                           INV  12
      XX(K)=X(1)                                                         INV  13
      YY(K)=X(2)                                                         INV  14
      ZZ(K)=X(3)                                                         INV  15
    2 CONTINUE                                                           INV  16
      RETURN                                                             INV  17
      END                                                                INV  18-
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13. ABSTRACT

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WORLD is a general-use computer subroutine which draws maps containing continental outlines and overlays data on the map. Projection of maps may be modified mercator, equidistant polar, or hemispherical.

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