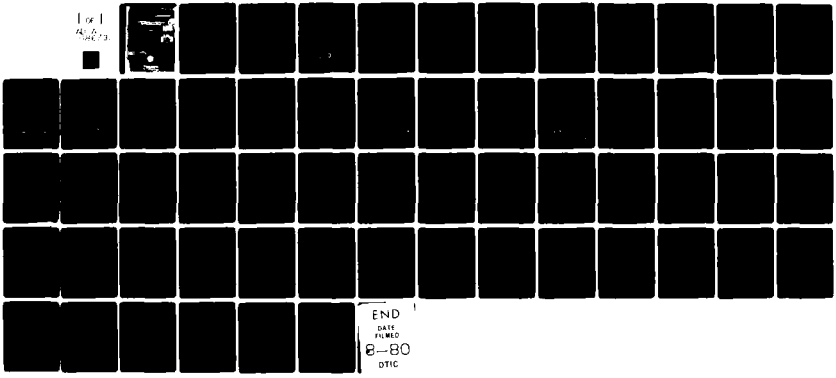
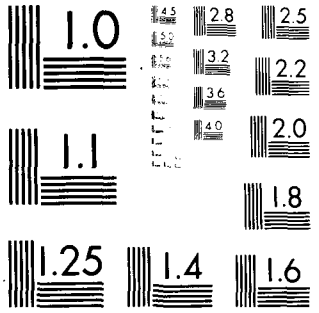
AD-A086 731 NAVAL RESEARCH LAB WASHINGTON DC F/G 17/1
ACOUSTIC RAYTRACING TO FIXED GROUND RECEIVERS (PROGRAM AIRRAY).(U)
APR 80 E B WRIGHT
UNCLASSIFIED NRL-MR-4185 SBIE-AD-E000 451 NL





MICROCOPY RESOLUTION TEST CHART

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER
NRL Memorandum Report 4185

2. GOVT ACCESSION NO.
AD-A086 731

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
ACCUSTIC RAYTRACING TO FIXED GROUND RECEIVERS (PROGRAM AIRRAY)

5. TYPE OF REPORT & PERIOD COVERED
Final report on one phase of continuing problem.

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
Evan B. Wright

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Naval Research Laboratory
Washington, D.C. 20375

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
81-0371-0-0

11. CONTROLLING OFFICE NAME AND ADDRESS

12. REPORT DATE
April 11, 1980

13. NUMBER OF PAGES
58

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report)
Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Raytracing, acoustic
Airborne Sound
Sonic boom
Wind, effects on sound propagation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
AIRRAY is a FORTRAN-IV program for air-acoustic raytracing with wind. It finds all multipath arrivals, from a source at arbitrary elevation, at a set of equally-spaced receivers along a ground track. Tables of transmission loss vs range and bearing, or range and source height, are computed.

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

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

CONTENTS

I. INTRODUCTION 1

II. THEORY 2

III. INPUT AND OUTPUT 3

IV. REFERENCES 5

APPENDIX A 6

APPENDIX B 23

DTIC
ELECTE
JUL 16 1980
S D
B

ACCESSION for
NTIS White Section ☑
DDC Buff Section ☐
UNANNOUNCED ☐
JUSTIFICATION
BY
DISTRIBUTION/AVAILABILITY CODES
Dist. AVAIL. and/or SPECIAL
A 23

ACOUSTIC RAYTRACING TO FIXED GROUND RECEIVERS (PROGRAM AIRRAY)

INTRODUCTION

AIRRAY is a FORTRAN-IV program which adapts some of the techniques used for some time in underwater acoustic ray computations to atmospheric ray tracing. The basic ray path integration algorithm of R. J. Thompson,[1,2] which has been incorporated into this program, computes the paths of sound rays reaching the ground from a source at an arbitrary altitude, and traveling in a fixed vertical plane. The effect of the horizontal component of the wind in the source-receiver plane, at each altitude, is considered in the program; other wind components are neglected. The present program is designed to find all eigenrays (rays connecting source and receiver) reaching a set of equally-spaced receivers along the ground track, either directly or by multiple surface reflection, and compute their travel times, ray intensity levels, ray angles and number of surface reflections. Eigenrays are found, and their trajectory parameters are computed, by linear interpolation in the set of rays traced to the ground. After the eigenrays along a user-specified set of tracks have been computed, a table of CW transmission losses vs. range and bearing is computed by random-phase addition; or, for a given bearing, a table of transmission loss vs. range and source altitude may be computed.

Since this program will often be used to model explosive or moving sources of sound, the eigenray listing may be a more useful output than the transmission loss table. The transmission loss calculation is strictly valid only for a stationary continuous source; however, the table may

Manuscript submitted November 18, 1979.

still be useful in indicating the locations of shadow zones on the ground. Transmission losses greater than 120 dB are not printed, so that high-loss regions stand out in the table as blank areas.

The physical input data required is a weather profile, i.e., a table of temperature, wind speed, and wind direction as functions of altitude. The receivers are always on the ground, and the ground is flat, although it may be at an arbitrary elevation with respect to sea level, where the weather profile is assumed to start.

THEORY

An outline of the theory will be found in Refs. 1 and 2. It is of interest here, however, to show a comparison between the equations used here and those of single-profile underwater acoustic ray tracing with currents neglected, where Snell's law applies. The basic differential equations in the Snell's law case are :[3]

$$\frac{dx}{dt} = \frac{c^2}{c_m} \tag{1A}$$

$$\frac{dz}{dt} = \pm\, c\sqrt{1 - \frac{c^2}{c_m^2}} \tag{1B}$$

and an invariant quantity along the trajectory of a ray is

$$c_m = \frac{c}{\cos\theta} \tag{2}$$

In the present model of an atmosphere with wind, the differential equations are

$$\frac{dx}{dt} = \frac{u(1 + ku) - kc^2}{1 + ku} \tag{3A}$$

$$\frac{dz}{dt} = \pm\, \frac{c\sqrt{(1 + ku)^2 - k^2c^2}}{1 + ku} \tag{3B}$$

and the invariant quantity along a ray trajectory is

$$k = \frac{1}{c^2 - u^2}\left[u - \frac{c^2}{\sqrt{c^2 + (c^2 - u^2)\tan^2\theta}}\right] \tag{4}$$

In all of the equations above, x and z are the horizontal and vertical coordinates, respectively, $c = c(z)$ is the soundspeed, $u = u(z)$ is the in-plane component of wind speed, and θ is the ray angle with the horizontal. Note that the present model is not the small-angle model sometimes used, where Eqs. 1 and 2 are used with the still-air sound speed c being replaced by $c + u$ at every altitude in the vertical plane.[4] The present model treats the wind component in the plane exactly (Eqs. 3A and 3B), although neglecting the ordinarily smaller effect of crosswind.

The interpolating function used here is piecewise-linear; i.e., the ray path equations are solved in closed form in each profile layer, under the assumption that c and u vary linearly with z within the layer, and are continuous at layer boundaries.

INPUTS AND OUTPUTS

The input card deck structure for AIRRAY is as follows:

Card 1: Any alphanumeric title in cols 1-72.

Card 2: DR, R2, (H(I), I = 1, 8) FORMAT (10F8)

DR is the initial receiver range (and range increment) in km.

R2 is the final range in km.

H is the array of source altitudes in m.

Additional source altitudes may be entered following card 2 in format (10F8), up to a total of 30. Always terminate the array of source altitudes with a blank or negative number, using an extra card if necessary. Note that the source altitudes entered are measured from ground level.

Card 3: (B (I), I = 1, 16) FORMAT (16F5)

Card 3A: (B (I), I = 17, 30) FORMAT (16F5)

B is the array of track bearings (source to receivers). Use card 3A if more that 16 are to be computed. Always terminate the bearing input with a negative number unless the full 30 are entered.

Card 4: (Y (I), T (I), D (I), W (I), I = 1, 50) FORMAT (4F8)

Y is the array of weather profile altitudes in m. (Y is measured from sea level—see below.)

T is the array of temperatures in degrees C.

D is the array of wind directions (bearings from which the wind blows) in degrees.

W is the array of wind speeds in knots.

The weather profile is read in, one altitude per card, from sea level up. The last altitude should be above 100,000 m, and its temperature should be the maximum on the profile. Always terminate the profile input with a blank card, unless all 50 altitudes are used. Since the first weather profile card is for sea level, the first profile altitude is always 0. If a non-zero ground elevation is desired, enter it in m. in the Y-position on the first profile card. The rest of the altitudes in the profile will be reduced to altitudes above ground level in the program. Source altitudes are always measured from ground level when entered.

The program finds and lists all eigenrays for a track (source-receiver bearing) before going on to the next track. (The listing for each eigenray includes the number of ground reflections the ray has had up to the receiver point, and the ray's source and receiver angles, travel time, intensity level, and mean horizontal speed.) After all tracks for a given source altitude are

done, a table of transmission loss in dB vs. range and bearing is computed by random-phase addition of eigenrays at each receiver, and printed. Then the program proceeds to the next source altitude and repeats the computations for the same set of bearings.

If only one bearing is entered, transmission loss is tabulated vs. range and source altitude rather than range and bearing. In this case the table is not printed until the very end.

Appendix A is a listing of the program; Appendix B is a listing of a sample data deck with the resulting output.

REFERENCES

[1] Thompson, R. J.: *Ray Theory for an Inhomogeneous Moving Medium*, J. Acoust. Soc. Am. 51, 1675-1682 (1972).

[2] Thompson, R. J.: *Computing Sound Ray Paths in the Presence of Wind*, Sandia Lab. Report SC-RR-67-53 (1967). Sandia Laboratory, Albuquerque, N.M. 87115.

[3] Wright, E. B.: *Acoustic Transmission Loss by Single-Profile Ray Tracing*, NRL Report 7815 (1974). Naval Research Lab., Washington, D.C. 20375.

[4] Roberts, B. G. and E. H. Bebbs: *Atmospheric Ray Tracing* NRL Memorandum Report 2865 (1974). Naval Research Lab., Washington, D.C. 20375.

Appendix A

```
          SOURCE LISTING            ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0001
CSN         STATEMENT               CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

0001          PROGRAM AIR RAY
        C   ATMOSPHERIC RAYTRACE PROGRAM INCLUDING WIND IN STRATIFIED WEATHER PROFILE.
        C   E B WRIGHT   CODE 8160


        C   NAVAL RESEARCH LABORATORY
        C   WASHINGTON DC  20375
        C   (202) 767-2261
        C
        C  SEE ALSO R J THOMPSON, SANDIA LAB REPORT SC-RR-67-53
        C   OR JASA 51, 1675-1682(1972).
        C
        C*****   THIS VERSION COMPUTES AND SUMS EIGENRAYS TO EQUALLY SPACED
        C   RECEIVERS ON THE GROUND, AND PRODUCES A RAY TRAJECTORY PLOT.
        C*****   PLOTTER NOT PROGRAMMED  8/24/79   *********
        C   THE RAYTRACING ALGORITHM ASSUMES A SINGLE WEATHER PROFILE AND
        C   A FLAT SURFACE.  THE TRAJECTORIES ARE PERIODIC IN THE VERTICAL
        C   PROPAGATION PLANE(CROSSWIND IS NEGLECTED), AND ONLY THE RAYS THAT
        C   WILL STRIKE THE SURFACE ARE TRACED.  THE PROGRAM STARTS WITH A
        C   FIXED SOURCE ALTITUDE AND TRACES RAYS IN EACH SPECIFIED DIRECTION
        C   BEFORE PROCEEDING TO THE NEXT SOURCE ALTITUDE.  THE USER MAY
        C   SPECIFY UP TO 30 BEARINGS AND 30 SOURCE ALTITUDES FOR EACH RUN.
        C*****     OUTLINE OF PROCEDURE:
        C   THE S-PROFILE IS USED TO FIND THE CRITICAL RAY ANGLES.  S = C + U,
        C   WHERE C(Z) IS THE SOUNDSPEED AND U(Z) IS THE WIND COMPONENT IN THE
        C   DIRECTION OF RAYTRACE.  CRITICAL RAYS ARE THOSE WHICH TURN OVER AT
        C   THE SET OF MONOTONICALLY INCREASING MAXIMA, ABOVE THE SOURCE, IN THE
        C   S-PROFILE.  THE CRITICAL RAYS DIVIDE THE ANGULAR RANGE INTO FANS
        C   SEPARATED BY SHADOW ZONES, SO THAT INTERPOLATION BETWEEN RAYS IS
        C   VALID ONLY FOR RAYS IN THE SAME FAN, AND ALSO HAVING THE SAME TURN-
        C   AROUND HISTORY.  IN TRACING THE RAYS, SUBROUTINE TRACE IS CALLED
        C   ONCE TO GET THE TRAJECTORY PARAMETERS FOR THE DOWNGOING PORTION OF
        C   THE PATH, AND AGAIN FOR THE UPGOING PORTION.  THE SAME RAYS ARE USED
        C   BOTH DOWNGOING AND UPGOING FROM THE SOURCE, EXCEPT THAT EXTRA RAYS
        C   TYPICALLY NEED TO BE TRACED DOWNGOING, TO GET THE STEEP PATHS TO THE
        C   GROUND NEAR THE SOURCE.   FOR EACH SOURCE ANGLE, AFTER THE CALLS
        C   TO TRACE, SUBROUTINE HISTRY IS CALLED TO ASSEMBLE THE TRAJECTORY
        C   ELEMENTS INTO PERIODIC PATHS FOR THE DOWNGOING AND UPGOING RAYS OF
        C   THAT ANGLE.   AFTER ALL RAYS ARE TRACED, SUBROUTINE EIGRAY PERFORMS
        C   THE INTERPOLATION OF TRAVEL TIME AND INTENSITY FOR EACH ARRIVAL
        C   AT THE EQUALLY-SPACED RECEIVER RANGES.  THE PROCEDURE IS REPEATED
        C   FOR EACH TRACK OR AZIMUTH, AND AN ARRAY OF TRANSMISSION LOSS VS
        C   RANGE AND BEARING IS THEN PRINTED.  THE ENTIRE PROCESS IS THEN
        C   REPEATED FOR THE NEXT SOURCE ALTITUDE.
        C*****   IF ONLY ONE BEARING IS SPECIFIED, THE TRANSMISSION LOSSES
        C   ARE TABULATED VS. RANGE AND SOURCE ALTITUDE INSTEAD, AND NOT PRINTED
        C   UNTIL THE VERY END, AFTER ALL SOURCE ALTITUDES ARE DONE.
0002          REAL*8 XR, DN, SO, AA
0003          COMMON /TITLE/ TITLE(20)
0004          COMMON /PROFL/ ZI(50), TI(50), DI(50), W(50), Z(50), C(50), N
0005          COMMON /MESH/ R1, DR, R2, HGT(30), BRG(30), NR, NHGT, NBRG
0006          COMMON /FANS/ THEXT(50), DTHEXT(50), NUTH(50), NFANS
```

```
AIRRAY          SOURCE LISTING          ASC FAST FORTRAN COMPILER       RELEASE FTFX0526.P214          PAGE 0002
  CSN             STATEMENT             CP OPTIONS = (U)               DATE = 09/20/79(79.263)     TIME = 14:23:31

 0007           COMMON /CYCLE/ ZDOWN(50), XDOWN(50), TDOWN(50), DXDOWN(50),
               1              ZUP(50),   XUP(50),   TUP(50),   DXUP(50)
 0008           COMMON /PATH/ X(2000), Y(2000)
 0009           COMMON /GROUND/ ANGLE(400), GANGLE(400), NHITS(400),
               1   RANGE(20,400), TIME(20,400), XLEVEL(20,400)
 0010           COMMON /RCVRS/ DB(500,30)
 0011           COMMON /RISC/ DXM, XMAX, HOBSQ, ISUPMX, IBRG, IH, NDOWN
 0012           COMMON /STNDRD/ HS(12), HNOM(30)
 0013           DIMENSION CA(50), CB(50), UA(50), UB(50), U(50), S(50)
 0014           DIMENSION CCA(50), CCB(50), CCCA(50), CCCB(50), UUA(50), UUB(50),
               1   UUUA(50), UUUB(50), SS(50), SSS(50)
 0015           DIMENSION LINE(61), LINE(30), IPMESH(30)
 0016           DATA IPOINT /'  . '/
 0017           DATA LINE/61*'   '/, IDOT/'.   '/, ISTAR/'*   '/, IBLANK/'    '/
 0018           DATA CSCALE/.5/, S0/260./, DBMAX/120./
 0019           DATA THMAX /60./, DTH /.5/, DTHMIN /.999/, ZERO/.1/
 0020        94 FORMAT(4X,'SOURCE ALTITUDE (ABOVE GROUND LEVEL)=',F10.2,2X,2HM.)
 0021        96 FORMAT(2X,8HBEARING= ,F10.2)
 0022       100 FORMAT(///,1X,'ALL RAYS WITH SOURCE ANGLE GREATER THAN',
               1  F12.4,' DEGREES STRIKE THE GROUND.')
 0023       995 FORMAT(1H1)
 0024      9000 FORMAT(4F16.3, 5X,61A1)
 0025      9004 FORMAT(1X, 3F15.3)
 0026      9500 FORMAT(5X,8HALTITUDE,13X,5HRANGE,15X,4HTIME,/,8X,3H(M),16X,
               1 3H(M),  15X, 5H(SEC),/)
 0027      9600 FORMAT(5X,8HALTITUDE,7X,14HWIND COMPONENT,5X,11HSOUND SPEED,9X,
               1 3HSUM,/,11X,3H(M),11X,7H(M/SEC),9X,7H(M/SEC),9X,7H(M/SEC),/)
 0028       900 FORMAT(//, 10X, 'LIST OF CRITICAL ANGLES WITH FAN PARAMETERS.'/)
 0029       901 FORMAT(1X, I5, 3F10.4, I10)
 0030       902 FORMAT(I4)
 0031       903 FORMAT(1X,F8.2, 3X, 30A4)
 0032       904 FORMAT('1', 20X, 20A4,/,10X,'SOURCE ALTITUDE IN METERS=', F10.2,
               1   //,10X,'TRANSMISSION LOSS VS. RANGE(KM) AND BEARING(DEGREES)',
               2   //,12X, 30I4)
 0033       905 FORMAT(/)
 0034       906 FORMAT('1', 20X, 20A4,/,10X,'BEARING TOWARD RECEIVER=', F10.2,
               1   //,10X,'TRANSMISSION LOSS VS. RANGE(KM) AND SOURCE ALTITUDE',
               2   '(KM)', //, 12X, 30I4)
 0035           CALL RESTOP
 0036           PI=3.1415926536
 0037           RAD=PI/180.
 0038           DO 200 NC=1,61,10
 0039           LINE(NC) = IDOT
 0040       200 CONTINUE
 0041           CALL DATA IN
 0042           IH=0
 0043           GO TO 501
 0044         2 IF(IH.GT.1) GO TO 51
 0045           NMESH = NMRG
 0046           IF(NMESH.EQ.1) NMESH = NHGT
```

```
AIRRAY          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0003
   CSN            STATEMENT              CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

0047            DO 50 IMESH=1,NMESH
0048            IF(NBRG.GT.1) IPMESH(IMESH) = BRG(IMESH) + .5
0049            IF(NBRG.EQ.1) IPMESH(IMESH) = .01*HGT(IMESH) + .5
0050         50 CONTINUE
0051         51 IF(NBRG.GT.1) PRINT 904, TITLE, HOM, (IPMESH(IMESH),IMESH=1,NMESH)
0052            IF(NBRG.EQ.1 .AND. IN.NE.NHGT) GO TO 501
0053            IF(NBRG.EQ.1)PRINT 906, TITLE,BRG(1),(IPMESH(IMESH),IMESH=1,NMESH)
0054            PRINT 905
0055            RP = R1
0056            DO 500 IR=1,NR
0057            DO 300 IMESH=1,29,2
0058            LYNE(IMESH) = IPOINT
0059            LYNE(IMESH+1) = IBLANK
0060        300 CONTINUE
0061            DO 400 IMESH=1,NMESH
0062            IF(DB(IR,IMESH).GE.DBMAX) GO TO 400
0063            NDB = DB(IR,IMESH) + .5
0064            ENCODE(4,902,LYNE(IMESH)) NDB
0065        400 CONTINUE
0066            PRINT 903, RP, LYNE
0067            RP = RP + DR
0068        500 CONTINUE
0069        501 IN = IN + 1
0070            IF(IN.GT.NHGT) STOP
0071            HOB = HGT(IN)
0072            HOM = HNOM(IN)
0073            IBRG=0
0074            DO 1003 I=1,N
0075            IF(HOB-Z(I))1003,1004,1003
0076       1003 CONTINUE
0077            GO TO 1005
0078       1004 NBURST=I
0079            GO TO 1006
0080       1005 N=N+1
0081            NM1=N-1
0082            DO 1009 I=1,NM1
0083            NI=N-I
0084            IF(HOB-Z(NI))1007,1007,1008
0085       1007 Z(NI+1)=Z(NI)
0086            W(NI+1)=W(NI)
0087            C(NI+1)=C(NI)
0088            D1(NI+1)=D1(NI)
0089       1009 CONTINUE
0090       1008 NBURST=NI+1
0091            FAC=(Z(NBURST)-HOB)/(Z(NBURST)-Z(NI))
0092            W(NBURST)=W(NBURST)+FAC*(W(NI)-W(NBURST))
0093            C(NBURST)=C(NBURST)+FAC*(C(NI)-C(NBURST))
0094            D1(NBURST)=D1(NBURST)+FAC*(D1(NI)-D1(NBURST))
0095            Z(NBURST)=HOB
0096       1006 NBRST1 = NBURST + 1
```

```
AIRRAY          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0004
  CSN             STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

 0097             NN=N-1
 0098             DO 1010 I=1,NN
 0099             CA(I)=(C(I)-C(I+1))/(Z(I)-Z(I+1))
 0100             CB(I)=C(I)-CA(I)*Z(I)
 0101       1010  CONTINUE
 0102             ZUP(1)=HOB
 0103             JJ=N-NBURST+1
 0104             DO 5000 I=2,JJ
 0105             ZUP(I)=Z(NBURST+I-1)
 0106             CCA(I)=CA(NBURST+I-2)
 0107       5000  CCB(I)=CB(NBURST+I-2)
 0108             IF(HOB) 3,3,5001
 0109       5001  ZDOWN(1)=HOB
 0110             KD=NBURST
 0111             IF(KD.LT.2) GO TO 3
 0112             DO 5002 I=2,KD
 0113             ZDOWN(I)=Z(NBURST-I+1)
 0114             CCCA(I)=CA(NBURST+1-I)
 0115       5002  CCCB(I)=CB(NBURST-I+1)
 0116          3  IBRG = IBRG + 1
 0117             IF(IBRG.GT.NBRG) GO TO 2
 0118             BEAR=BRG(IBRG)
 0119                PRINT 999
 0120             PRINT 94, HOM
 0121             PRINT 96,BEAR
 0122             PRINT 9600
 0123             DO 1011 J=1,N
 0124             I = N - J + 1
 0125             U(I)=-U(I)*COS ((D1(I)-BEAR)*RAD)
 0126             S(I)=C(I)+U(I)
 0127             NC = CSCALE*(S(I)-S0) + 1.5
 0128             IF(NC.LT.1) NC = 1
 0129             IF(NC.GT.61) NC = 61
 0130             NCSAVE = LINE(NC)
 0131             LINE(NC) = ISTAR
 0132             PRINT 9000, Z(I), U(I), C(I), S(I), LINE
 0133             LINE(NC) = NCSAVE
 0134       1011  CONTINUE
 0135             DO 1012 I=1,NN
 0136             UA(I)=(U(I)-U(I+1))/(Z(I)-Z(I+1))
 0137             UB(I)=U(I)-UA(I)*Z(I)
 0138       1012  CONTINUE
 0139             DO 5003 I=2,JJ
 0140             UUA(I)=UA(NBURST+I-2)
 0141             UUB(I)=UB(NBURST+I-2)
 0142       5003  SS(I)=S(NBURST+I-1)
 0143             SS(1)=S(NBURST)
 0144             IF(HOB) 5004,5004,5005
 0145       5005  DO 5006 I=2,KD
 0146             UUUA(I)=UA(NBURST+1-I)
```

```
AIRRAY          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0005
  CSN            STATEMENT              CP OPTIONS = (U)              DATE = 09/20/79(79.263)    TIME = 14:23:31

                 UUUB(I)=UB(NBURST+1-I)
           5006  SSS(I)=S(NBURST+1-I)
                 SSS(1)=S(NBURST)
           5004  CC=C(NBURST)
                 CCSQ = CC*CC
                 UU=U(NBURST)
                 UUSQ = UU*UU
                 AA = CCSQ - UUSQ
                 A = AA
                 THETA1=0
                 UPU=1.
                 SMAX = S(NBURST)
                 CG=C(1)
                 UG=U(1)
                 CGSQ = CG*CG
                 AG = CGSQ - UG*UG
                 HOBSQ = HOB*HOB
                 DO 1113 I=2,NBURST
                 IB=NBURST-I+1
                 IF(S(IB)-SMAX)1113,1113,1114
           1114  SMAX=S(IB)
                 ISAVE=IB
           1113  CONTINUE
                 IF(SMAX.LE.S(NBURST)) GO TO 6
                 R=SMAX
                 THETA1=ATAN (CC/(UU*R+A)*SQRT ((R-UU)**2-CCSQ))
                 THETA1=THETA1/RAD
              6  PRINT 100,THETA1
                 ISUPMX = 0
                 NEXT = 1
                 THEXT(1) = THETA1
                 SMAX = AMAX1(SMAX, S(NBURST))
                 DO 1014 I=NBRST1,N
                 IF(S(I).LE.SMAX) GO TO 1014
                 IF(I.LT.N .AND. S(I).LT.S(I+1)) GO TO 1014
                 SMAX = S(I)
                 NEXT = NEXT + 1
                 THEXT(NEXT) = ATAN(CC*SQRT((S(I)-UU)**2-CCSQ)/(UU*S(I)+A))/RAD
           1014  CONTINUE
                 THUPMX = THEXT(NEXT)
                 IF(THUPMX.GE.THMAX) GO TO 1020
                 NEXT = NEXT + 1
                 THEXT(NEXT) = THMAX
           1020  NFANS = NEXT-1
                 PRINT 900
                 DO 1015 I=1,NFANS
                 DELTH = THEXT(I+1) - THEXT(I)
                 NDTH(I) = DELTH/DTH + 1.5
                 IF(NDTH(I).LT.2) NDTH(I) = 2
                 DTHEXT(I) = DELTH/(NDTH(I)-1)
```

```
AIRRAY          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0006
  CSN             STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

0197            PRINT 901, I, THEXT(I), DELTH, DTHEXT(I), NDTH(I)
0198      1015  CONTINUE
0199            NDOWN = 0
0200            DO 1016 NF=1,NFANS
0201            NDOWN = NDOWN + NDTH(NF)
0202      1016  CONTINUE
0203            ISDOWN = NDOWN + 1
0204            ISUP = NDOWN
0205            PRINT 999
0206            DO 10000 NF=1,NFANS
0207            THETA = THEXT(NF)
          C*****    NOTE THAT THERE WILL BE A SHADOW ZONE BETWEEN THE SMALLEST
          C   DOWNGOING RAY ANGLE AND THE SMALLEST UPGOING RAY ANGLE, UNLESS THE
          C   0-DEGREE RAY REACHES THE GROUND AND IS NOT A BIFURCATING RAY.
          C   IF THERE IS NO SHADOW ZONE ABOUT 0 DEGREES, A DOWNGOING RAY OF
          C   SLIGHTLY DIFFERENT ANGLE IS TRACED AND IS USED IN BOTH THE UPGOING
          C   AND DOWNGOING SMALLEST RAY POSITIONS.  (SEE SUBROUTINE HISTRY FOR
          C   THE ADJUSTMENT OF THE RAY PATH IN THIS CASE.)  THE EIGENRAY SUB--
          C   ROUTINE THEN CAN OMIT INTERPOLATION BETWEEN THESE RAYS, JUST AS
          C   IF A SHADOW ZONE EXISTED, AND NOTHING WILL BE MISSED.
          C*****    THE VALUE OF THIS SMALL ANGLE IN DEGREES ("ZERO") MUST BE
          C   LARGE ENOUGH TO AVOID NUMERICAL PROBLEMS IN THE PATH-INTEGRATING
          C   SUBROUTINES DINTEG AND TDINTG.  PUTTING ZERO=.02 DEGREES MAKES
          C   ONE OR BOTH OF THESE SUBROUTINES BLOW UP FOR SOME PROFILES.
          C*****    SIMILARLY, THE SMALL ANGULAR DIFFERENCE DTHMIN (IN DEGREES)
          C   MUST NOT BE CHOSEN TOO SMALL, ESPECIALLY WHEN APPLIED AT 0.
          C   THE EDGES OF SHADOW ZONES ARE DEFINED BY TRACING RAYS OF ANGLE
          C   (CRITICAL ANGLE + AND - DTHMIN).  THIS INCLUDES THE SHADOW ZONE
          C   PAIR ABOUT 0 DEGREES, WHEN PRESENT.  A VALUE OF DTHMIN=.01 DEGREES
          C   IS TOO SMALL FOR SOME PROFILES, PRODUCING THE SAME KIND OF BLOWUP.
0208            IF(THETA.EQ.0. .AND. S(NBURST+1).GT.S(NBURST)) THETA = ZERO
0209            IF(THETA.NE.ZERO) THETA = THETA + DTHMIN
0210            THETA2 = THEXT(NF+1) - DTHMIN
0211            NRAYS = NDTH(NF)
0212            DO 6000 NRAY = 1,NRAYS
0213            ISDOWN = ISDOWN - 1
0214            ISUP = ISUP + 1
0215            IF(THETA.GE.THETA2) THETA = THETA2
0216            ANGLE(ISDOWN) = -THETA
0217            ANGLE(ISUP) = THETA
0218            IF(THETA.EQ.ZERO) ANGLE(ISUP) = -THETA
0219            TANTH=TAN (RAD*THETA)
0220            DN=(TANTH*TANTH)*AA + CCSQ
0221            SQ=DSQRT(DN)
0222            XR=(UU - CCSQ/SQ)/AA
0223            XR = -1.D0/XR
0224            FT = CCSQ*TANTH*(TANTH*TANTH+1.)*(XR*XR/(SQ*UN))
          C*****    THIS CALL TO TRACE COMPUTES THE TRAJECTORY ELEMENTS FOR THE
          C   BELOW-SOURCE PORTION OF THE RAY CYCLE, AND PUTS THEM IN ARRAYS
          C   ZDOWN, XDOWN, TDOWN, AND DXDOWN, ONE ENTRY FOR EACH LAYER TRAVERSED.
```

```
AIRRAY          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0007
   CSN            STATEMENT              CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

   0225           CALL TRACE(KD,XR,ZDOWN,CCCA,CCCB,UUUA,UUUB,TDOWN,XDOWN,DXDOWN,0.)
          C       PRINT 9500
   0226           SINGXR = XR
   0227           SXR = SIGN(1.,SINGXR)
   0228           TH = CG*DSQRT((XR-UG)**2-CGSQ)/(UG*XR+AG)
   0229           TH = SXR*ATAN(TH)
   0230           GANGLE(ISDOWN) = -TH/RAD
   0231           AGL = DARCOS((-CG)/(XR-UG))
   0232           TH = SIN(TH)/COS(AGL+TH)
   0233           DO 5010 I=1,KD
   0234           XDOWN(I) = -SXR*XDOWN(I)
   0235           TDOWN(I) = -SXR*TDOWN(I)
   0236           DXDOWN(I) = FT*SXR*DXDOWN(I)
   0237      5010 CONTINUE
   0238           DXDOWN(KD) = DXDOWN(KD)*TH*SQRT(TANTH*TANTH+1.)
   0239           IF(THETA.LE.THUPMX) GO TO 29
   0240           CALL HISTRY(ISDOWN, 0, KD, 0)
   0241           GO TO 5998
   0242        29 ISUPMX = ISUP
   0243           GANGLE(ISUP) = GANGLE(ISDOWN)
   0244           DO 5012 I=2,JJ
   0245           IF(SS(I)-XR) 5012, 5013, 5014
   0246      5012 CONTINUE
   0247      5013 TX = ZUP(I)
   0248           GO TO 5015
   0249      5014 TX = (XR-(CCB(I)+UUB(I)))/(CCA(I)+UUA(I))
   0250      5015 KU = I
   0251           TY = ZUP(KU)
   0252           ZUP(KU) = TX
          C*****     THIS CALL TO TRACE COMPUTES THE TRAJECTORY ELEMENTS FOR THE
          C    ABOVE-SOURCE PORTION OF THE RAY CYCLE AND PUTS THEM IN ARRAYS
          C    ZUP, XUP, TUP, AND DXUP.  SUBROUTINE HISTRY WILL THEN ASSEMBLE
          C    EACH RAY'S TRAJECTORY ELEMENTS INTO PATHS FOR BOTH THE INITIALLY
          C    DOWNGOING AND THE INITIALLY UPGOING RAY.
   0253           CALL TRACE(KU,XR,ZUP,CCA,CCB,UUA,UUB,TUP,XUP,DXUP,1.)
   0254           DO 5021 I=1,KU
   0255           DXUP(I) = FT*DXUP(I)
   0256      5021 CONTINUE
   0257           DXUP(KU) = DXUP(KU)*TH*SQRT(TANTH*TANTH+1.)
          C       PRINT 9004, ZUP(KU), XUP(KU), TUP(KU)
   0258           CALL HISTRY(ISDOWN, ISUP, KD, KU)
   0259           ZUP(KU) = TY
   0260      5998 THETA = THETA + DTMEXT(NF)
   0261      6000 CONTINUE
   0262     10000 CONTINUE
   0263           CALL EIGRAY
   0264           GO TO 3
   0265           END
```

```
          SOURCE LISTING            ASC FAST FORTRAN COMPILER       RELEASE FTFX0526.P214          PAGE 0001
CSN          STATEMENT              CP OPTIONS = (U)                DATE = 09/20/79(79.263)     TIME = 14:23:31

0001          SUBROUTINE DATA IN
0002          COMMON /TITLE/ TITLE(20)
0003          INTEGER TITLE
0004          COMMON /PROFL/ Y(50), T(50), D(50), W(50), Z(50), C(50), NZ
0005          COMMON /MESH/ R1, DR, R2, H(30), B(30), NR, NH, NB
0006          COMMON /STNDRD/ HS(12), HNOM(30)
0007          COMMON /MISC/ DXM, XMAX, HOBSQ, ISUPMX, IBRG, IH, NDOWN
0008          DATA HS /0., 1000., 2000., 4000., 6000., 8000., 10000., 12000.,
             1   14000., 16000., 20000., 24000./
0009          DATA NS /12/ , SCONV /.51444444/
0010          DIMENSION LINE(61), ISERVE(5)
0011          DATA LINE /61*'  '/
        C*****    MEAN RADIUS OF EARTH IS 6378388 M.
0012          DATA REARTH /6378388./
0013          DOUBLE PRECISION DYY
        C*****    DATA READ-IN SUBROUTINE FOR ATMOSPHERIC RAYTRACE.
        C    CARD 1 CONTAINS ANY ALPHANUMERIC TITLE IN COLS 1-72.
        C    CARD 2 CONTAINS FIRST AND LAST RANGES(KM) FOR TRANSMISSION LOSS
        C     COMPUTATION, AND UP TO 8 SOURCE ALTITUDES IN METERS.
        C     THE RANGE INCREMENT WILL EQUAL THE FIRST RANGE.
        C     IF MORE SOURCE ALTITUDES ARE WANTED, READ IN UP TO 22 MORE,
        C     TEN PER CARD, TERMINATING WITH A BLANK OR NEGATIVE.
        C    CARD 3 CONTAINS BEARINGS FOR DIRECTION OF RAYTRACE (SOURCE TO
        C     RECEIVER ON GROUND). UP TO 30 BEARINGS  (0. TO 360.) MAY BE READ,
        C     16 PER CARD, TERMINATED BY NEGATIVE NUMBER.
        C    THE WEATHER PROFILE CARDS FOLLOW IN ORDER OF INCREASING ELEVATION.
        C     EACH CARD HAS AN ELEVATION(M), TEMPERATURE(C), WIND DIRECTION
        C     (0. TO 360.), AND WIND SPEED(KT).  THESE CARDS ARE CODED IN (4F8),
        C     AND UP TO 50 CARDS MAY BE READ IN, TERMINATED BY BLANK CARD.
        C     THE WIND DIRECTION IS AZIMUTH FROM WHICH WIND BLOWS TOWARD SOURCE.
        C***    NOTE THAT THE ELEVATION OF THE FIRST WEATHER PROFILE CARD IS
        C    ALWAYS ZERO (SEA LEVEL) AND SO THIS FIELD CAN BE USED TO READ IN
        C    A DIFFERENT VARIABLE: THE GROUND ELEVATION ABOVE SEA LEVEL.
        C    THIS GROUND ELEVATION WILL BE SUBTRACTED FROM EACH ELEVATION IN THE
        C    WEATHER PROFILE, SO THAT THE RESULTING PROFILE IS FROM GROUND UP.
        C    THE SOURCE ALTITUDES ARE ALWAYS MEASURED FROM GROUND LEVEL.
0014          CALL S$DATE(ISERVE,0)
0015          READ 900, TITLE
0016          CALL T$DATE(ISERVE,IFDONE)
0017          TITLE(19) = ISERVE(2)
0018          TITLE(20) = ISERVE(3)
0019          PRINT 910,TITLE
0020          READ 901, DR, R2, (H(I), I=1,8)
0021          NR = R2/DR + .1
0022          R1 = DR
0023          DXM = 1000.*DR
0024          XMAX = 1000.*R2
0025          IF(H(1).GE.0.) GO TO 101
0026          DO 100 I=1,NS
0027          H(I) = HS(I)
```

```
DATAIN          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0002
  CSN             STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

 0028      100 CONTINUE
 0029          NM = NS
 0030          GO TO 1001
 0031      101 IF(H(2).EE.0. .OR. H(3).LE.0.) GO TO 201
 0032          DH = -H(2)
 0033          NM = (H(3)-H(1))/DH + 1.1
 0034          DO 200 I=2,NM
 0035          H(I) = H(I-1) + DH
 0036      200 CONTINUE
 0037          GO TO 1001
 0038      201 LAST = 8
 0039      202 IF(H(LAST).LE.0. .OR. LAST.EQ.30)GO TO 203
 0040          NEXT = LAST + 1
 0041          LAST = LAST + 10
 0042          READ 901, (H(I), I=NEXT,LAST)
 0043          GO TO 202
 0044      203 DO 300 I=1,LAST
 0045          IF(H(I).GT.0.) NM = I
 0046      300 CONTINUE
 0047     1001 READ 902, (B(I), I=1,16)
 0048          IF(B(16).GT.0.) READ 902, (B(I), I=17,30)
 0049          DO 1100 I=2,30
 0050          IF(B(I).LT.0.) GO TO 1101
 0051     1100 CONTINUE
 0052          I = 31
 0053     1101 NB = I-1
 0054          READ 901, Y(1), T(1), D(1), W(1)
 0055          RHGT = Y(1)
 0056          RGRND = REARTH + RHGT
 0057          DO 2000 I=2,50
 0058          READ 901, Y(I), T(I), D(I), W(I)
 0059          IF(Y(I).LE.0.) GO TO 2001
 0060          NZ = I
 0061     2000 CONTINUE
          C*****  THE FOLLOWING LOOP CREATES ALTITUDE ARRAY BY SUBTRACTING GROUND
          C    ELEVATION FROM INPUT HEIGHTS, CONVERTS WIND MAGNITUDE FROM KNOTS TO
          C    M/SEC, AND COMPUTES STILL-AIR SOUNDSPEED FROM TEMPERATURE.
          C    THE CURVED-EARTH CORRECTION IS APPLIED TO PROFILE ALTITUDES AND
          C    SOUNDSPEEDS-CF. PRYCE: PHIL. MAG. SUPP. 2, NO.5., P.67 (1953).
 0062     2001 DO 2100 I=1,NZ
 0063          YY = Y(I) - RHGT
 0064          DYY = 1.D0 + YY/RGRND
 0065          Z(I) = RGRND*DLOG(DYY)
 0066          WIND KT  = W(I)
 0067          W(I) = SCONV*W(I)
 0068          C(I) = 331.47*SQRT(1.+T(I)/273.18)*EXP(-YY/RGRND)
 0069          PRINT 904, I, Y(I), T(I), D(I), WIND KT, Z(I), C(I), W(I)
 0070     2100 CONTINUE
 0071          DO 2200 I=1,NM
 0072          DYY = 1.D0 + H(I)/RGRND
```

```
DATAIN          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0003
  CSN             STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

 0073          HNOW(I) = H(I)
 0074          H(I) = RGRND*DLOG(DYY)
 0075     2200 CONTINUE
 0076          RETURN
 0077      900 FORMAT(20A4)
 0078      901 FORMAT(10F8.0)
 0079      902 FORMAT(16F5.0)
 0080      903 FORMAT(18A4, F8.0)
 0081      904 FORMAT(1X, I4, F12.2, 3F8.2, F12.2, 2F8.2)
 0082      910 FORMAT( '1', 'INPUT DATA AND DERIVED PROFILE FOR RAYTRACE'/,
                1   20X, 'THE CURVED-EARTH CORRECTION CHANGES ALTITUDES SLIGHTLY.',
                2   ///, 20X, 20A4, ////)
 0083          END
```

```
                SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0001
CSN               STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

0001              SUBROUTINE TRACE (K, XR, Z, C1, C2, U1, U2, T, X, DX, U)
0002              DIMENSION Z(50),C1(50),C2(50),U1(50),U2(50),T(50),X(50),DX(50)
0003              REAL*8 XR
0004              T(1)=0.0
0005              X(1)=0.0
0006              DX(1)=0.0
0007              DO 10 I=2,K
0008              J=I-1
0009              Z1=Z(J)
0010              Z2=Z(I)
0011              CC1=C1(I)
0012              CC2=C2(I)
0013              UU1=U1(I)
0014              UU2=U2(I)
0015              IF(U)1,1,2
0016            2 IF(I-K)1,3,3
0017            3 CALL TDINTG(CC1,CC2,UU1,UU2,Z1,XR,XX,TT,DXX)
0018              GO TO 4
0019            1 CALL DINTEG(CC1,CC2,UU1,UU2,Z1,Z2,XR,XX,TT,DXX)
0020            4 T(I)=T(J)+TT
0021              DX(I)=DX(J)+DXX
0022           10 X(I)=X(J)+XX
0023              RETURN
0024              END
```

```
                SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0001
CSN               STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

0001              SUBROUTINE TDINTG(C1, C2, U1, U2, Z1, R, XX, TT, DXX)
0002              IMPLICIT REAL*8(A-H,O-Z)
0003              REAL*4 C1, C2, U1, U2, Z1, XX, TT, DXX
0004              B=U2-R
0005              E=C2*C2
0006              F=C1*C2
0007              A=B*B-E
0008              D=U1*B-F
0009              D1=2.*D
0010              C=U1*U1-C1*C1
0011              F1=A+(D1+C*Z1)*Z1
        C         IF(F1.LT.0.D0) CALL SNAG
0012              F1=DSQRT (F1)
0013              P=U1*C2-D*C1
0014              BB=C1*Z1+C2
0015              CC=U1*Z1+D
0016              IF(C) 1,2,3
0017           20 TT=-B*D1-U1*Q2
0018              FA=-U2*D+E
0019              FB=U1*(B-2.*U2)+2.*F
0020              XX=FA*Q1+FB*Q2-Q3
0021              DXX=FA*Q1P+FB*Q2P-Q3P+U2*Q1+U1*Q2
0022                RETURN
0023            1 ARG2=(-C*Z1-B)/P
0024              Q4=1.D0/DSQRT (-C)*(1.5707963268-DARSIN (ARG2))
0025              Q4P=BB/(P*F1)
0026              GO TO 4
0027            3 CS=DSQRT (C)
0028              DN=F1*CS+Z1*C+B
0029              Q4=1.D0/CS*DLOG((-P)/DN)
0030              Q4P=C1/(P*CS)+CC/(F1*DN)+U1/(CS*DN)
0031              GO TO 4
0032            2 Q3=0
0033              Q3P=0
0034              Q4=-F1/B
0035              Q4P=(CC/F1+Q4*U1)/B
0036              FD=1.D0/P
0037              FD=C1*F1
0038              Q1=PD*DLOG((P+FD)/(P-FD))
0039              Q1P=PD*C1*(1.D0/FD-Q1)
0040              Q2=(Q4-C2*Q1)/C1
0041              Q2P=(Q4P-C2*Q1P)/C1
0042              GO TO 20
0043            4 Q5=-(F1+B*Q4)/C
0044              Q5P=(U1*Q4-B*Q4P+CC/F1)/C
0045              IF(C1) 14,15,14
0046           15 Q1=Q4/C2
0047              Q1P=Q4P/C2
0048              Q2=Q5/C2
0049              Q2P=Q5P/C2
```

```
TDINTG          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0002
CSN               STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

0050              FA=3.*B*B-A*C
0051              FB=C*Z1-3.*B
0052              FC=1./(2.*C*C2)
0053              Q3=(FA*Q4-FB*F1)*FC
0054              Q3P=FA*Q4P+FB*CC/F1+(2.*D*C-6.*B*U1)*Q4-3.*U1*F1
0055              Q3P=Q3P*FC
0056              GO TO 20
0057           14 BMU=P+C1*F1-U1*BB
0058              Q1=DLOG(BMU/(C1*BB))/P
0059              Q1P=(1.-CC/F1)/BMU-Q1
0060              Q1P=C1*Q1P/P
0061           32 Q2=(Q4-C2*Q1)/C1
0062              Q2P=(Q4P-C2*Q1P)/C1
0063              Q3=C*(Q5-C2*Q2)/C1
0064              Q3P=C*(Q5P-C2*Q2P)/C1
0065              GO TO 20
0066              END
```

```
                SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0001
CSN               STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

0001              SUBROUTINE DINTEG(C1, C2, U1, U2, Z1, Z2, R, XX, TT, DXX)
0002              IMPLICIT REAL*8(A-H,O-Z)
0003              REAL*4 C1, C2, U1, U2, Z1, Z2, XX, TT, DXX
0004              D=U2-R
0005              E=C2*C2
0006              F=C1*C2
0007              A=D*D-E
0008              B=U1*D-F
0009              B1=2.*B
0010              C=U1*U1-C1*C1
0011              F1=A+(B1+C*Z1)*Z1
0012              F2=A+(B1+C*Z2)*Z2
C                 IF(F1.LT.0.D0 .OR. F2.LT.0.D0) CALL SNAG
0013              F1=DSQRT (F1)
0014              F2=DSQRT (F2)
0015              PP=D*C1-U1*C2
0016              IF(PP)50,51,50
0017           51 IF(C1)52,53,52
0018           53 DXX=((R*C2)/(F1*A))*(Z1-Z2)
0019              GO TO 54
0020           52 DXX=((R*C1)/C)*(1./F2-1./F1)
0021              GO TO 54
0022           50 DXX=(R/PP)*((U1*Z1+D)/F1-(U1*Z2+D)/F2)
0023           54 IF(C)1,2,3
0024           20 TT=-D*Q1-U1*Q2
0025              XX=(-U2*D+E)*Q1+(U1*(R-2.*U2)+2.*F)*Q2-Q3
0026              RETURN
0027            1 P=DABS (PP)
0028              ARG1=(-C*Z2-B)/P
0029              ARG2=(-C*Z1-B)/P
0030              Q4=1./DSQRT (-C)*(DARSIN (ARG1)-DARSIN (ARG2))
0031              GO TO 4
0032            3 Q=DSQRT (C)
0033              P=1./Q
0034              W=B*P
0035              Q4=P*DLOG((F2+Z2*Q+W)/(F1+Z1*Q+W))
0036              GO TO 4
0037            2 Q3=0
0038              IF(Q) 5,6,5
0039            6 Q1=1./(C2*F2)*(Z2-Z1)
0040              Q2=.5*(Z2+Z1)*Q1
0041              GO TO 20
0042            5 Q4=1./B*(F2-F1)
0043              Q=DABS (PP)
0044              Q1=1./Q*DLOG((C1*F2-Q)*(C1*F1+Q)/((C1*F1-Q)*(C1*F2+Q)))
0045              Q2=(Q4-C2*Q1)/C1
0046              GO TO 20
0047            4 Q5=(F2-F1-B*Q4)/C
0048              IF(C1) 14,15,14
0049           15 Q1=Q4/C2
```

```
INTEG           SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0002
CSN               STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

0050              Q2=Q5/C2
0051              Q3=((C*Z2-3.*B)*F2-(C*Z1-3.*B)*F1+(3.*B*B-A*C)
                 1*Q4)/(2.*C*C2)
0052              GO TO 20
0053           14 A=C1*Z2+C2
0054              B=C1*Z1+C2
0055              IF(PP)31,30,31
0056           30 Q1=SIGN (1.,C1)*(1.D0/B-1.D0/A)/DSQRT (C)
0057              GO TO 32
0058           31 Q1=DLOG(((PP+U1*A-C1*F2)*B)/((PP+U1*B-C1*F1)*A))/PP
0059           32 Q2=(Q4-C2*Q1)/C1
0060              Q3=C*(Q5-C2*Q2)/C1
0061              GO TO 20
0062              END
```

```
              SOURCE LISTING            ASC FAST FORTRAN COMPILER       RELEASE FTFX0526.P214          PAGE 0001
CSN             STATEMENT               CP OPTIONS = (U)               DATE = 09/20/79(79.263)     TIME = 14:23:31

0001            SUBROUTINE HISTRY(ISDOWN, ISUP, KD, KU)
0002            COMMON /MESH/ R1, DR, R2, MGT(30), BRG(30), NR, NMGT, NBRG
0003            COMMON /FANS/ THEXT(50), DTHEXT(50), NDTH(50), NFANS
0004            COMMON /CYCLE/ ZDOWN(50), XDOWN(50), TDOWN(50), DXDOWN(50),
               1      ZUP(50),    XUP(50),    TUP(50),    DXUP(50)
0005            COMMON /PATH/ X(2000), Y(2000)
0006            COMMON /GROUND/ ANGLE(400), GANGLE(400), NHITS(400),
               1      RANGE(20,400), TIME(20,400), XLEVEL(20,400)
0007            COMMON /RCVRS/ DB(500,30)
0008            COMMON /MISC/ DXM, XMAX, HOBSQ, ISUPMX, IBRG, IN, NDOWN
          C*****    THIS ROUTINE TAKES RAY INFO FOR ONE CYCLE AND CONSTRUCTS PATH
          C    ARRAYS FOR THE FULL TRAJECTORY.  THE PATH IS THEN PLOTTED, DOWNGOING
          C    RAY FROM ORIGIN OUT, AND UPGOING RAY BACK TO ORIGIN. THE ZERO-DEGREE
          C    RAY, IF PRESENT, IS PLOTTED ONLY ONCE.  THE RAY PATHS ARE SEARCHED
          C    FOR THEIR GROUND HITS, AND PARAMETERS AT THESE POINTS ARE INSERTED
          C    INTO THE RECEIVER ARRAYS RANGE, TIME, AND XLEVEL FOR INTERPOLATION
          C    OF EIGENRAYS.
0009            THETA = ABS(ANGLE(ISDOWN))
0010            NEXT = 0
0011            DO 100 I=1,KD
0012            NEXT = NEXT + 1
0013            X(NEXT) = XDOWN(I)
0014            Y(NEXT) = ZDOWN(I)
0015        100 CONTINUE
0016            X0 = X(KD) + X(KD)
0017            T0 = TDOWN(KD)
0018            D0 = ABS(DXDOWN(KD))
0019            DO 200 I=2,KD
0020            NEXT = NEXT + 1
0021            II = KD - I + 1
0022            X(NEXT) = X0 - XDOWN(II)
0023            Y(NEXT) = ZDOWN(II)
0024        200 CONTINUE
0025        251 LCYC = KD
0026            XCYC = X(KD)
0027            NCYCS = 1
0028            TCYC = TDOWN(KD)
0029            IF(KU.EQ.0) GO TO 601
0030            DO 300 I=2,KU
0031            NEXT = NEXT + 1
0032            X(NEXT) = X0 + XUP(I)
0033            Y(NEXT) = ZUP(I)
0034        300 CONTINUE
0035            D1 = DXUP(KU)
0036            XCYC = X0 + XUP(KU) + XUP(KU)
0037            NCYCS = XMAX/XCYC + 2.6
0038            IF(NCYCS.GT.20) NCYCS = 20
0039            TCYC = 2*(T0 + TUP(KU))
0040            IF(KU.LT.3) GO TO 401
0041            DO 400 I=3,KU
```

```
HISTRY          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0002
  CSN             STATEMENT             CP OPTIONS = (U)             DATE = 09/20/79(79.263)     TIME = 14:23:31

0042            NEXT = NEXT + 1
0043            II = KU - I + 2
0044            X(NEXT) = XCYC - XUP(II)
0045            Y(NEXT) = ZUP(II)
0046        400 CONTINUE
0047        401 DCYC = D0 + D0 + D1 + D1
0048            LCYC = NEXT
0049            DO 600 NCYC=2,NCYCS
0050            DO 500 I=1,LCYC
0051            NEXT = NEXT + 1
0052            X(NEXT) = XCYC + X(NEXT-LCYC)
0053            Y(NEXT) = Y(NEXT-LCYC)
0054        500 CONTINUE
0055        600 CONTINUE
0056        601 LAST = NEXT
          C     PRINT 901, ISDOWN, ISUP, LCYC, LAST
          C     PRINT 902, ANGLE(ISDOWN)
          C     PRINT 902, (X(I), Y(I), I=1,LAST)
          C*****  PLOT RAY TRAJECTORIES (UP AND DOWN) FROM X,Y ARRAYS HERE.
0057            TIME(1,ISDOWN) = T0
0058            IF(ISUP.GT.0.) TIME(1,ISUP) = TCYC - T0
0059            IF(ANGLE(ISUP).LT.0.) TIME(1,ISUP) = T0
0060            NHDOWN = 0
0061            NHUP = 0
0062            DDOWN = D0
0063            DUP = DCYC - D0
0064            IF(ANGLE(ISUP).LT.0.) DUP = D0
0065            DO 800 I=1,LAST
0066            IF(Y(I).NE.0.) GO TO 800
0067            NHDOWN = NHDOWN + 1
0068            XD = X(I)
0069            RANGE(NHDOWN,ISDOWN) = XD/DXM
0070            IF(NHDOWN.GT.1) TIME(NHDOWN,ISDOWN) = TIME(NHDOWN-1,ISDOWN) + TCYC
0071            XLEVEL(NHDOWN,ISDOWN) = 1./ABS(DDOWN*XD)
0072            DDOWN = DDOWN + DCYC
0073            IF(ANGLE(ISUP).LT.0.) GO TO 650
0074            IF(ISUP.EQ.0 .OR. NHDOWN.EQ.1) GO TO 800
0075        650 NHUP = NHUP + 1
0076            DX = X0
0077            IF(ANGLE(ISUP).LT.0.) DX = 0.
0078            XU = X(I) - DX
0079            RANGE(NHUP,ISUP) = XU/DXM
0080            IF(NHUP.GT.1) TIME(NHUP,ISUP) = TIME(NHUP-1,ISUP) + TCYC
0081            XLEVEL(NHUP,ISUP) = 1./ABS(DUP*XU)
0082            DUP = DUP + DCYC
0083        800 CONTINUE
          C     PRINT 903, (RANGE(II,ISDOWN), TIME(II,ISDOWN), XLEVEL(II,ISDOWN),
          C   1   II=1,NHDOWN)
0084            NHITS(ISDOWN) = NHDOWN
0085            IF(ISUP.EQ.0) RETURN
```

```
HISTRY          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0003
  CSN             STATEMENT             CP OPTIONS = (U)             DATE = 09/20/79(79.263)     TIME = 14:23:31

          C     PRINT 903, (RANGE(II,ISUP), TIME(II,ISUP), XLEVEL(II,ISUP),
          C   1   II=1,NHUP)
0086            NHITS(ISUP) = NHUP
0087            RETURN
0088        901 FORMAT(//,' RAY NOS., CYCLE LENGTH, ARRAY LENGTH= ',4I5,/)
0089        902 FORMAT(5(1X,F12.2,F10.2))
0090        903 FORMAT(4(2X,3F10.2))
0091            END
```

```
          SOURCE LISTING            ASC FAST FORTRAN COMPILER       RELEASE FTFX0526.P214          PAGE 0001
CSN          STATEMENT              CP OPTIONS = (U)                DATE = 09/20/79(79.263)     TIME = 14:23:31

0001          SUBROUTINE EIGRAY
0002          COMMON /MESH/ R1, DR, R2, HGT(30), BRG(30), NR, NHGT, NBRG
0003          COMMON /FANS/ THEXT(50), DTHEXT(50), NDTH(50), NFANS
0004          COMMON /GROUND/ ANGLE(400), GANGLE(400), NHITS(400),
             1   RANGE(20,400), TIME(20,400), XLEVEL(20,400)
0005          COMMON /EIGEN/ NINT(500), NREFL(40,500), THINT(40,500),
             1                GINT(40,500), TINT(40,500), XLINT(40,500)
0006          COMMON /RCVRS/ XINT(500,30)
0007          COMMON /MISC/ DXM, XMAX, HOBSQ, ISUPMX, IBRG, IH, NDOWN
0008          COMMON /STNDRD/ HS(12), HNOM(30)
0009          DATA MAXEIG /40/
        C*****   FINDS THE EIGENRAYS TO THE EQUALLY-SPACED RECEIVERS BY INTER-
        C   POLATION BETWEEN NEIGHBORING RAYS WHERE THEY INTERPOSE A RECEIVER
        C   AT THE GROUND.  NOTE THAT INTERPOLATION IS VALID ONLY BETWEEN
        C   RAYS OF THE SAME FAN, AND HAVING THE SAME NUMBER OF GROUND HITS.
        C*****   THE INTERPOLATED EIGENRAYS ARE STORED IN COMMON BLOCK EIGEN,
        C   INDEXED BY RANGE INCREMENT AND EIGENRAY NUMBER.  FOR A GIVEN RANGE,
        C   THEY WILL BE ARRANGED IN ORDER OF INCREASING MAGNITUDE OF ANGLE WITH
        C   HORIZONTAL (AT THE SOURCE). NOTE THAT THERE IS SPACE FOR 40 ARRIVALS
        C   FOR EACH RANGE INCREMENT, AND EIGENRAYS AFTER 40TH WILL BE LOST.
0010          DO 100 I=1,500
0011          NINT(I) = 0
0012      100 CONTINUE
0013          ISDOWN = NDOWN
0014          ISUP = NDOWN
0015          DO 5000 NF=1,NFANS
0016          NRAYS = NDTH(NF)
0017          DO 4000 NRAY=2,NRAYS
0018          ISDOWN = ISDOWN - 1
0019          NHIT = MIN0(NHITS(ISDOWN),NHITS(ISDOWN+1))
0020          DO 1000 NH=1,NHIT
0021          MAXR = MAX1(RANGE(NH,ISDOWN), RANGE(NH,ISDOWN+1))
0022          IF(MAXR.GT.NR) MAXR = NR
0023          MINR = MIN1(RANGE(NH,ISDOWN)+1., RANGE(NH,ISDOWN+1)+1.)
0024          IF(MINR.GT.MAXR) GO TO 1000
0025          DO 500 MR=MINR,MAXR
0026          IF(NINT(MR).GE.MAXEIG) GO TO 500
0027          NINT(MR) = NINT(MR) + 1
0028          NEIG = NINT(MR)
0029          DDX = (MR-RANGE(NH,ISDOWN))/(RANGE(NH,ISDOWN+1)-RANGE(NH,ISDOWN))
0030          NREFL(NEIG,MR) = NH - 1
0031          THINT(NEIG,MR) = (ANGLE(ISDOWN+1) - ANGLE(ISDOWN))*DDX +
             1                                                ANGLE(ISDOWN)
0032          GINT(NEIG,MR) = (GANGLE(ISDOWN+1) - GANGLE(ISDOWN))*DDX +
             1                                                GANGLE(ISDOWN)
0033          TINT(NEIG,MR) = (TIME(NH,ISDOWN+1) - TIME(NH,ISDOWN))*DDX +
             1                                               TIME(NH,ISDOWN)
0034          XLINT(NEIG,MR) = (XLEVEL(NH,ISDOWN+1) - XLEVEL(NH,ISDOWN))*DDX +
             1                                              XLEVEL(NH,ISDOWN)
        C     PRINT 9969, ISDOWN, NEIG, MR, NREFL(NEIG,MR), THINT(NEIG,MR),
```

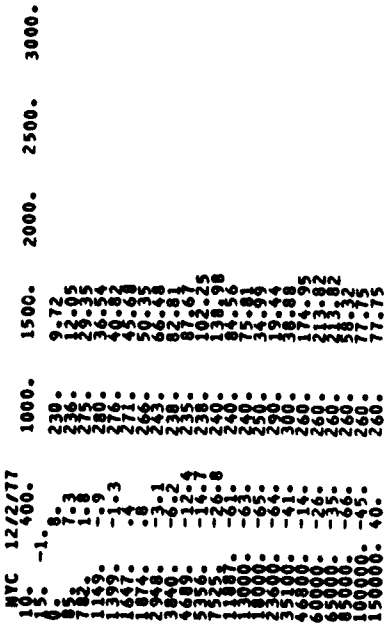
```
EIGRAY          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0002
  CSN             STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

            C     1   TINT(NEIG,MR), XLINT(NEIG,MR)
 0035        9969 FORMAT(1X, 4I10, 4F12.4)
 0036         500 CONTINUE
 0037        1000 CONTINUE
 0038              ISUP = ISUP + 1
 0039              IF(ISUP.GE.ISUPMX) GO TO 4000
 0040              NHIT = MINO(NHITS(ISUP),NHITS(ISUP+1))
 0041              DO 3000 NH=1,NHIT
 0042              MAXR = AMAX1(RANGE(NH,ISUP), RANGE(NH,ISUP+1))
 0043              IF(MAXR.GT.MR) MAXR = MR
 0044              MINR = AMIN1(RANGE(NH,ISUP)+1., RANGE(NH,ISUP+1)+1.)
 0045              IF(MINR.GT.MAXR) GO TO 3000
 0046              DO 1500 MR=MINR,MAXR
 0047              IF(NINT(MR).GE.MAXEIG) GO TO 1500
 0048              NINT(MR) = NINT(MR) + 1
 0049              NEIG = NINT(MR)
 0050              DDX = (MR-RANGE(NH,ISUP))/(RANGE(NH,ISUP+1)-RANGE(NH,ISUP))
 0051              NREFL(NEIG,MR) = NH - 1
 0052              THINT(NEIG,MR) = (ANGLE(ISUP+1) - ANGLE(ISUP))*DDX +
                  1                                                ANGLE(ISUP)
 0053              GINT(NEIG,MR) = (GANGLE(ISUP+1) - GANGLE(ISUP))*DDX +
                  1                                               GANGLE(ISUP)
 0054              TINT(NEIG,MR) = (TIME(NH,ISUP+1) - TIME(NH,ISUP))*DDX +
                  1                                                 TIME(NH,ISUP)
 0055              XLINT(NEIG,MR) = (XLEVEL(NH,ISUP+1) - XLEVEL(NH,ISUP))*DDX +
                  1                                               XLEVEL(NH,ISUP)
            C       PRINT 9969, ISUP, NEIG, MR, NREFL(NEIG,MR), THINT(NEIG,MR),
            C     1   TINT(NEIG,MR), XLINT(NEIG,MR)
 0056        1500 CONTINUE
 0057        3000 CONTINUE
 0058        4000 CONTINUE
 0059              ISDOWN = ISDOWN - 1
 0060              ISUP = ISUP + 1
 0061        5000 CONTINUE
 0062              R = R1
 0063              XM = DXM
 0064              PRINT 903, MMOM(IM), BRG(IBRG)
 0065              IMESH = IBRG
 0066              IF(IBRG.EQ.1) IMESH = IM
 0067              DO 10000 I=1,NR
 0068              XINT(I,IMESH) = 1.E-20
 0069              NEIGS = NINT(I)
 0070              IF(NEIGS.EQ.0) GO TO 6001
 0071              DO 6000 NEIG=1,NEIGS
 0072              XINT(I,IMESH) = XINT(I,IMESH) + XLINT(NEIG,I)
 0073              XLINT(NEIG,I) = 10.*ALOG10(XLINT(NEIG,I))
 0074              HVEL = XM/TINT(NEIG,I)
 0075              VEL = SQRT(XM*XM + HOBSQ)/TINT(NEIG,I)
 0076              PRINT 901, MMOM(IM), BRG(IBRG), I, NEIG, NREFL(NEIG,I), R,
                  1   THINT(NEIG,I), GINT(NEIG,I), TINT(NEIG,I), XLINT(NEIG,I), HVEL
```

```
EIGRAY          SOURCE LISTING          ASC FAST FORTRAN COMPILER      RELEASE FTFX0526.P214          PAGE 0003
  CSN             STATEMENT             CP OPTIONS = (U)              DATE = 09/20/79(79.263)     TIME = 14:23:31

 0077        6000 CONTINUE
 0078              PRINT 902
 0079        6001 R = R + DR
 0080              XM = XM + DXM
 0081              XINT(I,IMESH) = -10.*ALOG10(XINT(I,IMESH))
 0082       10000 CONTINUE
 0083              RETURN
 0084         901 FORMAT(1X, 2F9.2, 9X, 3I8, 8F10.2)
 0085         902 FORMAT(/)
 0086         903 FORMAT('1  EIGENRAYS AT GROUND RECEIVERS FOR SOURCE HEIGHT=',
                  1   F10.2,' M     TRACING TOWARD AZIMUTH', F8.2,//,41X,'NEIG',
                  2   4X,'NREFL  RANGE(KM)  SANGLE   RANGLE   TIME(SEC)   LEVEL',
                  3   4X, 'CHMEAN',/)
 0087              END
```

Appendix B


MYC 12/2/77
400.
-1.
1000.
1500.
2000.
2500.
3000.

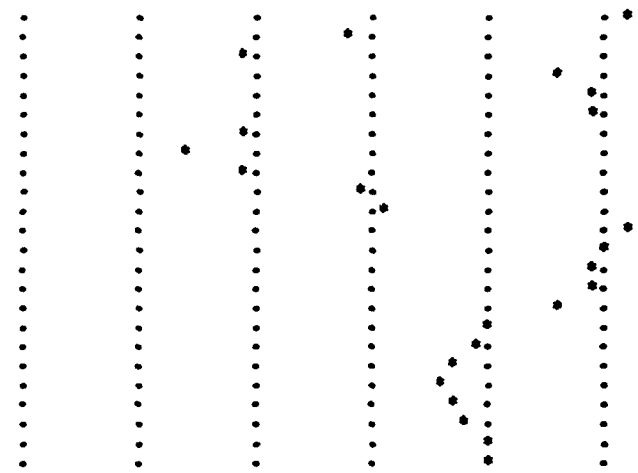
INPUT DATA AND DERIVED PROFILE FOR RAYTRACE
THE CURVED-EARTH CORRECTION CHANGES ALTITUDES SLIGHTLY.

NYC 12/2/77 09/24/79

1	0.00	8.00	230.00	9.72	0.00	336.29	5.00
2	85.00	7.30	236.00	12.05	85.00	335.86	6.20
3	782.00	1.80	275.00	29.35	781.95	332.52	15.10
4	1149.00	-0.90	280.00	36.54	1148.90	330.86	18.80
5	1399.00	-1.30	276.00	40.82	1398.85	330.61	21.00
6	1647.00	0.40	271.00	45.68	1646.79	331.63	23.50
7	1874.00	0.80	266.00	50.35	1873.72	331.86	25.90
8	2948.00	-3.10	243.00	66.48	2947.32	329.43	34.20
9	3840.00	-6.20	238.00	82.81	3838.84	327.49	42.60
10	4689.00	-12.40	235.00	87.67	4687.28	323.62	45.10
11	5356.00	-14.70	238.00	102.25	5353.75	322.16	52.60
12	7525.00	-26.80	240.00	138.98	7520.56	314.42	71.50
13	11887.00	-61.00	240.00	84.56	11875.93	291.58	43.50
14	13000.00	-63.00	240.00	75.81	12986.77	290.16	39.00
15	18000.00	-65.00	250.00	34.99	17974.65	288.54	18.00
16	23600.00	-64.00	290.00	19.44	23556.45	288.98	10.00
17	35100.00	-41.00	300.00	38.88	35003.77	303.91	20.00
18	46800.00	-14.00	260.00	174.95	46629.13	320.50	90.00
19	60000.00	-26.00	260.00	213.82	59719.54	312.35	110.00
20	65000.00	-35.00	260.00	213.82	64671.03	306.37	110.00
21	85000.00	-66.00	260.00	58.32	84438.62	284.84	30.00
22	100000.00	-45.00	260.00	77.75	99224.19	298.23	40.00
23	150000.00	40.00	260.00	77.75	148263.37	346.66	40.00

SOURCE ALTITUDE (ABOVE GROUND LEVEL)= 1000.00 M.
BEARING= 15.00

ALTITUDE (M)	WIND COMPONENT (M/SEC)	SOUND SPEED (M/SEC)	SUM (M/SEC)
148263.375	16.904	346.659	363.563
99224.187	16.904	298.229	315.132
84438.625	12.680	284.843	297.522
64671.031	46.488	306.370	352.857
59719.543	46.488	312.350	358.837
46629.133	38.037	320.504	358.541
35003.773	-5.177	303.908	298.731
23556.445	-0.872	288.983	288.111
17974.648	10.325	288.545	298.869
12986.770	27.577	290.155	317.732
11875.934	30.760	291.583	322.343
7520.562	50.556	314.420	364.976
5353.750	38.471	322.157	360.628
4687.277	34.550	323.622	358.171
3838.844	31.157	327.490	358.646
2947.318	22.884	329.431	352.316
1873.724	8.433	331.857	340.290
1646.787	5.685	331.627	337.312
1398.846	3.285	330.607	333.892
1148.896	1.638	330.864	332.502
999.921	2.117	331.535	333.652
781.952	2.622	332.519	335.141
84.999	4.678	335.865	340.543
0.000	4.096	336.288	340.384



ALL RAYS WITH SOURCE ANGLE GREATER THAN 11.5088 DEGREES STRIKE THE GROUND.

LIST OF CRITICAL ANGLES WITH FAN PARAMETERS.

1	11.5088	9.9387	0.4969	21
2	21.4474	2.3864	0.4773	6
3	23.8339	36.1661	3.5023	73

EIGENRAYS AT GROUND RECEIVERS FOR SOURCE HEIGHT= 1000.00 M TRACING TOWARD AZIMUTH 15.00

			NEIG	NREFL	RANGE(KM)	SANGLE	RANGLE	TIME(SEC)	LEVEL	CMMEAN
1000.00	15.00	3	1	0	30.00	19.45	-15.83	88.69	-92.30	338.25
1000.00	15.00	6	1	2	60.00	-14.49	-9.00	179.99	-87.17	333.35
1000.00	15.00	6	2	2	60.00	-17.19	-12.93	179.98	-87.10	333.37
1000.00	15.00	6	3	1	60.00	19.03	-15.31	178.27	-99.31	336.57
1000.00	15.00	7	1	2	70.00	-19.53	-15.93	208.34	-98.45	335.99
1000.00	15.00	8	1	2	80.00	12.76	-5.78	239.50	-92.28	334.03
1000.00	15.00	8	2	2	80.00	16.87	-12.50	239.42	-92.30	334.15
1000.00	15.00	8	3	0	80.00	22.64	-19.65	228.25	-105.19	350.49
1000.00	15.00	9	1	3	90.00	-13.37	-7.04	269.71	-93.55	333.70
1000.00	15.00	9	2	3	90.00	-18.48	-14.61	269.57	-93.68	333.87
1000.00	15.00	9	3	2	90.00	18.91	-15.16	267.84	-100.60	336.02
1000.00	15.00	10	1	3	100.00	-19.20	-15.52	297.92	-102.59	335.66
1000.00	15.00	10	2	2	100.00	19.85	-16.33	296.11	-101.73	337.71
1000.00	15.00	11	1	3	110.00	12.55	-5.31	329.23	-96.22	334.11
1000.00	15.00	11	2	3	110.00	17.75	-13.67	329.02	-95.96	334.33
1000.00	15.00	11	3	3	110.00	-20.33	-16.91	326.13	-101.71	337.29
1000.00	15.00	12	1	4	120.00	-12.99	-6.29	359.43	-96.92	333.86
1000.00	15.00	12	2	4	120.00	-18.53	-14.68	359.14	-96.76	334.14
1000.00	15.00	12	3	3	120.00	18.86	-15.09	357.41	-101.67	335.75
1000.00	15.00	13	1	4	130.00	-19.04	-15.33	387.50	-105.46	335.48
1000.00	15.00	13	2	3	130.00	19.48	-15.88	385.72	-104.42	337.03
1000.00	15.00	14	1	4	140.00	18.24	-14.31	418.60	-98.46	334.45
1000.00	15.00	14	2	4	140.00	-19.80	-16.27	415.76	-104.30	336.73
1000.00	15.00	14	3	3	140.00	20.36	-16.95	413.89	-104.19	338.25
1000.00	15.00	15	1	5	150.00	-12.84	-5.95	449.17	-99.12	333.95
1000.00	15.00	15	2	5	150.00	-18.56	-14.72	448.70	-99.06	334.30
1000.00	15.00	15	3	4	150.00	18.82	-15.35	446.98	-102.90	335.58
1000.00	15.00	16	1	5	160.00	-18.95	-15.22	477.08	-106.77	335.37
1000.00	15.00	16	2	4	160.00	19.30	-15.65	475.30	-106.71	336.63
1000.00	15.00	16	3	1	160.00	22.58	-19.58	457.57	-111.43	349.67
1000.00	15.00	17	1	6	170.00	-14.57	-9.13	509.76	-92.60	333.49
1000.00	15.00	17	2	6	170.00	-15.92	-11.18	509.75	-93.07	333.49
1000.00	15.00	17	3	5	170.00	18.48	-14.62	508.18	-100.39	334.53
1000.00	15.00	17	4	5	170.00	-19.51	-15.91	505.37	-106.40	336.39
1000.00	15.00	17	5	4	170.00	19.94	-16.43	503.54	-106.14	337.61
1000.00	15.00	17	6	2	170.00	-22.70	-19.72	487.37	-111.23	348.81

1000.00	15.00	18	1	6	180.00	-12.73	-5.70	538.91	-100.93	334.01
1000.00	15.00	18	2	6	180.00	-18.59	-14.75	538.27	-100.90	334.40
1000.00	15.00	18	3	5	180.00	18.80	-15.03	536.55	-104.06	335.48
1000.00	15.00	18	4	5	180.00	-20.23	-16.79	533.54	-106.15	337.37
1000.00	15.00	19	1	6	190.00	13.48	-7.25	569.24	-97.93	333.78
1000.00	15.00	19	2	6	190.00	16.26	-11.66	569.19	-97.80	333.81
1000.00	15.00	19	3	6	190.00	-18.91	-15.16	566.65	-106.48	335.31
1000.00	15.00	19	4	5	190.00	19.18	-15.50	564.88	-108.56	336.35
1000.00	15.00	20	1	7	200.00	-13.76	-7.76	599.46	-98.52	333.63
1000.00	15.00	20	2	7	200.00	-17.01	-12.69	599.38	-98.80	333.68
1000.00	15.00	20	3	6	200.00	18.51	-14.66	597.74	-101.95	334.59
1000.00	15.00	20	4	6	200.00	-19.35	-15.71	594.95	-108.25	336.16
1000.00	15.00	20	5	5	200.00	19.68	-16.11	593.15	-107.86	337.19
1000.00	15.00	21	1	7	210.00	-12.65	-5.52	628.64	-102.47	334.05
1000.00	15.00	21	2	7	210.00	-18.60	-14.77	627.84	-102.42	334.48
1000.00	15.00	21	3	6	210.00	18.79	-15.01	626.12	-105.11	335.40
1000.00	15.00	21	4	6	210.00	-19.89	-16.38	623.18	-107.77	336.98
1000.00	15.00	21	5	5	210.00	20.27	-16.84	621.31	-107.71	338.00
1000.00	15.00	22	1	7	220.00	13.18	-6.66	658.96	-100.32	333.86
1000.00	15.00	22	2	7	220.00	16.92	-12.57	658.82	-100.46	333.93
1000.00	15.00	22	3	7	220.00	-18.88	-15.12	656.22	-106.87	335.26
1000.00	15.00	22	4	6	220.00	19.10	-15.40	654.46	-110.10	336.15

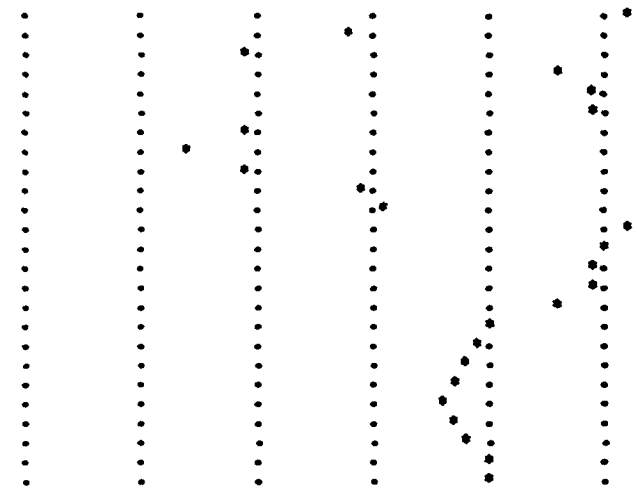
1000.00	15.00	23	1	8	230.00	-13.41	-7.11	689.18	-100.96	333.73
1000.00	15.00	23	2	8	230.00	-17.55	-13.41	688.98	-101.05	333.82
1000.00	15.00	23	3	7	230.00	18.54	-14.69	687.31	-103.28	334.64
1000.00	15.00	23	4	7	230.00	-19.24	-15.57	684.53	-109.83	335.99
1000.00	15.00	23	5	6	230.00	19.49	-15.88	682.75	-109.29	336.87
1000.00	15.00	24	1	8	240.00	-12.58	-5.38	718.38	-103.80	334.09
1000.00	15.00	24	2	8	240.00	-18.61	-14.79	717.41	-103.72	334.54
1000.00	15.00	24	3	7	240.00	18.78	-14.99	715.69	-106.06	335.34
1000.00	15.00	24	4	7	240.00	-19.67	-16.11	712.79	-109.23	336.70
1000.00	15.00	24	5	6	240.00	19.97	-16.48	710.96	-109.05	337.57
1000.00	15.00	24	6	3	240.00	-22.46	-19.44	689.04	-115.34	348.31
1000.00	15.00	24	7	2	240.00	22.55	-19.55	686.90	-115.03	349.40
1000.00	15.00	25	1	8	250.00	12.98	-6.26	748.69	-102.31	333.92
1000.00	15.00	25	2	8	250.00	17.35	-13.15	748.42	-102.20	334.04
1000.00	15.00	25	3	8	250.00	-18.86	-15.09	745.78	-107.44	335.22
1000.00	15.00	25	4	7	250.00	19.04	-15.32	744.04	-111.42	336.00
1000.00	15.00	25	5	7	250.00	-20.19	-16.74	740.96	-109.07	337.40
1000.00	15.00	25	6	3	250.00	-22.64	-19.65	716.69	-114.89	348.82
1000.00	15.00	25	7	2	250.00	22.73	-19.75	714.54	-114.60	349.87
1000.00	15.00	26	1	9	260.00	-13.21	-6.72	778.90	-102.55	333.80
1000.00	15.00	26	2	9	260.00	-17.91	-13.88	778.58	-102.69	333.94
1000.00	15.00	26	3	8	260.00	18.55	-14.71	776.88	-104.44	334.67
1000.00	15.00	26	4	8	260.00	-19.15	-15.47	774.11	-111.18	335.87
1000.00	15.00	26	5	7	260.00	19.37	-15.74	772.34	-110.65	336.64
1000.00	15.00	26	6	3	260.00	-22.81	-19.85	744.34	-114.48	349.30
1000.00	15.00	27	1	9	270.00	-12.53	-5.27	808.11	-104.98	334.11
1000.00	15.00	27	2	9	270.00	-18.62	-14.80	806.98	-104.85	334.58
1000.00	15.00	27	3	8	270.00	18.77	-14.98	805.25	-106.93	335.30
1000.00	15.00	27	4	8	270.00	-19.50	-15.90	802.40	-110.47	336.49
1000.00	15.00	27	5	7	270.00	19.77	-16.23	800.57	-110.31	337.26
1000.00	15.00	28	1	9	280.00	12.88	-6.05	838.43	-103.60	333.96
1000.00	15.00	28	2	10	280.00	-14.62	-9.21	839.52	-94.13	333.52
1000.00	15.00	28	3	10	280.00	-15.63	-10.76	839.52	-96.16	333.52
1000.00	15.00	28	4	9	280.00	17.67	-13.58	838.02	-103.59	334.12
1000.00	15.00	28	5	9	280.00	-18.84	-15.07	835.35	-108.06	335.19
1000.00	15.00	28	6	8	280.00	18.99	-15.26	833.62	-112.57	335.88
1000.00	15.00	28	7	8	280.00	-19.94	-16.43	830.61	-110.24	337.10
1000.00	15.00	28	8	7	280.00	20.22	-16.78	828.72	-110.21	337.87

1000.00	15.00	29	1	10	290.00	-13.04	-6.40	868.63	-104.03	333.86
1000.00	15.00	29	2	10	290.00	-18.17	-14.22	868.16	-103.99	334.04
1000.00	15.00	29	3	9	290.00	18.57	-14.73	866.45	-105.47	334.70
1000.00	15.00	29	4	9	290.00	-19.09	-15.39	863.69	-112.36	335.77
1000.00	15.00	29	5	8	290.00	19.29	-15.63	861.92	-111.87	336.46
1000.00	15.00	29	6	8	290.00	-20.41	-17.01	858.73	-110.22	337.71
1000.00	15.00	30	1	10	300.00	13.80	-7.83	898.99	-100.49	333.71
1000.00	15.00	30	2	10	300.00	16.03	-11.33	898.96	-100.90	333.72
1000.00	15.00	30	3	10	300.00	-18.63	-14.81	896.55	-105.86	334.62
1000.00	15.00	30	4	9	300.00	18.76	-14.97	894.82	-107.73	335.26
1000.00	15.00	30	5	9	300.00	-19.39	-15.77	891.99	-111.66	336.33
1000.00	15.00	30	6	8	300.00	19.62	-16.04	890.18	-111.41	337.01
1000.00	15.00	31	1	10	310.00	12.80	-5.87	928.16	-104.75	333.99
1000.00	15.00	31	2	11	310.00	-13.93	-8.06	929.22	-101.49	333.61
1000.00	15.00	31	3	11	310.00	-16.52	-12.02	929.16	-101.64	333.63
1000.00	15.00	31	4	10	310.00	17.93	-13.91	927.61	-104.78	334.19
1000.00	15.00	31	5	10	310.00	-18.82	-15.05	924.92	-108.68	335.16
1000.00	15.00	31	6	9	310.00	18.95	-15.21	923.20	-112.70	335.79
1000.00	15.00	31	7	9	310.00	-19.76	-16.22	920.21	-111.36	336.88
1000.00	15.00	31	8	8	310.00	20.00	-16.51	918.37	-111.24	337.55
1000.00	15.00	32	1	11	320.00	-12.95	-6.20	958.36	-105.14	333.90
1000.00	15.00	32	2	11	320.00	-18.37	-14.48	957.73	-105.12	334.12
1000.00	15.00	32	3	10	320.00	18.58	-14.74	956.02	-106.39	334.72
1000.00	15.00	32	4	10	320.00	-19.04	-15.32	953.27	-113.40	335.69
1000.00	15.00	32	5	9	320.00	19.22	-15.54	951.50	-112.94	336.31
1000.00	15.00	32	6	9	320.00	-20.16	-16.71	948.38	-111.25	337.42
1000.00	15.00	32	7	8	320.00	20.42	-17.02	946.49	-111.24	338.09
1000.00	15.00	32	8	4	320.00	-22.47	-19.46	918.37	-117.80	348.44
1000.00	15.00	32	9	3	320.00	22.54	-19.54	916.22	-117.56	349.26
1000.00	15.00	33	1	11	330.00	13.46	-7.21	988.71	-103.08	333.77
1000.00	15.00	33	2	11	330.00	16.56	-12.07	988.59	-103.09	333.81
1000.00	15.00	33	3	11	330.00	-18.64	-14.82	986.11	-106.76	334.65
1000.00	15.00	33	4	10	330.00	18.75	-14.96	984.39	-108.46	335.23
1000.00	15.00	33	5	10	330.00	-19.31	-15.66	981.57	-112.75	336.20
1000.00	15.00	33	6	9	330.00	19.49	-15.89	979.78	-112.39	336.81
1000.00	15.00	33	7	4	330.00	-22.61	-19.61	946.02	-117.46	348.83
1000.00	15.00	33	8	3	330.00	22.67	-19.69	943.87	-117.24	349.63
1000.00	15.00	34	1	11	340.00	12.74	-5.73	1017.90	-105.78	334.02
1000.00	15.00	34	2	12	340.00	-13.62	-7.51	1018.93	-103.40	333.68
1000.00	15.00	34	3	12	340.00	-16.99	-12.67	1018.78	-103.61	333.73
1000.00	15.00	34	4	11	340.00	18.13	-14.16	1017.19	-105.78	334.25
1000.00	15.00	34	5	11	340.00	-18.81	-15.04	1014.49	-109.28	335.14
1000.00	15.00	34	6	10	340.00	18.93	-15.19	1012.77	-112.52	335.71
1000.00	15.00	34	7	10	340.00	-19.62	-16.04	1009.82	-112.35	336.69
1000.00	15.00	34	8	9	340.00	19.83	-16.30	1007.99	-112.22	337.30
1000.00	15.00	34	9	4	340.00	-22.74	-19.76	973.67	-117.14	349.20
1000.00	15.00	34	10	3	340.00	22.80	-19.84	971.52	-116.94	349.97

1000.00	15.00	35	1	12	350.00	-12.88	-6.05	1048.10	-106.07	333.94
1000.00	15.00	35	2	12	350.00	-18.48	-14.62	1047.31	-106.09	334.19
1000.00	15.00	35	3	11	350.00	18.59	-14.76	1045.59	-107.23	334.74
1000.00	15.00	35	4	11	350.00	-19.00	-15.27	1042.85	-114.33	335.62
1000.00	15.00	35	5	10	350.00	19.16	-15.47	1041.08	-113.90	336.19
1000.00	15.00	35	6	10	350.00	-19.96	-16.47	1038.03	-112.17	337.18
1000.00	15.00	35	7	9	350.00	20.19	-16.75	1036.14	-112.15	337.79
1000.00	15.00	36	1	12	360.00	13.29	-6.87	1078.44	-104.41	333.82
1000.00	15.00	36	2	12	360.00	16.93	-12.59	1078.21	-104.59	333.89
1000.00	15.00	36	3	12	360.00	-18.64	-14.82	1075.68	-107.58	334.67
1000.00	15.00	36	4	11	360.00	18.75	-14.96	1073.96	-109.13	335.21
1000.00	15.00	36	5	11	360.00	-19.25	-15.58	1071.15	-113.73	336.09
1000.00	15.00	36	6	10	360.00	19.40	-15.78	1069.37	-113.36	336.65
1000.00	15.00	36	7	10	360.00	-20.34	-16.93	1066.15	-112.16	337.67
1000.00	15.00	37	1	12	370.00	12.69	-5.61	1107.63	-106.71	334.05
1000.00	15.00	37	2	13	370.00	-13.42	-7.13	1108.65	-104.88	333.74
1000.00	15.00	37	3	13	370.00	-17.32	-13.10	1108.39	-104.93	333.82
1000.00	15.00	37	4	12	370.00	18.29	-14.38	1106.77	-106.68	334.31
1000.00	15.00	37	5	12	370.00	-18.80	-15.03	1104.06	-109.86	335.13
1000.00	15.00	37	6	11	370.00	18.91	-15.16	1102.33	-112.59	335.65
1000.00	15.00	37	7	11	370.00	-19.50	-15.90	1099.43	-113.24	336.54
1000.00	15.00	37	8	10	370.00	19.70	-16.14	1097.60	-113.12	337.10
1000.00	15.00	38	1	13	380.00	-12.82	-5.92	1137.84	-106.93	333.97
1000.00	15.00	38	2	12	380.00	-18.96	-15.23	1132.43	-114.94	335.56
1000.00	15.00	38	3	13	380.00	-18.50	-14.64	1136.88	-106.93	334.25
1000.00	15.00	38	4	12	380.00	18.60	-14.77	1135.15	-108.00	334.76
1000.00	15.00	38	5	11	380.00	19.11	-15.41	1130.66	-114.77	336.09
1000.00	15.00	38	6	11	380.00	-19.82	-16.28	1127.64	-113.07	336.99
1000.00	15.00	38	7	10	380.00	20.01	-16.53	1125.79	-112.98	337.54
1000.00	15.00	39	1	13	390.00	13.14	-6.59	1168.16	-105.66	333.86
1000.00	15.00	39	2	14	390.00	-14.65	-9.25	1169.28	-94.39	333.54
1000.00	15.00	39	3	14	390.00	-15.54	-10.62	1169.28	-99.01	333.54
1000.00	15.00	39	4	13	390.00	17.22	-12.97	1167.82	-105.73	333.96
1000.00	15.00	39	5	13	390.00	-18.65	-14.83	1165.25	-108.33	334.69
1000.00	15.00	39	6	12	390.00	18.74	-14.95	1163.53	-109.76	335.19
1000.00	15.00	39	7	12	390.00	-19.19	-15.51	1160.73	-114.61	336.00
1000.00	15.00	39	8	11	390.00	19.34	-15.69	1158.95	-114.26	336.51
1000.00	15.00	39	9	11	390.00	-20.15	-16.69	1155.79	-112.99	337.43
1000.00	15.00	39	10	10	390.00	20.35	-16.94	1153.91	-112.98	337.98
1000.00	15.00	40	1	13	400.00	12.64	-5.51	1197.37	-107.57	334.07
1000.00	15.00	40	2	14	400.00	-13.28	-6.87	1198.38	-105.92	333.78
1000.00	15.00	40	3	14	400.00	-17.58	-13.45	1197.98	-106.07	333.89
1000.00	15.00	40	4	13	400.00	18.43	-14.56	1196.35	-107.50	334.35
1000.00	15.00	40	5	13	400.00	-18.79	-15.02	1193.63	-110.41	335.11
1000.00	15.00	40	6	12	400.00	18.89	-15.14	1191.90	-112.77	335.60
1000.00	15.00	40	7	12	400.00	-19.42	-15.80	1189.02	-114.11	336.41
1000.00	15.00	40	8	11	400.00	19.59	-16.00	1187.21	-113.93	336.93
1000.00	15.00	40	9	5	400.00	-22.48	-19.46	1147.69	-119.72	348.53
1000.00	15.00	40	10	4	400.00	22.54	-19.53	1145.54	-119.52	349.18

SOURCE ALTITUDE (ABOVE GROUND LEVEL)= 1500.00 M.
BEARING= 15.00

ALTITUDE (M)	WIND COMPONENT (M/SEC)	SOUND SPEED (M/SEC)	SUM (M/SEC)
148263.375	16.904	346.659	363.563
99224.187	16.904	298.229	315.132
84438.625	12.680	284.843	297.522
64671.031	46.488	306.370	352.857
59719.543	46.488	312.350	358.837
46629.133	38.037	320.504	358.541
35003.773	-5.177	303.908	298.731
23556.445	-0.872	288.983	288.111
17974.648	10.325	288.545	298.869
12986.770	27.577	290.155	317.732
11875.934	30.760	291.583	322.343
7520.562	50.556	314.420	364.976
5353.750	38.471	322.157	360.628
4687.277	34.550	323.622	358.171
3838.844	31.157	327.490	358.646
2947.318	22.884	329.431	352.316
1873.724	8.433	331.857	340.290
1646.787	5.685	331.627	337.312
1499.823	4.215	331.022	335.237
1398.846	3.285	330.607	333.892
1148.896	1.638	330.864	332.502
999.921	2.117	331.535	333.652
781.952	2.622	332.519	335.141
84.999	4.678	335.865	340.543
0.000	4.096	336.288	340.384



ALL RAYS WITH SOURCE ANGLE GREATER THAN 10.0630 DEGREES STRIKE THE GROUND.

LIST OF CRITICAL ANGLES WITH FAN PARAMETERS.

1	10.0630	10.6195	0.5057	22
2	20.6824	2.4579	0.4916	6
3	23.1403	36.8597	0.4981	75

EIGENRAYS AT GROUND RECEIVERS FOR SOURCE HEIGHT= 1500.00 M TRACING TOWARD AZIMUTH 15.00

			NEIG	NREFL	RANGE(KM)	SANGLE	RANGLE	TIME(SEC)	LEVEL	CHMEAN
1500.00	15.00	3	1	0	30.00	19.06	-16.37	88.18	-91.82	340.21
1500.00	15.00	4	1	1	40.00	-19.52	-16.91	119.23	-92.00	335.47
1500.00	15.00	5	1	1	50.00	15.57	-12.08	149.36	-88.60	334.76
1500.00	15.00	6	1	1	60.00	18.37	-15.54	177.77	-98.60	337.51
1500.00	15.00	7	1	2	70.00	-18.47	-15.67	208.84	-98.65	335.18
1500.00	15.00	8	1	2	80.00	16.81	-13.64	238.97	-93.44	334.78
1500.00	15.00	8	2	0	80.00	21.99	-19.73	227.66	-104.90	351.40
1500.00	15.00	9	1	3	90.00	-12.98	-8.42	270.07	-91.05	333.25
1500.00	15.00	9	2	3	90.00	-16.52	-13.28	270.04	-91.33	333.29
1500.00	15.00	9	3	2	90.00	18.15	-15.28	267.35	-102.61	336.63
1500.00	15.00	9	4	1	90.00	-22.12	-19.88	258.63	-104.87	347.99
1500.00	15.00	10	1	3	100.00	-18.20	-15.35	298.42	-102.71	335.10
1500.00	15.00	10	2	2	100.00	19.19	-16.52	295.60	-101.47	338.29
1500.00	15.00	11	1	3	110.00	17.42	-14.40	328.55	-96.52	334.81
1500.00	15.00	11	2	3	110.00	-19.34	-16.70	326.65	-101.54	336.75
1500.00	15.00	12	1	4	120.00	-12.16	-7.08	359.79	-95.42	333.53
1500.00	15.00	12	2	4	120.00	-17.46	-14.45	359.62	-95.74	333.68
1500.00	15.00	12	3	3	120.00	18.07	-15.19	356.92	-102.58	336.21
1500.00	15.00	13	1	4	130.00	-18.10	-15.22	388.00	-103.08	335.05
1500.00	15.00	13	2	3	130.00	18.77	-16.32	385.21	-104.14	337.48
1500.00	15.00	14	1	4	140.00	17.66	-14.69	418.12	-98.80	334.83
1500.00	15.00	14	2	4	140.00	-18.85	-16.12	416.27	-104.18	336.32
1500.00	15.00	15	1	5	150.00	-11.83	-6.48	449.51	-98.00	333.69
1500.00	15.00	15	2	5	150.00	-17.67	-14.70	449.19	-98.26	333.93
1500.00	15.00	15	3	4	150.00	18.03	-15.14	446.49	-103.40	335.95
1500.00	15.00	16	1	5	160.00	12.27	-7.26	479.16	-95.50	333.92
1500.00	15.00	16	2	5	160.00	15.01	-11.33	479.13	-95.82	333.94
1500.00	15.00	16	3	5	160.00	-18.05	-15.16	477.57	-103.47	335.03
1500.00	15.00	16	4	4	160.00	18.54	-15.75	474.81	-106.33	336.98
1500.00	15.00	16	5	2	160.00	-21.68	-19.39	460.30	-111.98	347.60
1500.00	15.00	16	6	1	160.00	21.89	-19.62	456.98	-111.25	350.12
1500.00	15.00	17	1	5	170.00	17.69	-14.73	507.69	-100.59	334.85
1500.00	15.00	17	2	5	170.00	-18.58	-15.80	505.87	-106.33	336.05
1500.00	15.00	17	3	4	170.00	19.22	-16.55	503.02	-105.93	337.96
1500.00	15.00	17	4	2	170.00	-21.95	-19.69	487.95	-111.24	348.40

1500.00	15.00	18	1	6	180.00	-11.62	-6.08	539.25	-100.06	333.80
1500.00	15.00	18	2	6	180.00	-17.70	-14.74	538.76	-100.16	334.10
1500.00	15.00	18	3	5	180.00	18.00	-15.10	536.06	-104.34	335.78
1500.00	15.00	18	4	5	180.00	-19.31	-16.66	534.07	-105.97	337.03
1500.00	15.00	19	1	6	190.00	11.86	-6.54	568.89	-98.72	333.98
1500.00	15.00	19	2	6	190.00	15.84	-12.42	568.76	-98.94	334.06
1500.00	15.00	19	3	6	190.00	-18.01	-15.12	567.13	-104.30	335.02
1500.00	15.00	19	4	5	190.00	18.40	-15.58	564.39	-108.18	336.65
1500.00	15.00	20	1	7	200.00	-13.13	-8.66	599.83	-96.09	333.43
1500.00	15.00	20	2	7	200.00	-15.31	-11.73	599.82	-96.18	333.43
1500.00	15.00	20	3	6	200.00	17.71	-14.76	597.26	-102.08	334.86
1500.00	15.00	20	4	6	200.00	-18.43	-15.62	595.46	-108.20	335.88
1500.00	15.00	20	5	5	200.00	18.93	-16.21	592.64	-107.61	337.48
1500.00	15.00	21	1	7	210.00	-11.50	-5.85	628.98	-101.63	333.87
1500.00	15.00	21	2	7	210.00	-17.72	-14.76	628.33	-101.73	334.22
1500.00	15.00	21	3	6	210.00	17.98	-15.08	625.63	-105.27	335.66
1500.00	15.00	21	4	6	210.00	-18.99	-16.28	623.70	-107.63	336.70
1500.00	15.00	21	5	5	210.00	19.55	-16.94	620.78	-107.52	338.28
1500.00	15.00	22	1	7	220.00	11.64	-6.12	658.62	-100.84	334.03
1500.00	15.00	22	2	7	220.00	16.36	-13.09	658.37	-100.94	334.16
1500.00	15.00	22	3	7	220.00	-17.99	-15.09	656.70	-105.18	335.01
1500.00	15.00	22	4	6	220.00	18.30	-15.46	653.97	-109.73	336.41
1500.00	15.00	22	5	6	220.00	-19.64	-17.04	651.84	-107.55	337.51
1500.00	15.00	23	1	8	230.00	-12.51	-7.66	689.54	-99.64	333.55
1500.00	15.00	23	2	8	230.00	-16.17	-12.84	689.44	-99.89	333.60
1500.00	15.00	23	3	7	230.00	17.73	-14.78	686.83	-103.37	334.87
1500.00	15.00	23	4	7	230.00	-18.32	-15.50	685.04	-109.75	335.75
1500.00	15.00	23	5	6	230.00	18.72	-15.97	682.25	-109.04	337.12
1500.00	15.00	24	1	8	240.00	-11.42	-5.69	718.72	-102.93	333.93
1500.00	15.00	24	2	8	240.00	-17.73	-14.78	717.90	-103.06	334.31
1500.00	15.00	24	3	7	240.00	17.96	-15.06	715.20	-106.14	335.57
1500.00	15.00	24	4	7	240.00	-18.77	-16.02	713.31	-109.07	336.46
1500.00	15.00	24	5	6	240.00	19.23	-16.57	710.44	-108.86	337.82
1500.00	15.00	24	6	3	240.00	-21.72	-19.43	689.62	-115.37	348.02
1500.00	15.00	24	7	2	240.00	21.85	-19.58	686.30	-114.88	349.70
1500.00	15.00	25	1	8	250.00	11.51	-5.88	748.35	-102.41	334.07
1500.00	15.00	25	2	8	250.00	16.74	-13.56	747.97	-102.50	334.24
1500.00	15.00	25	3	8	250.00	-17.97	-15.07	746.27	-106.03	335.00
1500.00	15.00	25	4	7	250.00	18.22	-15.37	743.55	-111.05	336.22
1500.00	15.00	25	5	7	250.00	-19.30	-16.65	741.49	-108.89	337.16
1500.00	15.00	25	6	3	250.00	-21.89	-19.63	717.27	-114.88	348.54
1500.00	15.00	25	7	2	250.00	22.03	-19.78	713.95	-114.44	350.16

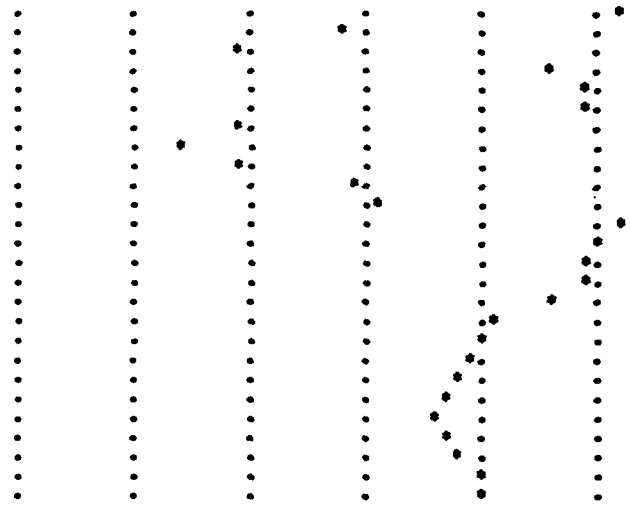
1500.00	15.00	26	1	9	260.00	-12.19	-7.12	779.26	-101.56	333.65
1500.00	15.00	26	2	9	260.00	-16.66	-13.46	779.04	-101.87	333.74
1500.00	15.00	26	3	8	260.00	17.74	-14.79	776.40	-104.49	334.88
1500.00	15.00	26	4	8	260.00	-18.24	-15.40	774.62	-111.08	335.65
1500.00	15.00	26	5	7	260.00	18.58	-15.80	771.84	-110.35	336.86
1500.00	15.00	26	6	3	260.00	-22.07	-19.83	744.92	-114.43	349.03
1500.00	15.00	27	1	9	270.00	-11.36	-5.56	808.46	-104.07	333.97
1500.00	15.00	27	2	9	270.00	12.62	-7.85	808.92	-99.08	333.78
1500.00	15.00	27	3	9	270.00	14.79	-11.04	808.90	-99.11	333.79
1500.00	15.00	27	4	9	270.00	-17.75	-14.80	807.47	-104.23	334.38
1500.00	15.00	27	5	8	270.00	17.95	-15.04	804.77	-106.95	335.50
1500.00	15.00	27	6	8	270.00	-18.61	-15.84	802.91	-110.35	336.28
1500.00	15.00	27	7	7	270.00	19.01	-16.30	800.06	-110.08	337.48
1500.00	15.00	28	1	9	280.00	11.44	-5.72	838.09	-103.63	334.09
1500.00	15.00	28	2	9	280.00	17.03	-13.92	837.56	-103.78	334.31
1500.00	15.00	28	3	9	280.00	-17.96	-15.05	835.84	-106.83	334.99
1500.00	15.00	28	4	8	280.00	18.16	-15.30	833.13	-112.20	336.08
1500.00	15.00	28	5	8	280.00	-19.05	-16.36	831.12	-110.09	336.89
1500.00	15.00	28	6	7	280.00	19.48	-16.86	828.20	-110.02	338.08

1500.00	15.00	29	1	10	290.00	-11.98	-6.75	868.99	-103.07	333.72
1500.00	15.00	29	2	10	290.00	-16.99	-13.87	868.63	-103.32	333.86
1500.00	15.00	29	3	9	290.00	17.75	-14.81	865.97	-105.49	334.89
1500.00	15.00	29	4	9	290.00	-18.18	-15.33	864.20	-112.23	335.57
1500.00	15.00	29	5	8	290.00	18.48	-15.68	861.42	-111.56	336.65
1500.00	15.00	29	6	8	290.00	-19.54	-16.93	859.25	-110.05	337.50
1500.00	15.00	30	1	10	300.00	-11.31	-5.45	898.20	-105.08	334.00
1500.00	15.00	30	2	10	300.00	12.24	-7.21	898.64	-101.61	333.84
1500.00	15.00	30	3	10	300.00	15.46	-11.92	898.54	-101.87	333.87
1500.00	15.00	30	4	10	300.00	-17.76	-14.81	897.04	-105.26	334.43
1500.00	15.00	30	5	9	300.00	17.94	-15.03	894.34	-107.70	335.44
1500.00	15.00	30	6	9	300.00	-18.51	-15.71	892.49	-111.56	336.14
1500.00	15.00	30	7	8	300.00	18.84	-16.11	889.67	-111.18	337.20
1500.00	15.00	31	1	10	310.00	11.37	-5.59	927.83	-104.71	334.11
1500.00	15.00	31	2	11	310.00	-13.24	-8.82	929.60	-98.47	333.48
1500.00	15.00	31	3	11	310.00	-14.95	-11.25	929.59	-98.86	333.48
1500.00	15.00	31	4	10	310.00	17.25	-14.19	927.14	-104.88	334.36
1500.00	15.00	31	5	10	310.00	-17.95	-15.04	925.41	-107.58	334.99
1500.00	15.00	31	6	9	310.00	18.13	-15.26	922.71	-112.40	335.97
1500.00	15.00	31	7	9	310.00	-18.88	-16.15	920.73	-111.20	336.69
1500.00	15.00	31	8	8	310.00	19.24	-16.58	917.85	-111.04	337.74
1500.00	15.00	31	9	3	310.00	21.70	-19.41	887.97	-117.81	349.11
1500.00	15.00	32	1	11	320.00	-11.84	-6.50	958.72	-104.23	333.78
1500.00	15.00	32	2	11	320.00	-17.25	-14.19	958.21	-104.55	333.95
1500.00	15.00	32	3	10	320.00	-18.14	-15.27	953.78	-112.92	335.51
1500.00	15.00	32	4	10	320.00	17.76	-14.82	955.53	-106.39	334.89
1500.00	15.00	32	5	9	320.00	18.40	-15.59	951.00	-112.63	336.49
1500.00	15.00	32	6	9	320.00	-19.29	-16.64	948.90	-111.07	337.23
1500.00	15.00	32	7	8	320.00	19.67	-17.09	945.97	-111.05	338.28
1500.00	15.00	32	8	4	320.00	-21.73	-19.45	918.94	-117.81	348.23
1500.00	15.00	32	9	3	320.00	21.84	-19.56	915.63	-117.44	349.49
1500.00	15.00	33	1	11	330.00	-11.27	-5.37	987.93	-106.00	334.03
1500.00	15.00	33	2	11	330.00	12.00	-6.79	988.36	-103.41	333.89
1500.00	15.00	33	3	11	330.00	15.90	-12.50	988.16	-103.54	333.95
1500.00	15.00	33	4	11	330.00	-17.77	-14.82	986.61	-106.18	334.48
1500.00	15.00	33	5	10	330.00	17.93	-15.02	983.91	-108.39	335.40
1500.00	15.00	33	6	10	330.00	-18.43	-15.61	982.07	-112.64	336.02
1500.00	15.00	33	7	9	330.00	18.70	-15.94	979.28	-112.16	336.98
1500.00	15.00	33	8	4	330.00	-21.87	-19.60	946.59	-117.44	348.62
1500.00	15.00	33	9	3	330.00	21.97	-19.71	943.28	-117.10	349.84
1500.00	15.00	34	1	11	340.00	11.32	-5.48	1017.57	-105.67	334.13
1500.00	15.00	34	2	12	340.00	-12.69	-7.97	1019.30	-102.07	333.56
1500.00	15.00	34	3	12	340.00	-15.67	-12.19	1019.22	-102.41	333.59
1500.00	15.00	34	4	11	340.00	17.43	-14.42	1016.72	-105.84	334.41
1500.00	15.00	34	5	11	340.00	-17.94	-15.03	1014.98	-108.28	334.98
1500.00	15.00	34	6	10	340.00	18.10	-15.23	1012.28	-112.21	335.88
1500.00	15.00	34	7	10	340.00	-18.73	-15.98	1010.34	-112.18	336.52
1500.00	15.00	34	8	9	340.00	19.06	-16.36	1007.48	-112.00	337.48
1500.00	15.00	34	9	4	340.00	-22.00	-19.75	974.24	-117.09	348.99
1500.00	15.00	34	10	3	340.00	22.10	-19.86	970.93	-116.78	350.18

1500.00	15.00	35	1	12	350.00	-11.72	-6.28	1048.45	-105.30	333.83
1500.00	15.00	35	2	12	350.00	-17.45	-14.43	1047.79	-105.58	334.04
1500.00	15.00	35	3	11	350.00	-18.11	-15.24	1043.35	-112.50	335.46
1500.00	15.00	35	4	11	350.00	17.77	-14.82	1045.10	-107.20	334.90
1500.00	15.00	35	5	10	350.00	18.34	-15.51	1040.58	-113.58	336.35
1500.00	15.00	35	6	10	350.00	-19.09	-16.41	1038.54	-112.01	337.01
1500.00	15.00	35	7	9	350.00	19.44	-16.81	1035.62	-111.96	337.96
1500.00	15.00	35	8	4	350.00	-22.13	-19.90	1001.89	-116.78	349.34
1500.00	15.00	36	1	12	360.00	-11.23	-5.29	1077.67	-106.84	334.05
1500.00	15.00	36	2	12	360.00	11.86	-6.53	1078.09	-104.59	333.92
1500.00	15.00	36	3	12	360.00	16.24	-12.93	1077.77	-104.84	334.02
1500.00	15.00	36	4	12	360.00	-17.77	-14.83	1076.17	-107.01	334.52
1500.00	15.00	36	5	11	360.00	17.92	-15.01	1073.47	-109.04	335.36
1500.00	15.00	36	6	11	360.00	-18.36	-15.53	1071.65	-113.60	335.93
1500.00	15.00	36	7	10	360.00	18.60	-15.83	1068.87	-113.09	336.80
1500.00	15.00	36	8	10	360.00	-19.49	-16.87	1066.67	-111.98	337.50
1500.00	15.00	37	1	12	370.00	11.28	-5.40	1107.31	-106.55	334.14
1500.00	15.00	37	2	13	370.00	-12.40	-7.49	1109.02	-103.80	333.63
1500.00	15.00	37	3	13	370.00	-16.10	-12.76	1108.84	-104.15	333.68
1500.00	15.00	37	4	12	370.00	17.59	-14.61	1106.30	-106.72	334.45
1500.00	15.00	37	5	12	370.00	-17.93	-15.02	1104.55	-108.93	334.98
1500.00	15.00	37	6	11	370.00	18.08	-15.20	1101.84	-112.27	335.80
1500.00	15.00	37	7	11	370.00	-18.62	-15.85	1099.94	-113.09	336.38
1500.00	15.00	37	8	10	370.00	18.91	-16.19	1097.09	-112.89	337.26
1500.00	15.00	38	1	13	380.00	-11.62	-6.09	1138.18	-106.30	333.87
1500.00	15.00	38	2	13	380.00	12.84	-8.20	1138.68	-100.87	333.72
1500.00	15.00	38	3	13	380.00	14.69	-10.89	1138.67	-101.46	333.72
1500.00	15.00	38	4	13	380.00	-17.61	-14.64	1137.37	-106.51	334.10
1500.00	15.00	38	5	12	380.00	-18.09	-15.21	1132.92	-112.43	335.42
1500.00	15.00	38	6	12	380.00	17.77	-14.83	1134.67	-107.95	334.90
1500.00	15.00	38	7	11	380.00	18.29	-15.45	1130.17	-114.45	336.23
1500.00	15.00	38	8	11	380.00	-18.95	-16.23	1128.15	-112.90	336.83
1500.00	15.00	38	9	10	380.00	19.24	-16.58	1125.27	-112.79	337.70
1500.00	15.00	39	1	13	390.00	-11.20	-5.23	1167.41	-107.61	334.87
1500.00	15.00	39	2	13	390.00	11.74	-6.30	1167.82	-105.68	333.96
1500.00	15.00	39	3	13	390.00	16.50	-13.27	1167.38	-105.90	334.08
1500.00	15.00	39	4	13	390.00	-17.78	-14.84	1165.74	-107.78	334.55
1500.00	15.00	39	5	12	390.00	17.92	-15.01	1163.04	-109.64	335.33
1500.00	15.00	39	6	12	390.00	-18.30	-15.47	1161.23	-114.47	335.85
1500.00	15.00	39	7	11	390.00	18.53	-15.74	1158.45	-113.99	336.66
1500.00	15.00	39	8	11	390.00	-19.29	-16.63	1156.32	-112.81	337.28
1500.00	15.00	39	9	10	390.00	19.60	-17.00	1153.39	-112.80	338.13
1500.00	15.00	39	10	4	390.00	21.72	-19.43	1117.30	-119.71	349.06
1500.00	15.00	40	1	13	400.00	11.25	-5.32	1197.04	-107.35	334.16
1500.00	15.00	40	2	14	400.00	-12.19	-7.13	1198.74	-105.11	333.69
1500.00	15.00	40	3	14	400.00	-16.42	-13.15	1198.45	-105.37	333.77
1500.00	15.00	40	4	13	400.00	-17.92	-15.01	1194.11	-109.54	334.98
1500.00	15.00	40	5	12	400.00	18.06	-15.18	1191.41	-112.45	335.74
1500.00	15.00	40	6	13	400.00	17.65	-14.68	1195.87	-107.49	334.48
1500.00	15.00	40	7	12	400.00	-18.54	-15.76	1189.52	-113.99	336.27
1500.00	15.00	40	8	11	400.00	18.79	-16.05	1186.70	-113.70	337.07
1500.00	15.00	40	9	11	400.00	-19.65	-17.06	1184.44	-112.81	337.71
1500.00	15.00	40	10	5	400.00	-21.74	-19.46	1148.26	-119.71	348.35
1500.00	15.00	40	11	4	400.00	21.83	-19.55	1144.95	-119.41	349.36

SOURCE ALTITUDE (ABOVE GROUND LEVEL)= 2000.00 M.
BEARING= 15.00

ALTITUDE (M)	WIND COMPONENT (M/SEC)	SOUND SPEED (M/SEC)	SUM (M/SEC)
148263.375	15.904	346.659	363.563
99224.187	16.904	298.229	315.132
84438.625	12.680	284.843	297.522
64671.031	45.488	306.370	352.857
59719.543	46.488	312.350	358.837
46629.133	38.037	320.504	358.541
35003.773	-5.177	303.908	298.731
23556.445	-0.872	288.983	288.111
17974.648	10.325	288.545	298.869
12986.770	27.577	290.155	317.732
11875.934	30.760	291.583	322.343
7520.562	50.556	314.420	364.976
5353.750	38.471	322.157	360.628
4687.277	34.550	323.622	358.171
3838.844	31.157	327.490	358.646
2947.318	22.884	329.431	352.316
1999.686	9.937	331.572	341.509
1873.724	8.433	331.857	340.290
1646.787	5.685	331.627	337.312
1499.823	4.215	331.022	335.237
1398.846	3.285	330.607	333.892
1148.896	1.638	330.864	332.502
999.921	2.117	331.535	333.652
781.952	2.622	332.519	335.141
84.999	4.678	335.865	340.543
0.000	4.096	336.288	340.384



ALL RAYS WITH SOURCE ANGLE GREATER THAN 0.0000 DEGREES STRIKE THE GROUND.

LIST OF CRITICAL ANGLES WITH FAN PARAMETERS.

1	0.0000	17.5203	0.5006	36
2	17.5203	2.8310	0.4718	7
3	20.3513	39.6487	0.5019	80

EIGENRAYS AT GROUND RECEIVERS FOR SOURCE HEIGHT= 2000.00 M TRACING TOWARD AZIMUTH 15.00

			NEIG	NREFL	RANGE(KM)	SANGLE	RANGLE	TIME(SEC)	LEVEL	CHMEAN
2000.00	15.00	1	1	0	10.00	-7.09	-8.51	30.27	-77.46	330.31
2000.00	15.00	2	1	0	20.00	11.10	-12.10	59.40	-82.26	336.73
2000.00	15.00	3	1	0	30.00	16.27	-17.03	87.74	-90.93	341.93
2000.00	15.00	4	1	1	40.00	-4.88	-6.75	119.99	-85.15	333.35
2000.00	15.00	4	2	1	40.00	-15.33	-16.13	119.69	-91.25	334.19
2000.00	15.00	5	1	1	50.00	13.18	-14.07	149.00	-89.34	335.57
2000.00	15.00	6	1	1	60.00	15.04	-15.84	177.37	-97.18	338.28
2000.00	15.00	7	1	2	70.00	-3.98	-6.12	209.73	-88.99	333.77
2000.00	15.00	7	2	2	70.00	-14.56	-15.39	209.29	-98.20	334.47
2000.00	15.00	7	3	0	70.00	18.60	-19.30	199.48	-106.55	350.92
2000.00	15.00	8	1	2	80.00	13.71	-14.57	238.58	-93.83	335.32
2000.00	15.00	8	2	1	80.00	-18.58	-19.28	231.49	-107.29	345.59
2000.00	15.00	8	3	0	80.00	19.11	-19.80	227.15	-103.92	352.19
2000.00	15.00	9	1	2	90.00	14.66	-15.48	266.96	-101.14	337.13
2000.00	15.00	9	2	1	90.00	-19.09	-19.79	259.16	-104.31	347.27
2000.00	15.00	10	1	3	100.00	-3.51	-5.82	299.46	-91.57	333.94
2000.00	15.00	10	2	3	100.00	-14.41	-15.24	298.87	-102.45	334.59
2000.00	15.00	10	3	2	100.00	16.00	-16.77	295.17	-100.58	338.78
2000.00	15.00	11	1	3	110.00	13.81	-14.66	328.16	-97.24	335.20
2000.00	15.00	11	2	3	110.00	-15.69	-16.47	327.13	-100.66	336.26
2000.00	15.00	12	1	4	120.00	-7.72	-9.05	360.05	-90.86	333.29
2000.00	15.00	12	2	4	120.00	-12.53	-13.45	360.02	-92.19	333.31
2000.00	15.00	12	3	3	120.00	14.52	-15.34	356.55	-104.16	336.56
2000.00	15.00	13	1	4	130.00	-3.22	-5.65	389.19	-93.51	334.02
2000.00	15.00	13	2	4	130.00	5.28	-7.05	389.21	-90.65	334.01
2000.00	15.00	13	3	4	130.00	10.28	-11.35	389.18	-92.61	334.03
2000.00	15.00	13	4	4	130.00	-14.33	-15.16	388.45	-105.34	334.66
2000.00	15.00	13	5	3	130.00	15.42	-16.21	384.81	-103.13	337.83
2000.00	15.00	14	1	4	140.00	13.87	-14.72	417.75	-99.88	335.13
2000.00	15.00	14	2	4	140.00	-15.16	-15.96	416.75	-103.30	335.93

2000.00	15.00	15	1	5	150.00	-6.31	-7.86	449.75	-94.02	333.51
2000.00	15.00	15	2	5	150.00	-13.62	-14.48	449.61	-96.16	333.62
2000.00	15.00	15	3	4	150.00	14.44	-15.27	446.13	-106.50	336.22
2000.00	15.00	15	4	4	150.00	-16.35	-17.11	444.90	-103.19	337.15
2000.00	15.00	15	5	1	150.00	18.71	-19.42	428.80	-111.78	349.81
2000.00	15.00	16	1	5	160.00	-3.02	-5.54	478.93	-95.08	334.08
2000.00	15.00	16	2	5	160.00	4.38	-6.39	478.94	-93.43	334.07
2000.00	15.00	16	3	5	160.00	11.64	-12.61	478.82	-96.33	334.16
2000.00	15.00	16	4	5	160.00	-14.29	-15.12	478.04	-107.53	334.70
2000.00	15.00	16	5	4	160.00	15.08	-15.89	474.43	-105.19	337.25
2000.00	15.00	16	6	2	160.00	-18.70	-19.41	460.81	-112.09	347.21
2000.00	15.00	16	7	1	160.00	18.95	-19.65	456.49	-110.32	350.50
2000.00	15.00	17	1	5	170.00	13.91	-14.76	507.33	-102.04	335.09
2000.00	15.00	17	2	5	170.00	-14.89	-15.70	506.35	-105.50	335.73
2000.00	15.00	17	3	4	170.00	15.94	-16.72	502.61	-105.04	338.23
2000.00	15.00	17	4	2	170.00	-18.94	-19.64	488.50	-110.56	348.01
2000.00	15.00	17	5	1	170.00	19.28	-19.97	484.11	-109.94	351.16
2000.00	15.00	18	1	6	180.00	-5.53	-7.24	539.47	-95.93	333.66
2000.00	15.00	18	2	6	180.00	-13.70	-14.56	539.19	-98.60	333.83
2000.00	15.00	18	3	5	180.00	14.38	-15.21	535.71	-108.38	336.00
2000.00	15.00	18	4	5	180.00	-15.76	-16.54	534.57	-105.08	336.72
2000.00	15.00	18	5	2	180.00	-19.27	-19.97	516.12	-110.12	348.75
2000.00	15.00	19	1	6	190.00	-2.87	-5.46	568.66	-96.39	334.12
2000.00	15.00	19	2	6	190.00	3.89	-6.07	568.67	-95.22	334.11
2000.00	15.00	19	3	6	190.00	12.43	-13.35	568.43	-98.62	334.26
2000.00	15.00	19	4	6	190.00	-14.26	-15.09	567.62	-109.29	334.73
2000.00	15.00	19	5	5	190.00	14.89	-15.70	564.02	-106.99	336.86
2000.00	15.00	20	1	6	200.00	13.93	-14.78	596.91	-103.86	335.06
2000.00	15.00	20	2	6	200.00	-14.72	-15.54	595.95	-107.29	335.60
2000.00	15.00	20	3	5	200.00	15.55	-16.34	592.25	-106.63	337.69
2000.00	15.00	21	1	7	210.00	-5.02	-6.85	629.20	-97.36	333.76
2000.00	15.00	21	2	7	210.00	-13.76	-14.62	628.78	-100.63	333.98
2000.00	15.00	21	3	6	210.00	14.35	-15.18	625.30	-109.94	335.84
2000.00	15.00	21	4	6	210.00	-15.39	-16.19	624.20	-106.73	336.43
2000.00	15.00	21	5	5	210.00	16.32	-17.08	620.38	-106.68	338.50
2000.00	15.00	22	1	7	220.00	-2.76	-5.40	658.40	-97.53	334.14
2000.00	15.00	22	2	7	220.00	3.58	-5.86	658.40	-96.62	334.14
2000.00	15.00	22	3	7	220.00	12.98	-13.87	658.02	-100.39	334.33
2000.00	15.00	22	4	7	220.00	-14.24	-15.07	657.20	-110.76	334.75
2000.00	15.00	22	5	6	220.00	14.74	-15.56	653.62	-108.49	336.59
2000.00	15.00	22	6	6	220.00	-16.17	-16.94	652.35	-106.68	337.24
2000.00	15.00	22	7	2	220.00	18.59	-19.30	630.44	-116.34	348.96
2000.00	15.00	23	1	7	230.00	-0.18	-4.63	687.66	-91.70	334.47
2000.00	15.00	23	2	7	230.00	0.13	-4.64	687.65	-91.80	334.47
2000.00	15.00	23	3	8	230.00	-7.99	-9.28	689.83	-94.64	333.42
2000.00	15.00	23	4	8	230.00	-11.03	-12.04	689.82	-95.53	333.42
2000.00	15.00	23	5	7	230.00	13.96	-14.80	686.49	-105.44	335.04
2000.00	15.00	23	6	7	230.00	-14.60	-15.42	685.54	-108.00	335.50
2000.00	15.00	23	7	6	230.00	15.29	-16.09	681.87	-108.05	337.31
2000.00	15.00	23	8	3	230.00	-18.58	-19.29	662.45	-116.59	347.20
2000.00	15.00	23	9	2	230.00	18.75	-19.45	658.13	-115.07	349.48

2000.00	15.00	24	1	8	240.00	-4.64	-6.58	718.92	-98.54	333.83
2000.00	15.00	24	2	8	240.00	6.59	-8.09	718.98	-95.03	333.81
2000.00	15.00	24	3	8	240.00	9.96	-11.05	718.97	-96.09	333.81
2000.00	15.00	24	4	8	240.00	-13.81	-14.66	718.36	-102.37	334.09
2000.00	15.00	24	5	7	240.00	14.32	-15.15	714.88	-111.27	335.72
2000.00	15.00	24	6	7	240.00	-15.14	-15.94	713.82	-108.15	336.22
2000.00	15.00	24	7	6	240.00	15.92	-16.69	710.04	-107.97	338.01
2000.00	15.00	24	8	3	240.00	-18.74	-19.45	690.14	-115.27	347.76
2000.00	15.00	24	9	2	240.00	18.91	-19.61	685.81	-114.09	349.95
2000.00	15.00	25	1	8	250.00	-2.67	-5.35	748.13	-98.53	334.16
2000.00	15.00	25	2	8	250.00	3.36	-5.73	748.13	-97.76	334.16
2000.00	15.00	25	3	8	250.00	13.38	-14.25	747.61	-101.82	334.40
2000.00	15.00	25	4	8	250.00	-14.22	-15.06	746.79	-112.02	334.77
2000.00	15.00	25	5	7	250.00	14.63	-15.46	743.22	-109.78	336.38
2000.00	15.00	25	6	7	250.00	-15.78	-16.56	742.00	-108.00	336.93
2000.00	15.00	25	7	3	250.00	-18.90	-19.60	717.82	-114.26	348.28
2000.00	15.00	25	8	2	250.00	19.10	-19.80	713.46	-113.60	350.41
2000.00	15.00	26	1	8	260.00	-0.43	-4.65	777.39	-94.29	334.45
2000.00	15.00	26	2	8	260.00	0.68	-4.68	777.38	-94.43	334.46
2000.00	15.00	26	3	9	260.00	-6.83	-8.30	779.53	-97.68	333.54
2000.00	15.00	26	4	9	260.00	-12.14	-13.08	779.44	-99.31	333.57
2000.00	15.00	26	5	8	260.00	13.97	-14.82	776.08	-106.82	335.02
2000.00	15.00	26	6	8	260.00	-14.54	-15.36	775.13	-110.23	335.43
2000.00	15.00	26	7	7	260.00	15.10	-15.90	771.49	-109.28	337.01
2000.00	15.00	26	8	7	260.00	-16.48	-17.24	770.10	-108.07	337.62
2000.00	15.00	26	9	3	260.00	-19.10	-19.79	745.47	-113.73	348.77
2000.00	15.00	26	10	2	260.00	19.34	-20.03	741.07	-113.46	350.84
2000.00	15.00	27	1	9	270.00	-4.36	-6.38	808.65	-99.54	333.89
2000.00	15.00	27	2	9	270.00	5.69	-7.36	808.69	-97.57	333.87
2000.00	15.00	27	3	9	270.00	11.07	-12.07	808.61	-99.49	333.90
2000.00	15.00	27	4	9	270.00	-13.84	-14.69	807.94	-103.89	334.18
2000.00	15.00	27	5	8	270.00	14.29	-15.13	804.46	-112.44	335.63
2000.00	15.00	27	6	8	270.00	-14.98	-15.79	803.42	-109.47	336.06
2000.00	15.00	27	7	7	270.00	15.62	-16.41	799.70	-109.12	337.63
2000.00	15.00	27	8	3	270.00	-19.33	-20.02	773.08	-113.58	349.25
2000.00	15.00	28	1	9	280.00	-2.60	-5.32	837.87	-99.43	334.18
2000.00	15.00	28	2	9	280.00	3.19	-5.63	837.87	-98.78	334.18
2000.00	15.00	28	3	9	280.00	13.63	-14.49	837.19	-103.08	334.45
2000.00	15.00	28	4	9	280.00	-14.21	-15.05	836.37	-113.12	334.78
2000.00	15.00	28	5	8	280.00	14.57	-15.39	832.80	-111.02	336.21
2000.00	15.00	28	6	8	280.00	-15.51	-16.29	831.64	-109.19	336.68
2000.00	15.00	28	7	7	280.00	16.20	-16.97	827.82	-109.16	338.24
2000.00	15.00	29	1	9	290.00	-0.63	-4.67	867.13	-96.91	334.44
2000.00	15.00	29	2	9	290.00	0.86	-4.71	867.11	-96.00	334.44
2000.00	15.00	29	3	10	290.00	-6.16	-7.74	869.24	-99.28	333.63
2000.00	15.00	29	4	10	290.00	-12.76	-13.67	869.05	-101.28	333.70
2000.00	15.00	29	5	9	290.00	13.99	-14.83	865.66	-108.05	335.01
2000.00	15.00	29	6	9	290.00	-14.49	-15.32	864.71	-111.48	335.37
2000.00	15.00	29	7	8	290.00	14.96	-15.77	861.09	-110.45	336.78
2000.00	15.00	29	8	8	290.00	-16.09	-16.86	859.79	-109.16	337.29
2000.00	15.00	29	9	3	290.00	18.53	-19.24	832.08	-119.47	348.52

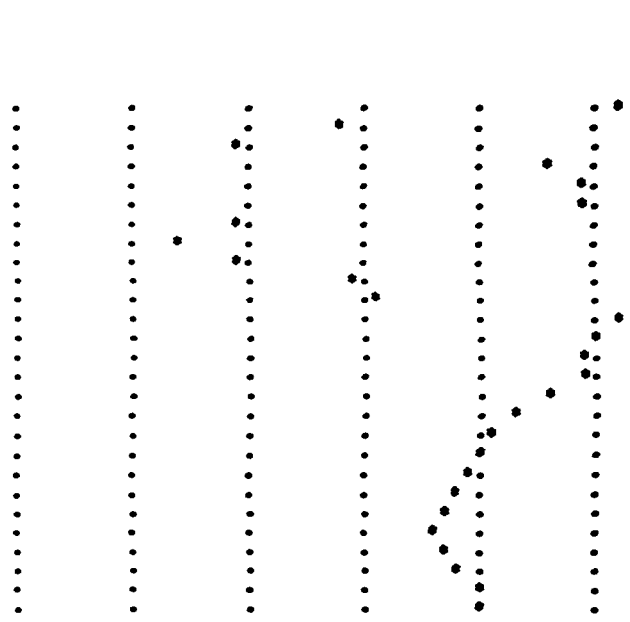
2000.00	15.00	30	1	10	300.00	-4.13	-6.22	898.38	-100.43	333.93
2000.00	15.00	30	2	10	300.00	5.15	-6.95	898.41	-99.05	333.92
2000.00	15.00	30	3	10	300.00	11.74	-12.71	898.24	-101.40	333.99
2000.00	15.00	30	4	10	300.00	-13.87	-14.72	897.52	-105.24	334.25
2000.00	15.00	30	5	9	300.00	14.28	-15.11	894.04	-113.47	335.55
2000.00	15.00	30	6	9	300.00	-14.85	-15.67	893.01	-110.63	335.94
2000.00	15.00	30	7	8	300.00	15.41	-16.20	889.32	-110.20	337.34
2000.00	15.00	30	8	4	300.00	-18.52	-19.23	864.09	-119.67	347.19
2000.00	15.00	30	9	3	300.00	18.65	-19.35	859.76	-118.35	348.93
2000.00	15.00	31	1	10	310.00	-2.54	-5.29	927.60	-100.22	334.19
2000.00	15.00	31	2	10	310.00	3.05	-5.56	927.60	-99.67	334.19
2000.00	15.00	31	3	10	310.00	13.67	-14.53	926.77	-104.26	334.49
2000.00	15.00	31	4	10	310.00	-14.20	-15.04	925.95	-114.10	334.79
2000.00	15.00	31	5	9	310.00	14.53	-15.35	922.39	-112.14	336.08
2000.00	15.00	31	6	9	310.00	-15.30	-16.10	921.26	-110.28	336.50
2000.00	15.00	31	7	8	310.00	15.90	-16.68	917.48	-110.15	337.88
2000.00	15.00	31	8	4	310.00	-18.64	-19.35	891.77	-118.52	347.62
2000.00	15.00	31	9	3	310.00	18.77	-19.47	887.45	-117.46	349.32
2000.00	15.00	32	1	10	320.00	-0.76	-4.69	956.86	-97.97	334.43
2000.00	15.00	32	2	10	320.00	1.00	-4.74	956.85	-97.36	334.43
2000.00	15.00	32	3	11	320.00	-5.69	-7.37	958.95	-100.43	333.70
2000.00	15.00	32	4	11	320.00	-13.20	-14.08	958.64	-102.77	333.81
2000.00	15.00	32	5	10	320.00	14.00	-14.84	955.24	-109.16	334.99
2000.00	15.00	32	6	10	320.00	-14.45	-15.28	954.29	-112.58	335.33
2000.00	15.00	32	7	9	320.00	14.85	-15.67	950.68	-111.48	336.60
2000.00	15.00	32	8	9	320.00	-15.80	-16.58	949.44	-110.18	337.04
2000.00	15.00	32	9	8	320.00	16.43	-17.19	945.57	-110.23	338.42
2000.00	15.00	32	10	4	320.00	-18.76	-19.47	919.46	-117.60	348.03
2000.00	15.00	32	11	3	320.00	18.89	-19.59	915.14	-116.72	349.67
2000.00	15.00	33	1	11	330.00	-3.94	-6.10	988.12	-101.21	333.97
2000.00	15.00	33	2	11	330.00	4.78	-6.67	988.14	-100.14	333.96
2000.00	15.00	33	3	11	330.00	12.24	-13.17	987.85	-102.84	334.06
2000.00	15.00	33	4	11	330.00	-13.89	-14.74	987.11	-106.45	334.31
2000.00	15.00	33	5	10	330.00	14.26	-15.10	983.63	-114.39	335.49
2000.00	15.00	33	6	10	330.00	-14.75	-15.57	982.61	-111.66	335.84
2000.00	15.00	33	7	9	330.00	15.24	-16.04	978.94	-111.17	337.10
2000.00	15.00	33	8	9	330.00	-16.34	-17.10	977.54	-110.23	337.58
2000.00	15.00	33	9	4	330.00	-18.89	-19.58	947.15	-116.85	348.42
2000.00	15.00	33	10	3	330.00	19.02	-19.71	942.81	-116.17	350.02

2000.00	15.00	34	1	11	340.00	-2.49	-5.27	1017.34	-100.95	334.20
2000.00	15.00	34	2	11	340.00	2.95	-5.50	1017.34	-100.45	334.21
2000.00	15.00	34	3	12	340.00	-8.14	-9.42	1019.61	-96.89	333.46
2000.00	15.00	34	4	12	340.00	-10.42	-11.48	1019.61	-97.36	333.46
2000.00	15.00	34	5	11	340.00	13.71	-14.57	1016.36	-105.34	334.53
2000.00	15.00	34	6	11	340.00	-14.19	-15.03	1015.53	-114.98	334.80
2000.00	15.00	34	7	10	340.00	14.49	-15.31	1011.97	-113.15	335.98
2000.00	15.00	34	8	10	340.00	-15.13	-15.94	1010.88	-111.25	336.34
2000.00	15.00	34	9	9	340.00	15.67	-16.45	1007.13	-111.06	337.59
2000.00	15.00	34	10	4	340.00	-19.01	-19.71	974.82	-116.27	348.78
2000.00	15.00	34	11	3	340.00	19.19	-19.88	970.42	-116.06	350.36
2000.00	15.00	35	1	11	350.00	-0.87	-4.71	1046.60	-98.94	334.42
2000.00	15.00	35	2	11	350.00	1.11	-4.76	1046.59	-98.54	334.42
2000.00	15.00	35	3	12	350.00	-5.34	-7.09	1048.68	-101.37	333.75
2000.00	15.00	35	4	12	350.00	7.15	-8.56	1048.75	-97.38	333.73
2000.00	15.00	35	5	12	350.00	9.77	-10.87	1048.75	-98.18	333.73
2000.00	15.00	35	6	12	350.00	-13.52	-14.39	1048.22	-103.97	333.90
2000.00	15.00	35	7	11	350.00	14.01	-14.85	1044.82	-110.16	334.98
2000.00	15.00	35	8	11	350.00	-14.42	-15.25	1043.87	-113.56	335.29
2000.00	15.00	35	9	10	350.00	14.76	-15.58	1040.28	-112.41	336.45
2000.00	15.00	35	10	10	350.00	-15.57	-16.36	1039.08	-111.10	336.84
2000.00	15.00	35	11	9	350.00	16.13	-16.90	1035.26	-111.08	338.08
2000.00	15.00	35	12	4	350.00	-19.19	-19.88	1002.43	-116.15	349.15

2000.00	15.00	36	1	12	360.00	-3.79	-6.00	1077.05	-101.93	334.00
2000.00	15.00	36	2	12	360.00	4.49	-6.47	1077.07	-101.06	333.99
2000.00	15.00	36	3	12	360.00	12.63	-13.54	1077.45	-104.05	334.12
2000.00	15.00	36	4	12	360.00	-13.91	-14.76	1076.69	-107.55	334.36
2000.00	15.00	36	5	11	360.00	14.25	-15.08	1073.21	-115.23	335.44
2000.00	15.00	36	6	11	360.00	-14.67	-15.49	1072.21	-112.58	335.76
2000.00	15.00	36	7	10	360.00	15.10	-15.90	1068.55	-112.05	336.90
2000.00	15.00	36	8	10	360.00	-16.04	-16.81	1067.22	-111.10	337.32
2000.00	15.00	37	1	12	370.00	-2.45	-5.25	1107.08	-101.62	334.21
2000.00	15.00	37	2	12	370.00	2.86	-5.45	1107.07	-101.18	334.21
2000.00	15.00	37	3	13	370.00	-7.12	-8.54	1109.30	-100.05	333.54
2000.00	15.00	37	4	13	370.00	-11.45	-12.43	1109.25	-101.30	333.56
2000.00	15.00	37	5	12	370.00	13.74	-14.60	1105.94	-106.33	334.56
2000.00	15.00	37	6	12	370.00	-14.18	-15.02	1105.12	-115.78	334.81
2000.00	15.00	37	7	11	370.00	14.46	-15.28	1101.55	-114.06	335.89
2000.00	15.00	37	8	11	370.00	-15.02	-15.82	1100.48	-112.19	336.22
2000.00	15.00	37	9	10	370.00	15.49	-16.28	1096.76	-111.93	337.36
2000.00	15.00	37	10	4	370.00	18.59	-19.29	1061.40	-120.83	348.59
2000.00	15.00	38	1	12	380.00	-0.96	-4.73	1136.33	-99.83	334.41
2000.00	15.00	38	2	12	380.00	1.19	-4.78	1136.32	-99.42	334.41
2000.00	15.00	38	3	13	380.00	-5.04	-6.87	1138.40	-102.19	333.80
2000.00	15.00	38	4	13	380.00	6.31	-7.86	1138.46	-99.98	333.78
2000.00	15.00	38	5	13	380.00	10.73	-11.76	1138.41	-101.52	333.80
2000.00	15.00	38	6	13	380.00	-13.64	-14.50	1137.80	-105.03	333.98
2000.00	15.00	38	7	12	380.00	14.01	-14.86	1134.41	-111.08	334.98
2000.00	15.00	38	8	12	380.00	-14.40	-15.23	1133.46	-114.45	335.26
2000.00	15.00	38	9	11	380.00	14.69	-15.51	1129.88	-113.26	336.32
2000.00	15.00	38	10	11	380.00	-15.40	-16.19	1128.70	-111.99	336.67
2000.00	15.00	38	11	10	380.00	15.89	-16.67	1124.91	-111.90	337.80
2000.00	15.00	38	12	5	380.00	-18.58	-19.29	1093.41	-120.98	347.54
2000.00	15.00	38	13	4	380.00	18.68	-19.39	1089.09	-120.02	348.92
2000.00	15.00	39	1	13	390.00	-3.65	-5.91	1167.58	-102.59	334.02
2000.00	15.00	39	2	13	390.00	4.26	-6.31	1167.60	-101.85	334.02
2000.00	15.00	39	3	13	390.00	12.93	-13.83	1167.04	-105.04	334.18
2000.00	15.00	39	4	13	390.00	-13.92	-14.77	1166.27	-108.55	334.40
2000.00	15.00	39	5	12	390.00	-14.61	-15.43	1161.80	-113.44	335.69
2000.00	15.00	39	6	12	390.00	14.24	-15.87	1162.79	-116.00	335.40
2000.00	15.00	39	7	11	390.00	15.00	-15.81	1158.15	-112.92	336.74
2000.00	15.00	39	8	11	390.00	-15.81	-16.59	1156.87	-111.92	337.12
2000.00	15.00	39	9	10	390.00	16.32	-17.08	1153.02	-111.95	338.24
2000.00	15.00	39	10	5	390.00	-18.68	-19.38	1121.18	-120.14	347.87
2000.00	15.00	39	11	4	390.00	18.78	-19.48	1116.77	-119.33	349.22
2000.00	15.00	40	1	13	400.00	-2.41	-5.23	1196.81	-102.25	334.22
2000.00	15.00	40	2	13	400.00	2.79	-5.41	1196.81	-101.84	334.22
2000.00	15.00	40	3	14	400.00	-6.54	-8.05	1199.81	-101.49	333.61
2000.00	15.00	40	4	14	400.00	-12.05	-12.99	1198.87	-103.18	333.65
2000.00	15.00	40	5	13	400.00	13.76	-14.62	1195.52	-107.24	334.58
2000.00	15.00	40	6	13	400.00	-14.18	-15.02	1194.70	-116.51	334.81
2000.00	15.00	40	7	12	400.00	14.43	-15.26	1191.13	-114.89	335.81
2000.00	15.00	40	8	12	400.00	-14.92	-15.73	1190.07	-113.05	336.11
2000.00	15.00	40	9	11	400.00	15.34	-16.13	1186.38	-112.73	337.16
2000.00	15.00	40	10	11	400.00	-16.25	-17.01	1184.99	-111.95	337.56
2000.00	15.00	40	11	5	400.00	-18.78	-19.48	1148.78	-119.45	348.19
2000.00	15.00	40	12	4	400.00	18.88	-19.58	1144.46	-118.74	349.51

SOURCE ALTITUDE (ABOVE GROUND LEVEL)= 2500.00 M.
BEARING= 15.00

ALTITUDE (M)	WIND COMPONENT (M/SEC)	SOUND SPEED (M/SEC)	SUM (M/SEC)
148263.375	16.904	346.659	363.563
99224.187	16.904	298.229	315.132
84438.625	12.680	284.843	297.522
64671.031	46.488	306.370	352.857
59719.543	46.488	312.350	358.837
46629.133	38.037	320.504	358.541
35003.773	-5.177	303.908	298.731
23556.445	-0.872	288.983	288.111
17974.648	10.325	288.545	298.869
12986.770	27.577	290.155	317.732
11875.934	30.760	291.583	322.343
7520.562	50.556	314.420	364.976
5353.750	38.471	322.157	360.628
4687.277	34.550	323.622	358.171
3838.844	31.157	327.490	358.646
2947.318	22.884	329.431	352.316
2499.510	16.474	330.443	346.917
1999.686	9.937	331.572	341.509
1873.724	8.433	331.857	340.290
1646.787	5.685	331.627	337.312
1499.823	4.215	331.022	335.237
1398.846	3.285	330.607	333.892
1148.896	1.638	330.864	332.502
999.921	2.117	331.535	333.652
781.952	2.622	332.519	335.141
84.999	4.678	335.865	340.543
0.000	4.096	336.288	340.384



ALL RAYS WITH SOURCE ANGLE GREATER THAN 0.0000 DEGREES STRIKE THE GROUND.

LIST OF CRITICAL ANGLES WITH FAN PARAMETERS.

1	0.0000	14.3379	0.4944	30
2	14.3379	3.3215	0.4745	8
3	17.6594	42.3406	0.4981	86

EIGENRAYS AT GROUND RECEIVERS FOR SOURCE HEIGHT= 2500.00 M TRACING TOWARD AZIMUTH 15.00

			NEIG	NREFL	RANGE(KM)	SANGLE	RANGLE	TIME(SEC)	LEVEL	CHMEAN
2500.00	15.00	1	1	0	10.00	-7.54	-13.45	30.46	-78.08	328.27
2500.00	15.00	2	1	0	20.00	9.69	-14.79	59.14	-84.66	338.17
2500.00	15.00	4	1	1	40.00	-3.46	-11.61	120.11	-84.39	333.02
2500.00	15.00	4	2	1	40.00	-10.42	-15.29	120.04	-91.26	333.21
2500.00	15.00	5	1	1	50.00	9.84	-14.89	148.74	-92.31	336.16
2500.00	15.00	6	1	1	60.00	11.79	-16.27	177.04	-95.88	338.92
2500.00	15.00	7	1	2	70.00	-0.55	-11.08	209.79	-87.94	333.67
2500.00	15.00	7	2	2	70.00	-10.19	-15.13	209.64	-98.12	333.91
2500.00	15.00	7	3	0	70.00	15.69	-19.36	199.04	-98.45	351.69
2500.00	15.00	8	1	2	80.00	9.89	-14.92	238.33	-96.78	335.67
2500.00	15.00	8	2	2	80.00	-12.99	-17.19	237.86	-96.11	336.33
2500.00	15.00	8	3	1	80.00	-15.52	-19.21	231.94	-97.40	344.92
2500.00	15.00	8	4	0	80.00	16.35	-19.91	226.70	-103.04	352.89
2500.00	15.00	9	1	2	90.00	11.10	-15.77	266.66	-99.57	337.51
2500.00	15.00	9	2	1	90.00	-16.09	-19.69	259.62	-103.81	346.66
2500.00	15.00	10	1	3	100.00	4.72	-12.06	299.46	-88.07	333.93
2500.00	15.00	10	2	3	100.00	-10.12	-15.08	299.23	-101.88	334.19
2500.00	15.00	10	3	2	100.00	12.87	-17.09	294.82	-99.63	339.18
2500.00	15.00	11	1	3	110.00	9.91	-14.94	327.93	-99.98	335.44
2500.00	15.00	11	2	3	110.00	-11.70	-16.21	327.52	-99.53	335.86
2500.00	15.00	12	1	3	120.00	10.78	-15.55	356.26	-102.34	336.83
2500.00	15.00	13	1	4	130.00	7.39	-13.36	389.11	-92.77	334.10
2500.00	15.00	13	2	4	130.00	-10.09	-15.06	388.83	-104.49	334.34
2500.00	15.00	13	3	3	130.00	12.03	-16.46	384.49	-101.97	338.11
2500.00	15.00	14	1	4	140.00	9.93	-14.95	417.52	-102.47	335.31
2500.00	15.00	14	2	4	140.00	-11.15	-15.80	417.14	-102.20	335.62
2500.00	15.00	14	3	1	140.00	15.53	-19.23	400.67	-102.17	349.41
2500.00	15.00	15	1	4	150.00	10.60	-15.41	445.86	-104.50	336.43
2500.00	15.00	15	2	4	150.00	-12.63	-16.91	445.32	-102.09	336.84
2500.00	15.00	15	3	2	150.00	-15.44	-19.15	433.57	-102.17	345.97
2500.00	15.00	15	4	1	150.00	15.76	-19.42	428.38	-107.27	350.15

2500.00	15.00	16	1	5	160.00	8.79	-14.20	478.73	-95.69	334.22
2500.00	15.00	16	2	5	160.00	-10.07	-15.05	478.42	-106.49	334.43
2500.00	15.00	16	3	4	160.00	11.55	-16.10	474.13	-103.92	337.46
2500.00	15.00	16	4	2	160.00	-15.68	-19.35	461.28	-105.53	346.86
2500.00	15.00	16	5	1	160.00	16.10	-19.70	456.04	-109.45	350.84
2500.00	15.00	17	1	5	170.00	9.94	-14.96	507.12	-104.51	335.23
2500.00	15.00	17	2	5	170.00	-10.85	-15.59	506.75	-104.36	335.47
2500.00	15.00	17	3	4	170.00	12.65	-16.93	502.28	-104.03	338.45
2500.00	15.00	17	4	2	170.00	-15.97	-19.59	488.96	-109.90	347.67
2500.00	15.00	17	5	1	170.00	16.49	-20.03	483.66	-109.18	351.49
2500.00	15.00	18	1	6	180.00	-2.80	-11.43	539.69	-92.78	333.52
2500.00	15.00	18	2	6	180.00	-9.52	-14.68	539.64	-94.42	333.55
2500.00	15.00	18	3	5	180.00	10.47	-15.33	535.46	-106.26	336.16
2500.00	15.00	18	4	5	180.00	-11.95	-16.40	534.98	-103.94	336.46
2500.00	15.00	18	5	2	180.00	-16.35	-19.91	516.60	-109.42	348.43
2500.00	15.00	19	1	6	190.00	9.51	-14.67	568.33	-97.80	334.31
2500.00	15.00	19	2	6	190.00	-10.06	-15.04	568.02	-108.12	334.50
2500.00	15.00	19	3	5	190.00	11.23	-15.87	563.75	-105.60	337.03
2500.00	15.00	19	4	5	190.00	-13.20	-17.35	563.08	-104.17	337.43
2500.00	15.00	20	1	6	200.00	9.95	-14.96	596.71	-106.23	335.17
2500.00	15.00	20	2	6	200.00	-10.67	-15.47	596.35	-106.15	335.37
2500.00	15.00	20	3	5	200.00	12.12	-16.53	591.95	-105.52	337.87
2500.00	15.00	21	1	7	210.00	-0.99	-11.12	629.37	-94.78	333.67
2500.00	15.00	21	2	7	210.00	-9.59	-14.72	629.24	-96.65	333.74
2500.00	15.00	21	3	6	210.00	10.41	-15.28	625.06	-107.83	335.97
2500.00	15.00	21	4	6	210.00	-11.53	-16.08	624.61	-105.57	336.21
2500.00	15.00	21	5	5	210.00	13.08	-17.26	620.05	-105.73	338.68
2500.00	15.00	21	6	2	210.00	15.48	-19.18	602.30	-105.23	348.66
2500.00	15.00	22	1	7	220.00	9.57	-14.71	657.93	-99.41	334.38
2500.00	15.00	22	2	7	220.00	-10.05	-15.03	657.61	-109.48	334.54
2500.00	15.00	22	3	6	220.00	11.01	-15.71	653.36	-107.03	336.72
2500.00	15.00	22	4	6	220.00	-12.52	-16.83	652.78	-105.59	337.02
2500.00	15.00	22	5	3	220.00	-15.42	-19.13	635.20	-105.30	346.35
2500.00	15.00	22	6	2	220.00	15.63	-19.31	630.01	-107.42	349.20
2500.00	15.00	23	1	7	230.00	9.95	-14.97	686.30	-107.72	335.13
2500.00	15.00	23	2	7	230.00	-10.55	-15.38	685.95	-107.63	335.30
2500.00	15.00	23	3	6	230.00	11.75	-16.25	681.59	-106.85	337.45
2500.00	15.00	23	4	3	230.00	-15.57	-19.26	662.91	-107.11	346.95
2500.00	15.00	23	5	2	230.00	15.79	-19.44	657.73	-112.06	349.69
2500.00	15.00	24	1	8	240.00	5.71	-12.49	719.04	-94.21	333.78
2500.00	15.00	24	2	8	240.00	-9.64	-14.76	718.83	-98.55	333.88
2500.00	15.00	24	3	7	240.00	10.36	-15.24	714.65	-109.18	335.83
2500.00	15.00	24	4	7	240.00	-11.25	-15.88	714.23	-107.00	336.03
2500.00	15.00	24	5	6	240.00	12.56	-16.85	709.74	-106.93	338.15
2500.00	15.00	24	6	3	240.00	-15.73	-19.39	690.62	-110.27	347.51
2500.00	15.00	24	7	2	240.00	16.02	-19.63	685.38	-113.14	350.17

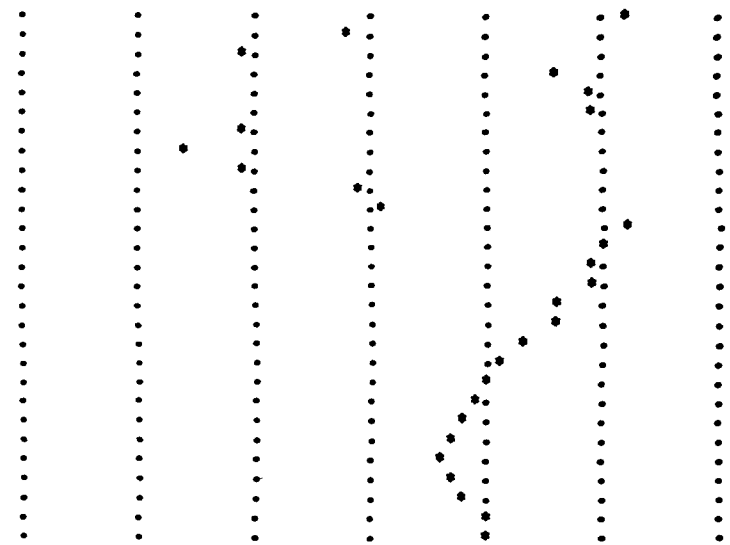
2500.00	15.00	25	1	8	250.00	9.62	-14.74	747.52	-100.84	334.44
2500.00	15.00	25	2	8	250.00	-10.04	-15.03	747.20	-110.66	334.58
2500.00	15.00	25	3	7	250.00	10.86	-15.60	742.97	-108.33	336.49
2500.00	15.00	25	4	7	250.00	-12.06	-16.48	742.44	-106.87	336.73
2500.00	15.00	25	5	3	250.00	-15.93	-19.56	718.30	-113.45	340.04
2500.00	15.00	25	6	2	250.00	16.26	-19.83	713.03	-112.79	350.62
2500.00	15.00	26	1	8	260.00	9.96	-14.97	775.90	-109.03	335.10
2500.00	15.00	26	2	8	260.00	-10.46	-15.32	775.55	-108.94	335.25
2500.00	15.00	26	3	7	260.00	11.48	-16.05	771.22	-108.03	337.13
2500.00	15.00	26	4	7	260.00	-12.93	-17.14	770.55	-107.02	337.42
2500.00	15.00	26	5	3	260.00	-16.18	-19.77	745.95	-113.07	348.55
2500.00	15.00	26	6	2	260.00	16.54	-20.07	740.62	-112.73	351.06
2500.00	15.00	27	1	9	270.00	7.35	-13.34	808.68	-97.79	333.88
2500.00	15.00	27	2	9	270.00	-9.68	-14.79	808.43	-100.19	333.98
2500.00	15.00	27	3	8	270.00	10.32	-15.22	804.25	-110.35	335.72
2500.00	15.00	27	4	8	270.00	-11.04	-15.73	803.85	-108.25	335.89
2500.00	15.00	27	5	7	270.00	12.17	-16.56	799.40	-108.03	337.75
2500.00	15.00	27	6	3	270.00	-16.45	-19.99	773.56	-112.89	349.04
2500.00	15.00	28	1	9	280.00	9.65	-14.77	837.11	-102.13	334.48
2500.00	15.00	28	2	9	280.00	-10.04	-15.02	836.80	-111.70	334.61
2500.00	15.00	28	3	8	280.00	10.75	-15.52	832.57	-109.48	336.31
2500.00	15.00	28	4	8	280.00	-11.73	-16.23	832.08	-108.04	336.51
2500.00	15.00	28	5	7	280.00	12.89	-17.11	827.51	-108.18	338.36
2500.00	15.00	28	6	3	280.00	15.45	-19.16	803.93	-107.53	348.29
2500.00	15.00	29	1	10	290.00	-4.75	-12.07	869.60	-92.37	333.49
2500.00	15.00	29	2	10	290.00	-7.07	-13.18	869.60	-93.32	333.49
2500.00	15.00	29	3	9	290.00	9.96	-14.97	865.49	-110.20	335.07
2500.00	15.00	29	4	9	290.00	-10.41	-15.28	865.14	-110.14	335.20
2500.00	15.00	29	5	8	290.00	11.28	-15.90	860.84	-109.12	336.88
2500.00	15.00	29	6	8	290.00	-12.47	-16.78	860.24	-108.08	337.12
2500.00	15.00	29	7	4	290.00	-15.41	-19.12	836.83	-107.60	346.55
2500.00	15.00	29	8	3	290.00	15.57	-19.26	831.64	-108.94	348.71

2500.00	15.00	30	1	10	300.00	8.31	-13.90	898.30	-99.88	333.96
2500.00	15.00	30	2	10	300.00	-9.72	-14.81	898.02	-101.65	334.07
2500.00	15.00	30	3	9	300.00	10.29	-15.20	893.84	-111.39	335.63
2500.00	15.00	30	4	9	300.00	-10.89	-15.62	893.45	-109.39	335.78
2500.00	15.00	30	5	8	300.00	11.87	-16.34	889.05	-109.03	337.44
2500.00	15.00	30	6	8	300.00	-13.24	-17.38	888.30	-108.27	337.72
2500.00	15.00	30	7	4	300.00	-15.52	-19.22	864.54	-108.85	347.00
2500.00	15.00	30	8	3	300.00	15.68	-19.35	859.36	-111.05	349.10
2500.00	15.00	31	1	10	310.00	9.69	-14.79	926.71	-103.29	334.52
2500.00	15.00	31	2	10	310.00	-10.03	-15.02	926.39	-112.63	334.63
2500.00	15.00	31	3	9	310.00	10.66	-15.46	922.17	-110.50	336.16
2500.00	15.00	31	4	9	310.00	-11.47	-16.04	921.71	-109.09	336.33
2500.00	15.00	31	5	8	310.00	12.51	-16.81	917.20	-109.11	337.99
2500.00	15.00	31	6	4	310.00	-15.64	-19.32	892.25	-110.60	347.43
2500.00	15.00	31	7	3	310.00	15.80	-19.45	887.07	-115.31	349.47
2500.00	15.00	32	1	11	320.00	-2.49	-11.35	959.27	-96.81	333.59
2500.00	15.00	32	2	11	320.00	-8.77	-14.19	959.23	-98.86	333.60
2500.00	15.00	32	3	10	320.00	9.97	-14.98	955.09	-111.25	335.05
2500.00	15.00	32	4	10	320.00	-10.37	-15.25	954.74	-111.20	335.17
2500.00	15.00	32	5	9	320.00	11.12	-15.79	950.45	-110.10	336.68
2500.00	15.00	32	6	9	320.00	-12.12	-16.52	949.89	-109.06	336.88
2500.00	15.00	32	7	8	320.00	13.16	-17.32	945.27	-109.28	338.53
2500.00	15.00	32	8	4	320.00	-15.76	-19.41	919.97	-113.59	347.84
2500.00	15.00	32	9	3	320.00	15.98	-19.60	914.72	-115.72	349.83
2500.00	15.00	33	1	11	330.00	9.00	-14.33	987.91	-101.45	334.04
2500.00	15.00	33	2	11	330.00	-9.74	-14.82	987.61	-102.95	334.14
2500.00	15.00	33	3	10	330.00	10.26	-15.18	983.44	-112.32	335.56
2500.00	15.00	33	4	10	330.00	-10.78	-15.55	983.05	-110.43	335.69
2500.00	15.00	33	5	9	330.00	11.64	-16.17	978.69	-109.96	337.19
2500.00	15.00	33	6	9	330.00	-12.79	-17.03	978.01	-109.18	337.42
2500.00	15.00	33	7	4	330.00	-15.91	-19.54	947.64	-115.95	348.23
2500.00	15.00	33	8	3	330.00	16.16	-19.75	942.37	-115.45	350.18
2500.00	15.00	34	1	11	340.00	9.71	-14.80	1016.30	-104.35	334.55
2500.00	15.00	34	2	11	340.00	-10.03	-15.02	1015.99	-113.47	334.65
2500.00	15.00	34	3	10	340.00	10.58	-15.40	1011.77	-111.42	336.04
2500.00	15.00	34	4	10	340.00	-11.29	-15.91	1011.32	-110.08	336.19
2500.00	15.00	34	5	9	340.00	12.20	-16.58	1006.86	-109.98	337.68
2500.00	15.00	34	6	4	340.00	15.34	-19.07	977.85	-108.52	347.70
2500.00	15.00	34	7	4	340.00	-16.10	-19.70	975.29	-115.67	348.61
2500.00	15.00	34	8	3	340.00	16.35	-19.91	970.00	-115.27	350.52
2500.00	15.00	35	1	12	350.00	-1.19	-11.14	1048.95	-98.33	333.67
2500.00	15.00	35	2	12	350.00	-9.50	-14.66	1048.83	-100.98	333.71
2500.00	15.00	35	3	11	350.00	9.97	-14.98	1044.68	-112.21	335.03
2500.00	15.00	35	4	11	350.00	-10.33	-15.23	1044.33	-112.15	335.14
2500.00	15.00	35	5	10	350.00	10.99	-15.69	1040.07	-110.98	336.52
2500.00	15.00	35	6	10	350.00	-11.84	-16.32	1039.54	-109.97	336.69
2500.00	15.00	35	7	9	350.00	12.78	-17.12	1034.97	-110.09	338.17
2500.00	15.00	35	8	4	350.00	15.43	-19.15	1005.56	-109.36	348.06
2500.00	15.00	35	9	4	350.00	-16.28	-19.85	1002.94	-115.40	348.98
2500.00	15.00	35	10	3	350.00	16.56	-20.09	997.58	-115.24	350.85

2500.00	15.00	36	1	12	360.00	-9.76	-14.84	1077.21	-104.12	334.20
2500.00	15.00	36	2	12	360.00	9.50	-14.66	1077.52	-102.70	334.10
2500.00	15.00	36	3	11	360.00	10.24	-15.16	1073.03	-113.17	335.50
2500.00	15.00	36	4	11	360.00	-10.69	-15.48	1072.66	-111.36	335.62
2500.00	15.00	36	5	10	360.00	11.45	-16.03	1068.32	-110.81	336.98
2500.00	15.00	36	6	10	360.00	-12.44	-16.76	1067.69	-110.01	337.18
2500.00	15.00	36	7	5	360.00	-15.40	-19.12	1038.46	-109.43	346.67
2500.00	15.00	36	8	4	360.00	15.53	-19.22	1033.28	-110.40	348.41
2500.00	15.00	36	9	4	360.00	-16.50	-20.03	1030.52	-115.36	349.34
2500.00	15.00	37	1	12	370.00	9.73	-14.82	1105.90	-105.33	334.57
2500.00	15.00	37	2	12	370.00	-10.03	-15.02	1105.58	-114.23	334.67
2500.00	15.00	37	3	11	370.00	10.52	-15.36	1101.37	-112.25	335.94
2500.00	15.00	37	4	11	370.00	-11.13	-15.80	1100.94	-110.97	336.08
2500.00	15.00	37	5	10	370.00	11.95	-16.39	1096.51	-110.78	337.43
2500.00	15.00	37	6	10	370.00	-13.05	-17.23	1095.77	-110.16	337.66
2500.00	15.00	37	7	5	370.00	-15.49	-19.19	1066.17	-110.38	347.04
2500.00	15.00	37	8	4	370.00	15.62	-19.30	1060.99	-111.78	348.73
2500.00	15.00	38	1	13	380.00	-0.21	-11.07	1138.63	-99.70	333.73
2500.00	15.00	38	2	13	380.00	0.29	-11.08	1138.63	-97.32	333.74
2500.00	15.00	38	3	13	380.00	6.20	-12.73	1138.61	-98.24	333.74
2500.00	15.00	38	4	13	380.00	-9.54	-14.69	1138.42	-102.07	333.79
2500.00	15.00	38	5	12	380.00	9.97	-14.98	1134.28	-113.08	335.02
2500.00	15.00	38	6	12	380.00	-10.31	-15.21	1133.93	-113.01	335.12
2500.00	15.00	38	7	11	380.00	10.89	-15.62	1129.67	-111.84	336.38
2500.00	15.00	38	8	11	380.00	-11.63	-16.15	1129.17	-110.82	336.53
2500.00	15.00	38	9	10	380.00	12.47	-16.79	1124.66	-110.84	337.88
2500.00	15.00	38	10	5	380.00	-15.59	-19.27	1093.89	-111.60	347.39
2500.00	15.00	38	11	4	380.00	15.72	-19.38	1088.70	-113.81	349.04
2500.00	15.00	39	1	13	390.00	-9.78	-14.85	1166.80	-105.20	334.25
2500.00	15.00	39	2	13	390.00	9.53	-14.68	1167.11	-103.62	334.16
2500.00	15.00	39	3	12	390.00	10.22	-15.15	1162.62	-113.94	335.45
2500.00	15.00	39	4	12	390.00	-10.62	-15.43	1162.26	-112.20	335.55
2500.00	15.00	39	5	11	390.00	11.30	-15.92	1157.93	-111.62	336.81
2500.00	15.00	39	6	11	390.00	-12.15	-16.55	1157.35	-110.81	336.98
2500.00	15.00	39	7	10	390.00	13.01	-17.20	1152.74	-110.97	338.33
2500.00	15.00	39	8	5	390.00	-15.68	-19.35	1121.60	-113.30	347.72
2500.00	15.00	39	9	4	390.00	15.81	-19.46	1116.41	-117.75	349.33
2500.00	15.00	40	1	13	400.00	9.75	-14.83	1195.49	-106.24	334.59
2500.00	15.00	40	2	13	400.00	-10.03	-15.02	1195.18	-114.94	334.68
2500.00	15.00	40	3	12	400.00	10.47	-15.32	1190.97	-113.03	335.86
2500.00	15.00	40	4	12	400.00	-11.01	-15.70	1190.55	-111.78	335.98
2500.00	15.00	40	5	11	400.00	11.75	-16.25	1186.15	-111.54	337.23
2500.00	15.00	40	6	11	400.00	-12.70	-16.97	1185.46	-110.90	337.42
2500.00	15.00	40	7	5	400.00	-15.77	-19.43	1149.31	-116.13	348.04
2500.00	15.00	40	8	4	400.00	15.95	-19.58	1144.06	-117.71	349.63

SOURCE ALTITUDE (ABOVE GROUND LEVEL)= 3000.00 M.
BEARING= 15.00

ALTITUDE (M)	WIND COMPONENT (M/SEC)	SOUND SPEED (M/SEC)	SUM (M/SEC)
148263.375	16.904	346.659	363.563
99224.187	16.904	298.229	315.132
84438.625	12.680	284.843	297.522
64671.031	46.488	306.370	352.857
59719.543	46.488	312.350	358.837
46629.133	38.037	320.504	358.541
35003.773	-5.177	303.908	298.731
23556.445	-0.872	288.983	288.111
17974.648	10.325	288.545	298.869
12986.770	27.577	290.155	317.732
11875.934	30.760	291.583	322.343
7520.562	50.556	314.420	364.976
5353.750	38.471	322.157	360.628
4687.277	34.550	323.622	358.171
3838.844	31.157	327.490	358.646
2999.294	23.343	329.318	352.661
2947.318	22.884	329.431	352.316
2499.510	16.474	330.443	346.917
1999.686	9.937	331.572	341.509
1873.724	8.433	331.857	340.290
1646.787	5.685	331.627	337.312
1499.823	4.215	331.022	335.237
1398.846	3.285	330.607	333.892
1148.896	1.638	330.864	332.502
999.921	2.117	331.535	333.652
781.952	2.622	332.519	335.141
84.999	4.678	335.865	340.543
0.000	4.096	336.288	340.384



ALL RAYS WITH SOURCE ANGLE GREATER THAN 0.0000 DEGREES STRIKE THE GROUND.

LIST OF CRITICAL ANGLES WITH FAN PARAMETERS.

1	0.0000	10.1275	0.5064	21
2	10.1275	4.2919	0.4769	10
3	14.4194	45.5806	0.5009	92

3000.00	15.00	18	1	5	180.00	3.59	-15.51	535.25	-101.26	336.29
3000.00	15.00	18	2	5	180.00	-5.53	-16.09	535.20	-100.39	336.32
3000.00	15.00	18	3	2	180.00	-12.70	-19.85	516.98	-108.38	348.18
3000.00	15.00	19	1	5	190.00	5.48	-16.07	563.50	-102.35	337.18
3000.00	15.00	19	2	5	190.00	-7.90	-17.08	563.34	-101.72	337.27
3000.00	15.00	19	3	2	190.00	-13.25	-20.21	544.56	-108.35	348.90
3000.00	15.00	20	1	6	200.00	0.37	-15.08	596.51	-96.64	335.28
3000.00	15.00	20	2	6	200.00	-1.68	-15.17	596.51	-97.21	335.28
3000.00	15.00	20	3	5	200.00	7.16	-16.73	591.68	-103.19	338.02
3000.00	15.00	20	4	2	200.00	11.38	-19.00	574.24	-102.38	348.28
3000.00	15.00	20	5	2	200.00	11.63	-19.15	574.23	-100.61	348.29
3000.00	15.00	21	1	6	210.00	3.20	-15.42	624.84	-102.27	336.08
3000.00	15.00	21	2	6	210.00	-4.72	-15.82	624.81	-101.52	336.10
3000.00	15.00	21	3	5	210.00	8.69	-17.47	619.74	-103.95	338.85
3000.00	15.00	21	4	2	210.00	11.79	-19.25	601.95	-102.35	348.87
3000.00	15.00	22	1	6	220.00	4.92	-15.88	653.12	-103.37	336.84
3000.00	15.00	22	2	6	220.00	-6.82	-16.59	653.02	-102.75	336.90
3000.00	15.00	22	3	3	220.00	-11.15	-18.86	635.58	-106.95	346.14
3000.00	15.00	22	4	3	220.00	-11.66	-19.17	635.56	-102.29	346.15
3000.00	15.00	22	5	2	220.00	11.95	-19.36	629.66	-105.27	349.39
3000.00	15.00	23	1	7	230.00	-0.40	-15.08	686.10	-90.37	335.23
3000.00	15.00	23	2	7	230.00	-1.02	-15.11	686.10	-93.24	335.23
3000.00	15.00	23	3	6	230.00	6.43	-16.43	681.33	-104.15	337.58
3000.00	15.00	23	4	6	230.00	-8.62	-17.43	681.10	-103.71	337.69
3000.00	15.00	23	5	3	230.00	-11.82	-19.28	663.27	-104.15	346.76
3000.00	15.00	23	6	2	230.00	12.13	-19.47	657.36	-112.24	349.88
3000.00	15.00	24	1	7	240.00	2.88	-15.35	714.44	-103.11	335.93
3000.00	15.00	24	2	7	240.00	-4.12	-15.64	714.42	-102.48	335.94
3000.00	15.00	24	3	6	240.00	7.81	-17.04	709.45	-104.84	338.29
3000.00	15.00	24	4	3	240.00	-11.98	-19.38	690.99	-107.47	347.33
3000.00	15.00	24	5	2	240.00	12.43	-19.67	685.02	-111.85	350.35
3000.00	15.00	25	1	7	250.00	4.47	-15.74	742.73	-104.26	336.60
3000.00	15.00	25	2	7	250.00	-6.01	-16.26	742.66	-103.67	336.63
3000.00	15.00	25	3	6	250.00	9.10	-17.68	737.48	-105.48	338.99
3000.00	15.00	25	4	3	250.00	-12.20	-19.52	718.68	-112.37	347.86
3000.00	15.00	25	5	2	250.00	12.75	-19.88	712.65	-111.67	350.80
3000.00	15.00	26	1	7	260.00	5.85	-16.20	770.96	-105.01	337.24
3000.00	15.00	26	2	7	260.00	-7.63	-16.95	770.88	-104.55	337.31
3000.00	15.00	26	3	3	260.00	-12.51	-19.72	746.34	-111.95	348.37
3000.00	15.00	26	4	2	260.00	13.10	-20.11	740.24	-111.65	351.24
3000.00	15.00	27	1	8	270.00	2.61	-15.30	804.03	-103.86	335.81
3000.00	15.00	27	2	8	270.00	-3.65	-15.52	804.02	-103.30	335.81
3000.00	15.00	27	3	7	270.00	7.12	-16.72	799.12	-105.65	337.87
3000.00	15.00	27	4	7	270.00	-9.10	-17.68	798.83	-105.32	337.99
3000.00	15.00	27	5	3	270.00	11.35	-18.98	775.88	-105.40	347.99
3000.00	15.00	27	6	3	270.00	11.63	-19.16	775.87	-103.34	348.00
3000.00	15.00	27	7	3	270.00	-12.85	-19.95	773.95	-111.83	348.86

EIGENRAYS AT GROUND RECEIVERS FOR SOURCE HEIGHT= 3000.00 M TRACING TOWARD AZIMUTH 15.00

			NEIG	NREFL	RANGE(KM)	SANGLE	RANGLE	TIME(SEC)	LEVEL	CHMEAN
3000.00	15.00	2	1	0	20.00	4.06	-15.63	58.96	-86.08	339.23
3000.00	15.00	5	1	1	50.00	2.81	-15.34	148.55	-91.48	336.58
3000.00	15.00	6	1	1	60.00	7.40	-16.85	176.78	-93.87	339.41
3000.00	15.00	7	1	0	70.00	12.07	-19.43	198.68	-100.90	352.32
3000.00	15.00	8	1	2	80.00	2.13	-15.22	238.15	-94.24	335.93
3000.00	15.00	8	2	2	80.00	-6.31	-16.38	238.12	-92.41	335.97
3000.00	15.00	8	3	1	80.00	-11.69	-19.19	232.30	-94.21	344.39
3000.00	15.00	8	4	0	80.00	13.00	-20.04	226.32	-101.90	353.49
3000.00	15.00	9	1	2	90.00	5.76	-16.17	266.42	-96.56	337.81
3000.00	15.00	9	2	1	90.00	-12.28	-19.57	260.00	-102.92	346.16
3000.00	15.00	10	1	2	100.00	8.72	-17.48	294.53	-97.99	339.52
3000.00	15.00	10	2	1	100.00	-13.34	-20.27	287.60	-102.44	347.70
3000.00	15.00	11	1	3	110.00	1.65	-15.16	327.74	-95.89	335.64
3000.00	15.00	11	2	3	110.00	-4.14	-15.65	327.73	-94.70	335.64
3000.00	15.00	12	1	3	120.00	4.77	-15.83	356.04	-98.51	337.04
3000.00	15.00	12	2	3	120.00	-8.57	-17.41	355.89	-97.52	337.19
3000.00	15.00	13	1	3	130.00	7.22	-16.76	384.23	-99.74	338.34
3000.00	15.00	13	2	1	130.00	11.44	-19.04	372.61	-97.82	348.89
3000.00	15.00	13	3	1	130.00	11.62	-19.15	372.60	-96.63	348.90
3000.00	15.00	14	1	4	140.00	1.25	-15.13	417.33	-96.73	335.47
3000.00	15.00	14	2	4	140.00	-3.01	-15.38	417.33	-96.21	335.47
3000.00	15.00	14	3	1	140.00	11.86	-19.30	400.31	-99.52	349.72
3000.00	15.00	15	1	4	150.00	4.09	-15.63	445.64	-100.03	336.59
3000.00	15.00	15	2	4	150.00	-6.71	-16.54	445.57	-99.07	336.65
3000.00	15.00	15	3	2	150.00	-11.67	-19.18	433.93	-99.15	345.68
3000.00	15.00	15	4	1	150.00	12.11	-19.46	428.02	-108.68	350.45
3000.00	15.00	16	1	4	160.00	6.22	-16.34	473.88	-101.16	337.64
3000.00	15.00	16	2	2	160.00	-11.91	-19.33	461.64	-102.43	346.59
3000.00	15.00	16	3	1	160.00	12.56	-19.75	455.68	-108.11	351.12
3000.00	15.00	17	1	5	170.00	0.86	-15.10	506.92	-96.63	335.36
3000.00	15.00	17	2	5	170.00	-2.27	-15.25	506.92	-97.07	335.36
3000.00	15.00	17	3	4	170.00	8.10	-17.17	501.99	-102.09	338.65
3000.00	15.00	17	4	2	170.00	-12.22	-19.53	489.34	-108.88	347.41
3000.00	15.00	17	5	1	170.00	13.07	-20.09	483.28	-108.07	351.76

3000.00	15.00	28	1	8	280.00	4.10	-15.64	832.33	-105.04	336.40
3000.00	15.00	28	2	8	280.00	-5.38	-16.03	832.28	-104.49	336.42
3000.00	15.00	28	3	7	280.00	8.30	-17.27	827.21	-106.23	338.49
3000.00	15.00	28	4	3	280.00	11.75	-19.23	803.58	-104.58	348.44
3000.00	15.00	28	5	3	280.00	-13.22	-20.19	801.52	-111.83	349.33
3000.00	15.00	29	1	8	290.00	5.38	-16.03	860.59	-105.77	336.98
3000.00	15.00	29	2	8	290.00	-6.86	-16.61	860.46	-105.32	337.03
3000.00	15.00	29	3	4	290.00	-11.18	-18.87	837.22	-108.81	346.39
3000.00	15.00	29	4	4	290.00	-11.66	-19.17	837.19	-104.59	346.40
3000.00	15.00	29	5	3	290.00	11.87	-19.31	831.29	-106.32	348.85
3000.00	15.00	30	1	9	300.00	2.37	-15.26	893.62	-104.44	335.71
3000.00	15.00	30	2	9	300.00	-3.26	-15.43	893.62	-103.99	335.71
3000.00	15.00	30	3	8	300.00	6.55	-16.48	888.78	-106.38	337.54
3000.00	15.00	30	4	8	300.00	-8.21	-17.23	888.56	-106.03	337.63
3000.00	15.00	30	5	4	300.00	-11.78	-19.25	864.91	-105.89	346.86
3000.00	15.00	30	6	3	300.00	11.99	-19.38	859.01	-109.28	349.24
3000.00	15.00	31	1	9	310.00	3.78	-15.55	921.93	-105.74	336.25
3000.00	15.00	31	2	9	310.00	-4.87	-15.87	921.90	-105.22	336.26
3000.00	15.00	31	3	8	310.00	7.65	-16.96	916.90	-106.92	338.09
3000.00	15.00	31	4	4	310.00	-11.90	-19.32	892.62	-107.77	347.29
3000.00	15.00	31	5	3	310.00	12.14	-19.48	886.70	-114.76	349.61
3000.00	15.00	32	1	9	320.00	4.98	-15.90	950.20	-106.46	336.77
3000.00	15.00	32	2	9	320.00	-6.25	-16.35	950.11	-106.02	336.80
3000.00	15.00	32	3	8	320.00	8.68	-17.46	944.95	-107.44	338.64
3000.00	15.00	32	4	4	320.00	-12.02	-19.40	920.33	-111.13	347.70
3000.00	15.00	32	5	3	320.00	12.36	-19.62	914.36	-114.46	349.97
3000.00	15.00	33	1	10	330.00	2.17	-15.23	983.21	-104.99	335.63
3000.00	15.00	33	2	10	330.00	-2.94	-15.37	983.21	-104.58	335.63
3000.00	15.00	33	3	9	330.00	6.08	-16.29	978.42	-107.04	337.28
3000.00	15.00	33	4	9	330.00	-7.49	-16.88	978.25	-106.68	337.34
3000.00	15.00	33	5	4	330.00	-12.19	-19.51	948.02	-114.86	348.09
3000.00	15.00	33	6	3	330.00	12.59	-19.77	942.01	-114.21	350.31
3000.00	15.00	34	1	10	340.00	3.52	-15.49	1011.53	-106.36	336.12
3000.00	15.00	34	2	10	340.00	-4.46	-15.74	1011.50	-105.89	336.13
3000.00	15.00	34	3	9	340.00	7.10	-16.71	1006.57	-107.56	337.78
3000.00	15.00	34	4	9	340.00	-8.63	-17.44	1006.30	-107.28	337.87
3000.00	15.00	34	5	4	340.00	11.33	-18.97	977.52	-107.66	347.82
3000.00	15.00	34	6	4	340.00	11.64	-19.16	977.50	-105.41	347.83
3000.00	15.00	34	7	4	340.00	-12.42	-19.66	975.68	-114.54	348.48
3000.00	15.00	34	8	3	340.00	12.85	-19.95	969.61	-114.18	350.66
3000.00	15.00	35	1	10	350.00	4.65	-15.79	1039.81	-107.10	336.60
3000.00	15.00	35	2	10	350.00	-5.74	-16.16	1039.74	-106.67	336.62
3000.00	15.00	35	3	9	350.00	8.06	-17.15	1034.66	-108.04	338.27
3000.00	15.00	35	4	4	350.00	11.73	-19.22	1005.21	-106.37	348.19
3000.00	15.00	35	5	4	350.00	-12.66	-19.82	1003.31	-114.34	348.85
3000.00	15.00	35	6	3	350.00	13.12	-20.12	997.20	-114.17	350.98

3000.00	15.00	36	1	11	360.00	1.98	-15.21	1072.81	-105.38	335.57
3000.00	15.00	36	2	11	360.00	-2.68	-15.31	1072.81	-105.12	335.57
3000.00	15.00	36	3	10	360.00	5.67	-16.14	1068.05	-107.66	337.06
3000.00	15.00	36	4	10	360.00	-6.89	-16.62	1067.91	-107.30	337.11
3000.00	15.00	36	5	9	360.00	8.97	-17.62	1062.69	-108.50	338.76
3000.00	15.00	36	6	5	360.00	-11.19	-18.88	1038.85	-110.38	346.54
3000.00	15.00	36	7	5	360.00	-11.65	-19.17	1038.83	-106.41	346.55
3000.00	15.00	36	8	4	360.00	11.83	-19.28	1032.92	-107.62	348.52
3000.00	15.00	36	9	4	360.00	-12.93	-20.00	1030.91	-114.30	349.21
3000.00	15.00	36	10	3	360.00	13.39	-20.31	1024.75	-114.23	351.31
3000.00	15.00	37	1	11	370.00	3.28	-15.44	1101.13	-106.92	336.02
3000.00	15.00	37	2	11	370.00	-4.11	-15.64	1101.11	-106.50	336.03
3000.00	15.00	37	3	10	370.00	6.63	-16.51	1096.23	-108.15	337.52
3000.00	15.00	37	4	10	370.00	-7.96	-17.11	1096.01	-107.86	337.59
3000.00	15.00	37	5	5	370.00	-11.75	-19.23	1066.54	-107.41	346.92
3000.00	15.00	37	6	4	370.00	11.92	-19.34	1060.64	-109.37	348.85
3000.00	15.00	37	7	4	370.00	-13.20	-20.18	1058.48	-114.31	349.56
3000.00	15.00	38	1	11	380.00	4.35	-15.71	1129.42	-107.66	336.46
3000.00	15.00	38	2	11	380.00	-5.31	-16.01	1129.36	-107.26	336.47
3000.00	15.00	38	3	10	380.00	7.53	-16.91	1124.35	-108.60	337.97
3000.00	15.00	38	4	10	380.00	-8.96	-17.61	1124.04	-108.38	338.07
3000.00	15.00	38	5	5	380.00	-11.85	-19.29	1094.25	-108.72	347.27
3000.00	15.00	38	6	4	380.00	12.02	-19.40	1088.35	-112.37	349.15
3000.00	15.00	39	1	12	390.00	1.81	-15.18	1162.40	-105.73	335.51
3000.00	15.00	39	2	12	390.00	-2.43	-15.27	1162.40	-105.51	335.51
3000.00	15.00	39	3	11	390.00	5.32	-16.01	1157.67	-108.22	336.88
3000.00	15.00	39	4	11	390.00	-6.39	-16.41	1157.56	-107.87	336.92
3000.00	15.00	39	5	10	390.00	8.39	-17.32	1152.42	-109.03	338.42
3000.00	15.00	39	6	5	390.00	-11.94	-19.35	1121.96	-110.61	347.60
3000.00	15.00	39	7	4	390.00	12.14	-19.48	1116.04	-116.71	349.45
3000.00	15.00	40	1	12	400.00	3.08	-15.39	1190.73	-107.43	335.93
3000.00	15.00	40	2	12	400.00	-3.81	-15.56	1190.71	-107.03	335.93
3000.00	15.00	40	3	11	400.00	6.23	-16.35	1185.87	-108.69	337.30
3000.00	15.00	40	4	11	400.00	-7.39	-16.84	1185.70	-108.40	337.35
3000.00	15.00	40	5	5	400.00	-12.04	-19.41	1149.68	-114.01	347.92
3000.00	15.00	40	6	4	400.00	12.32	-19.60	1143.70	-116.46	349.74

TRANSMISSION LOSS VS. RANGE(KM) AND SOURCE ALTITUDE(KM)

	10	15	20	25	30											
10.00	.		77	78	.	.	.	.	.	.	.	.	.	.	.	.
20.00	.		82	85	86	.	.	.	.	.	.	.	.	.	.	.
30.00	92	92	91		.	.	.	.	.	.	.	.	.	.	.	.
40.00	.	92	84	84	.	.	.	.	.	.	.	.	.	.	.	.
50.00	.	89	89	92	91	.	.	.	.	.	.	.	.	.	.	.
60.00	84	99	97	96	94	.	.	.	.	.	.	.	.	.	.	.
70.00	98	99	88	87	101	.	.	.	.	.	.	.	.	.	.	.
80.00	89	93	93	92	89	.	.	.	.	.	.	.	.	.	.	.
90.00	90	88	99	98	96	.	.	.	.	.	.	.	.	.	.	.
100.00	99	99	91	88	97	.	.	.	.	.	.	.	.	.	.	.
110.00	93	95	96	97	92	.	.	.	.	.	.	.	.	.	.	.
120.00	93	92	88	102	95	.	.	.	.	.	.	.	.	.	.	.
130.00	102	101	87	92	93	.	.	.	.	.	.	.	.	.	.	.
140.00	97	98	98	98	92	.	.	.	.	.	.	.	.	.	.	.
150.00	95	95	91	98	94	.	.	.	.	.	.	.	.	.	.	.
160.00	103	92	90	94	98	.	.	.	.	.	.	.	.	.	.	.
170.00	89	98	99	99	93	.	.	.	.	.	.	.	.	.	.	.
180.00	96	96	93	90	97	.	.	.	.	.	.	.	.	.	.	.
190.00	94	95	92	96	99	.	.	.	.	.	.	.	.	.	.	.
200.00	94	92	101	101	92	.	.	.	.	.	.	.	.	.	.	.
210.00	97	97	95	92	96	.	.	.	.	.	.	.	.	.	.	.
220.00	97	97	93	97	97	.	.	.	.	.	.	.	.	.	.	.
230.00	96	96	87	101	88	.	.	.	.	.	.	.	.	.	.	.
240.00	99	98	91	92	98	.	.	.	.	.	.	.	.	.	.	.
250.00	98	98	94	99	99	.	.	.	.	.	.	.	.	.	.	.
260.00	98	97	90	101	101	.	.	.	.	.	.	.	.	.	.	.
270.00	100	94	93	95	96	.	.	.	.	.	.	.	.	.	.	.
280.00	91	99	95	99	99	.	.	.	.	.	.	.	.	.	.	.
290.00	99	98	92	89	99	.	.	.	.	.	.	.	.	.	.	.
300.00	96	96	95	96	98	.	.	.	.	.	.	.	.	.	.	.
310.00	96	94	96	100	100	.	.	.	.	.	.	.	.	.	.	.
320.00	99	99	93	94	101	.	.	.	.	.	.	.	.	.	.	.
330.00	98	98	96	98	99	.	.	.	.	.	.	.	.	.	.	.
340.00	98	97	92	101	99	.	.	.	.	.	.	.	.	.	.	.
350.00	101	100	91	95	101	.	.	.	.	.	.	.	.	.	.	.
360.00	99	99	97	98	98	.	.	.	.	.	.	.	.	.	.	.
370.00	99	98	94	101	100	.	.	.	.	.	.	.	.	.	.	.
380.00	101	96	93	93	101	.	.	.	.	.	.	.	.	.	.	.
390.00	92	99	97	99	100	.	.	.	.	.	.	.	.	.	.	.
400.00	100	99	95	102	101	.	.	.	.	.	.	.	.	.	.	.