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EXPLOR
(EXAMINATION OF POLLUTION LEVELS OF ROADWAYS)
VOLUME II THE USER'S GUIDE FOR EXPLOR

J. W. Kirsch
B. F. Mason

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RECOMMENDATIONS

The EXPLOR code has been designed to be used under a wide variety of geometrical and meteorological conditions. For this reason, no specific limitations are noted, although the user should be aware of certain facts:

1) EXPLOR has been validated for at-grade, cut, and fill geometries. Bridges and viaducts (in which there is air flow under the roadway) may also be used, but for these latter cases no validating data was available.

2) Although there is no reason to doubt EXPLOR calculations at distances up to one mile from the roadway, validating data was available only to a maximum distance of 600 feet.

3) Major changes in concentration can occur with variation of the stability calss. For this reason, the user must be very careful in determining the correct stability class.

PART A

LISTING OF EXPLOR

```
      @FOR,IS EXPLOR,EXPLOR
            COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,
           .        DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),
           .        FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),
           .        IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,
           .        NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,
           .        P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11),
           .        UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26)
           .        ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,
           .        11)
            LOGICAL KILL
            NX = 25
            NY = 10
            NXM1 = NX-1
            NXP1 = NX+1
            NYM1 = NY-1
            NYP1 = NY+1
            XNX = NX
            XNY = NY
            XNYP1 = NYP1
            XNXP1 = NXP1
            KILL = .FALSE.
            CALL CARDS
            CALL XYGEN
            CALL TGEN
            CALL MDGEN
            CALL DATAP
            IF (KILL) GO TO 20
            CALL TIMSTP
            IF ((FINAL .EQ. 0.0) .AND. (MAXCYC .EQ. 0)) CALL FIN
            IF (MAXCYC .EQ. 0) MAXCYC = FINAL/DT+0.5
         10 TIME = TIME+DT
            ICYCL = ICYCL+1
            CALL SOURCE
            CALL DIFFUS
            IF (DM .EQ. 0.0) CALL MIX
            CALL ADVECT
            IF (ICYCL .LT. MAXCYC) GO TO 10
            IF (DM .EQ. 0.0) CALL MIX
            CALL FINCON
            CALL PRINT
         20 CALL EXIT
            END
      @FOR,IS ADVECT,ADVECT
            SUBROUTINE ADVECT
            COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,
           .        DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),
           .        FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),
           .        IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,
           .        NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,
           .        P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11),
           .        UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26)
```

```
     .        ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,     B   90
     .        11)                                                           B  100
      DO 10 I=1,NX                                                          B  110
      DO 10 J=1,NY                                                          B  120
      IP1 = MIND(I+1,NX)                                                    B  130
      IM1 = MAXD(I-1,1)                                                     B  140
      CX(I,J) = AMAX1(C(IM1,J),C(I,J),C(IP1,J))                             B  150
      CN(I,J) = AMIN1(C(IM1,J),C(I,J),C(IP1,J))                             B  160
   10 CONTINUE                                                              B  170
      DO 20 J=1,NY                                                          B  180
      C1 = EXQ(C(1,J),C(2,J),C(3,J),0)                                      B  190
      C2 = U(1,J)*DT                                                        B  200
      C3 = C2/(2.*DX(1))                                                    B  210
      FOLD = C3*(C(1,J)*DX(1)+C1*DX(1))-C2*C3*(C(1,J)-C1)                   B  220
      DO 20 I=1,NX                                                          B  230
      IP1 = MIND(I+1,NX)                                                    B  240
      C1 = C(IP1,J)                                                         B  250
      IF (I .EQ. NX) C1 = EXQ(C(NX,J),C(NX-1,J),C(NX-2,J),1)                B  260
      C2 = U(I+1,J)*DT                                                      B  270
      C3 = C2/(DX(IP1)+DX(I))                                               B  280
      FNEW = C3*(C1*DX(I)+C(I,J)*DX(IP1))-C2*C3*(C1-C(I,J))                 B  290
      C(I,J) = C(I,J)+(FOLD-FNEW)/DX(I)                                     B  300
      C(I,J) = AMIN1(C(I,J),CX(I,J))                                        B  310
      C(I,J) = AMAX1(C(I,J),CN(I,J))                                        B  320
      FOLD = FNEW                                                           B  330
   20 CONTINUE                                                              B  340
      DO 30 I=1,NX                                                          B  350
      DO 30 J=1,NY                                                          B  360
      JP1 = MIND(J+1,NY)                                                    B  370
      JM1 = MAXD(J-1,1)                                                     B  380
      CX(I,J) = AMAX1(C(I,JM1),C(I,J),C(I,JP1))                             B  390
      CN(I,J) = AMIN1(C(I,JM1),C(I,J),C(I,JP1))                             B  400
   30 CONTINUE                                                              B  410
      DO 40 I=1,NX                                                          B  420
      FOLD = 0.0                                                            B  430
      DO 40 J=1,NY                                                          B  440
      JP1 = MIND(J+1,NY)                                                    B  450
      C1 = C(I,JP1)                                                         B  460
      IF (J .EQ. NY) C1 = C(I,NY)                                           B  470
      C2 = V(I,J+1)*DT                                                      B  480
      C3 = C2/(DY(JP1)+DY(J))                                               B  490
      FNEW = C3*(C1*DY(J)+C(I,J)*DY(JP1))-C2*C3*(C1-C(I,J))                 B  500
      C(I,J) = C(I,J)+(FOLD-FNEW)/DY(J)                                     B  510
      C(I,J) = AMIN1(C(I,J),CX(I,J))                                        B  520
      C(I,J) = AMAX1(C(I,J),CN(I,J))                                        B  530
      FOLD = FNEW                                                           B  540
   40 CONTINUE                                                              B  550
      RETURN                                                                B  560
      END                                                                   B  570
WFOR,IS CARDS,CARDS
      SUBROUTINE CARDS                                                      C   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,      C   20
     .       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),         C   30
     .       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),      C   40
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     *        IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,      C   50
     *        NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,      C   60
     *        P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11),     C   70
     *        UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSE(8),X(26)    C   80
     *        ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,      C   90
     *        11)                                                            C  100
      LOGICAL KILL                                                          C  110
      DIMENSION KLOC(10)                                                    C  120
C                                                                           C  130
C     INPUT                                                                 C  140
C                                                                           C  150
C     (HEAD(I),I=1,12)                                    12A6              C  160
C     GH,GL,RH,RW,HMC,SC,FGB                              8E10.4            C  170
C     FWP,PV,FD,DV,DM,DTF                                 8E10.4            C  180
C     NTP,IP,NYR,MAXCYC                                   10I5              C  190
C     (IYR(I),I=1,NYR)                                    10I5              C  200
C     (DMS(I),I=1,8)                                      8E10.4            C  210
C     (HMS(I),I=1,8)                                      8E10.4            C  220
C     (WS(I),I=1,8)                                       8E10.4            C  230
C     (WA(I),I=1,8)                                       8E10.4            C  240
C     (TD(I),I=1,NTP)                                     8E10.4            C  250
C     (TH(I),I=1,NTP)                                     8E10.4            C  260
C     (X(I),I=1,NXP1)    (ONLY IF FGB GT 0)               8E10.4            C  270
C     (Y(I),I=1,NYP1)    (ONLY IF FGB GT 0)               8E10.4            C  280
C     (CARS(I),FAC(I),I=1,NYR)                            8E10.4            C  290
C                                                                           C  300
C     VARIABLES AND DEFAULT VALUES                                          C  310
C                                                                           C  320
C     HEAD = ANY INFORMATION, USED AS COMMENT IN OUTPUT                     C  330
C     GH = GRID HEIGHT IN FEET (200)                                        C  340
C     GL = GRID LENGTH IN FEET (1000)                                       C  350
C     RH = ROAD HEIGHT IN FEET (0)                                          C  360
C     RW = ROAD WIDTH IN FEET (100)                                         C  370
C     HMC = HEIGHT OF MIXING CELL IN FEET (10)                              C  380
C     SC = STABILITY CLASS  1=A,2=B,...,7=G  (4)                            C  390
C     FGB=FORCE GRID BOUNDARIES IF GT 0 (0)                                 C  400
C     FWP=FORCE WIND PROFILE IF NE 0 (0)                                    C  410
C     PV = PROFILE (EXPONENT) VALUE IF FWP NE 0 (0)                         C  420
C     FD = FORCE DIFFUSIVITIES IF NE 0 (0)                                  C  430
C     DV = DIFFUSIVITY VALUE IN 1/FEET**2 IF FD NE 0 (0)                    C  440
C     DM = DELETE MIXING IF NE 0 (0)                                        C  450
C     DTF = DELTA T FORCE TO THIS VALUE IN SEC IF NE 0 (0)                  C  460
C     NTP = NUMBER OF TERRAIN POINTS IN INPUT                               C  470
C     IP = POLLUTANT PRESENT (1)                                            C  480
C          CURRENTLY                                                        C  490
C                  1 = CO                                                   C  500
C     NYR = NUMBER OF YEARS, MAXIMUM OF FOUR (1)                            C  510
C     MAXCYC = MAXIMUM CYCLES (0)                                           C  520
C     IYR = YEARS CALCULATED                                                C  530
C     DMS = DISTANCE TO METEOROLOGICAL STATION IN FEET (0)                  C  540
C     HMS = HEIGHT OF METEOROLOGICAL STATION IN FEET (0)                    C  550
C     WS = WIND SPEED IN MPH (0)                                            C  560
C     WA = WIND ANGLE IN DEGREES (90)                                       C  570
C     TD = TERRAIN DISTANCE IN FEET FROM ROADWAY CENTER (0)                 C  580
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C     TH = TERRAIN HEIGHT IN FEET (0)                                  C  590
C     X = X BOUNDARIES IN FEET (0)                                     C  600
C     Y = Y BOUNDARIES IN FEET (0)                                     C  610
C     CARS = NUMBER OF CARS (1)                                        C  620
C     FAC = EMISSION FACTOR IN GRAMS/MILE (1)                          C  630
C                                                                      C  640
      READ (5,70) (HEAD(I),I=1,12)                                     C  650
      READ (5,80) GH,GL,RH,RW,HMC,SC,FGB                               C  660
      IF (GH .EQ. 0.) GH = 200.                                        C  670
      IF (GL .EQ. 0.) GL = 1000.                                       C  680
      IF (RW .EQ. 0.) RW = 100.                                        C  690
      IF (HMC .EQ. 0.) HMC = 10.                                       C  700
      IF (SC .EQ. 0.) SC = 4                                           C  710
      READ (5,80) FWP,PV,FD,DV,DM,DTF                                  C  720
      READ (5,90) NTP,IP,NYR,MAXCYC                                    C  730
      IF (NTP .EQ. 0) KLOC(1) = 1                                      C  740
      IP=1                                                             C  750
      IF (NYR .EQ. 0) NYR = 1                                          C  760
      IF (NYR .GT. 4) NYR = 4                                          C  770
      READ (5,90) (IYR(I),I=1,NYR)                                     C  780
      READ (5,80) (DMS(I),I=1,8)                                       C  790
      READ (5,80) (HMS(I),I=1,8)                                       C  800
      IF (HMS(1) .EQ. 0.) KLOC(2) = 1                                  C  810
      READ (5,80) (WS(I),I=1,8)                                        C  820
      IF (WS(1) .EQ. 0.) KLOC(3) = 1                                   C  830
      READ (5,80) (WA(I),I=1,8)                                        C  840
      DO 10 I=1,8                                                      C  850
      IF ((WA(I) .EQ. 0.) .AND. (WS(I) .NE. 0.)) WA(I) = 90.           C  860
   10 CONTINUE                                                         C  870
      DO 20 I=1,8                                                      C  880
      IF ((WS(I) .NE. 0.0) .OR. (WA(I) .NE. 0.0)) NW = NW+1            C  890
   20 CONTINUE                                                         C  900
      DO 30 I=1,NW                                                     C  910
      WAR(I) = WA(I)*0.017453                                          C  920
      SINE = SIN(WAR(I))                                               C  930
      WSC(I) = WS(I)*SINE                                              C  940
   30 CONTINUE                                                         C  950
      READ (5,80) (TD(I),I=1,NTP)                                      C  960
      IF ((TD(1) .GE. 0.) .AND. (FGB .EQ. 0.)) KLOC(4) = 1             C  970
      READ (5,80) (TH(I),I=1,NTP)                                      C  980
      IF (FGB .EQ. 0.) GO TO 40                                        C  990
      READ (5,80) (X(I),I=1,NXP1)                                      C 1000
      IF (X(1) .GE. 0.) KLOC(5) = 1                                    C 1010
      READ (5,80) (Y(I),I=1,NYP1)                                      C 1020
      IF (Y(1) .NE. 0.) KLOC(6) = 1                                    C 1030
   40 CONTINUE                                                         C 1040
      READ (5,80) (CARS(I),FAC(I),I=1,NYR)                             C 1050
      IF (CARS(1) .EQ. 0.) CARS(1) = 1.                                C 1060
      IF (FAC(1) .EQ. 0.) FAC(1) = 1.                                  C 1070
      DO 50 I=1,10                                                     C 1080
      IF (KLOC(I) .GT. 0) KILL = .TRUE.                                C 1090
   50 CONTINUE                                                         C 1100
      IF(.NOT.KILL) GO TO 60                                           C 1110
      WRITE (6,100) (HEAD(I),I=1,12)                                   C 1120
```

```
      IF (KLOC(1) .EQ. 1) WRITE (6,110)                                 C 1130
      IF (KLOC(2) .EQ. 1) WRITE (6,120)                                 C 1140
      IF (KLOC(3) .EQ. 1) WRITE (6,130)                                 C 1150
      IF (KLOC(4) .EQ. 1) WRITE (6,140)                                 C 1160
      IF (KLOC(5) .EQ. 1) WRITE (6,150)                                 C 1170
      IF (KLOC(6) .EQ. 1) WRITE (6,160)                                 C 1180
      CALL EXIT                                                         C 1190
   60 CONTINUE                                                          C 1200
      RETURN                                                            C 1210
   70 FORMAT (12A6)                                                     C 1220
   80 FORMAT (8E10.4)                                                   C 1230
   90 FORMAT (10I5)                                                     C 1240
  100 FORMAT (1H1//////////1X,                                          C 1250
     .        60HTHE FOLLOWING RUN HAS BEEN TERMINATED DUE TO INCORRECT I  C 1260
     .NPUT//30X,12A6/////)                                              C 1270
  110 FORMAT (50X,36HNUMBER OF TERRAIN POINTS EQUALS ZERO)              C 1280
  120 FORMAT (50X,45HMETEOROLOGICAL STATION NOT PROPERLY SPECIFIED)     C 1290
  130 FORMAT (50X,32HWIND DATA NOT PROPERLY SPECIFIED)                  C 1300
  140 FORMAT (50X,                                                      C 1310
     .        67HFIRST TERRAIN DISTANCE MUST BE NEGATIVE NUMBER SINCE X-Y  C 1320
     . NOT FORCED)                                                      C 1330
  150 FORMAT (50X,39HFIRST VALUE OF X MUST BE NEGATIVE VALUE)           C 1340
  160 FORMAT (50X,29HFIRST VALUE OF Y MUST BE ZERO)                     C 1350
      END                                                               C 1360
@FOR,IS DATAP,DATAP
      SUBROUTINE DATAP                                                  D   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,  D   20
     .       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),     D   30
     .       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),  D   40
     .       IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,  D   50
     .       NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,  D   60
     .       P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11), D   70
     .       UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26) D   80
     .       ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,  D   90
     .       11)                                                        D  100
      WRITE (6,10) (HEAD(I),I=1,12)                                     D  110
      WRITE (6,20) (X(I),I=1,NXP1)                                      D  120
      WRITE (6,30) (DX(I),I=1,NX)                                       D  130
      WRITE (6,40) (Y(I),I=1,NYP1)                                      D  140
      WRITE (6,50) (DY(I),I=1,NY)                                       D  150
      WRITE (6,60) GH,GL,RH,RW,HMC,SC,NTP,FWP,FD,DM,DTF,MAXCYC,FGB      D  160
      WRITE (6,70) (IYR(I),CARS(I),FAC(I),I=1,NYR)                      D  170
      WRITE (6,80) IP                                                   D  180
      WRITE (6,90) (DMS(I),I=1,8)                                       D  190
      WRITE (6,100) (HMS(I),I=1,8)                                      D  200
      WRITE (6,110) (WS(I),I=1,8)                                       D  210
      WRITE (6,120) (WA(I),I=1,8)                                       D  220
      WRITE (6,130) (TD(I),I=1,NTP)                                     D  230
      WRITE (6,140) (TH(I),I=1,NTP)                                     D  240
      WRITE (6,150) (WAR(I),I=1,NW)                                     D  250
      WRITE (6,160) (WSC(I),I=1,NW)                                     D  260
      RETURN                                                            D  270
   10 FORMAT (1H1,1X12A6)                                               D  280
   20 FORMAT (/1X,12HX (DISTANCE)/(10(1X,1PE12.6)))                     D  290
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```
   30 FORMAT (/1X,12HDX (DELTA X)/(10(1X,1PE12.6)))                    D  300
   40 FORMAT (/1X,10HY (HEIGHT)/(10(1X,1PE12.6)))                      D  310
   50 FORMAT (/1X,12HDY (DELTA Y)/(10(1X,1PE12.6)))                    D  320
   60 FORMAT (/1X,3HGH=1PE12.6,3X,3HGL=E12.6,3X,3HRH=E12.6,3X,         D  330
     .        3HRW=E12.6,3X,4HHMC=E12.6,3X,3HSC=E12.6,3X,4HNTP=I4/1X,  D  340
     .        4HFWP=E12.6,3X,3HFD=E12.6,3X,3HDM=E12.6,3X,4HDTF=E12.6,3X, D  350
     .        7HMAXCYC=I6,3X,4HFGB=E12.6)                              D  360
   70 FORMAT (1X,8HCAR DATA,5X,4HYEAR,4X,4HCARS,4X,8HEMISSION/(14X,I4, D  370
     .        1X,1PE9.3,1X,E9.3))                                      D  380
   80 FORMAT(/1X,10HPOLLUTANT ,I2,2X,10HWHERE 1=CO)                    D  390
   90 FORMAT (/1X,40HDMS (DISTANCE TO METEOROLOGICAL STATION)/         D  400
     .        (10(1X,1PE12.6)))                                        D  410
  100 FORMAT (/1X,38HHMS (HEIGHT OF METEOROLOGICAL STATION)/           D  420
     .        (10(1X,1PE12.6)))                                        D  430
  110 FORMAT (/1X,15HWS (WIND SPEED)/(10(1X,1PE12.6)))                 D  440
  120 FORMAT (/1X,15HWA (WIND ANGLE)/(10(1X,1PE12.6)))                 D  450
  130 FORMAT (/1X,21HTD (TERRAIN DISTANCE)/(10(1X,1PE12.6)))           D  460
  140 FORMAT (/1X,19HTH (TERRAIN HEIGHT)/(10(1X,1PE12.6)))             D  470
  150 FORMAT (/1X,25HWAR (WIND ANGLE, RADIANS)/(10(1X,1PE12.6)))       D  480
  160 FORMAT (/1X,26HWSC (WIND SPEED COMPONENT)/(10(1X,1PE12.6)))      D  490
      END                                                              D  500
@FOR,IS DIFFUS,DIFFUS
      SUBROUTINE DIFFUS                                                E   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM, E   20
     .       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),    E   30
     .       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8), E   40
     .       IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE, E   50
     .       NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR, E   60
     .       P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11), E   70
     .       UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26) E   80
     .       ,XC(25),XK(26,11),XNX,XNXPI,XNY,XNYPI,Y(11),YC(10),YK(26, E   90
     .       11)                                                      E  100
      DO 30 J=1,NY                                                    E  110
      FOLD = 0.                                                       E  120
      IF (J .LE. IBC(1)) GO TO 10                                     E  130
      CP = EXQ(C(1,J),C(2,J),C(3,J),0)                                E  140
      FOLD = DT*(CP-C(1,J))*D(1,1,J)/DX(1)                            E  150
   10 CONTINUE                                                        E  160
      DO 30 I=1,NX                                                    E  170
      IP1 = MIN0(I+1,NX)                                              E  180
      IM1 = I-1                                                       E  190
      FNEW = 0.                                                       E  200
      IF (J .LE. IBC(I)) GO TO 20                                     E  210
      IF (J .LE. IBC(IP1)) GO TO 20                                   E  220
      CP = C(IP1,J)                                                   E  230
      IF (I .EQ. NX) CP = EXQ(C(NX,J),C(NX-1,J),C(NX-2,J),1)          E  240
      FNEW = DT*(C(I,J)-CP)*(D(1,I,J)+D(1,IP1,J))/(DX(I)+DX(IP1))     E  250
   20 CONTINUE                                                        E  260
      C(I,J) = C(I,J)+(FOLD-FNEW)/DX(I)                               E  270
      FOLD = FNEW                                                     E  280
   30 CONTINUE                                                        E  290
      DO 50 I=1,NX                                                    E  300
      FOLD = 0.                                                       E  310
      DO 50 J=1,NY                                                    E  320
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```
      JP1 = MIN0(J+1,NY)                                                E  330
      JM1 = J-1                                                         E  340
      FNEW = 0.                                                         E  350
      IF (J .LE. IBC(I)) GO TO 40                                       E  360
      CP = C(I,JP1)                                                     E  370
      IF (J .EQ. NY) CP = AMAX1(0.,C(I,J)+(C(I,J)-C(I,JM1))*2.*DY(J)/   E  380
     .        (DY(J)+DY(JM1)))                                          E  390
      FNEW = DT*(C(I,J)-CP)*(D(2,I,J)+D(2,I,JP1))/(DY(J)+DY(JP1))       E  400
   40 CONTINUE                                                          E  410
      C(I,J) = C(I,J)+(FOLD-FNEW)/DY(J)                                 E  420
      FOLD = FNEW                                                       E  430
   50 CONTINUE                                                          E  440
      RETURN                                                            E  450
      END                                                               E  460
@FOR,IS EXQ,EXQ
      FUNCTION EXQ (Y1,Y2,Y3,LR)                                        F   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,  F   20
     .        DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),    F   30
     .        FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8), F   40
     .        IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE, F   50
     .        NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR, F   60
     .        P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11), F   70
     .        UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26) F   80
     .        ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,  F   90
     .        11)                                                       F  100
      IF (LR .EQ. 1) GO TO 10                                           F  110
      X1 = DX(1)                                                        F  120
      X2 = X1+0.5*(DX(1)+DX(2))                                         F  130
      X3 = X2+0.5*(DX(2)+DX(3))                                         F  140
      GO TO 20                                                          F  150
   10 X1 = -DX(NX)                                                      F  160
      X2 = X1-0.5*(DX(NX)+DX(NX-1))                                     F  170
      X3 = X2-0.5*(DX(NX-1)+DX(NX-2))                                   F  180
   20 Y12 = Y1-Y2                                                       F  190
      X12 = X1-X2                                                       F  200
      Y13 = Y1-Y3                                                       F  210
      X13 = X1-X3                                                       F  220
      X122 = X1*X1-X2*X2                                                F  230
      X132 = X1*X1-X3*X3                                                F  240
      COF1 = (Y12*X13-Y13*X12)/(X13*X122-X12*X132)                      F  250
      COF2 = (Y12-COF1*X122)/X12                                        F  260
      FACTR = Y1-X1*(COF1*X1+COF2)                                      F  270
      EXQ = AMAX1(FACTR,0.0)                                            F  280
      RETURN                                                            F  290
      END                                                               F  300
@FOR,IS FIN,FIN
      SUBROUTINE FIN                                                    G   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,  G   20
     .        DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),    G   30
     .        FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8), G   40
     .        IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE, G   50
     .        NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR, G   60
     .        P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11), G   70
     .        UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26) G   80
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```
     *        ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,    G   90
     *        11)                                                          G  100
      DO 10 I=1,NX                                                         G  110
      J = IB(I)                                                            G  120
      SUM = SUM+ABS(U(I,J))                                                G  130
   10 CONTINUE                                                             G  140
      N1 = IB(NX)                                                          G  150
      SUM = SUM+ABS(U(NXP1,N1))                                            G  160
      SUM = SUM/XNXP1                                                      G  170
      FINAL = AMIN1(X(NXP1)*1.1/SUM,10000.)                                G  180
      RETURN                                                               G  190
      END                                                                  G  200
@FOR,IS FINCON,FINCON
      SUBROUTINE FINCON                                                    H   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,     H   20
     *       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),        H   30
     *       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),     H   40
     *       IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,     H   50
     *       NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,     H   60
     *       P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11),    H   70
     *       UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26)   H   80
     *       ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,     H   90
     *       11)                                                           H  100
      DIMENSION CF(4)                                                      H  110
      CC = 28.8/28*1.548E-3                                                H  120
      DO 10 I=1,NYR                                                        H  130
      CF(I) = CARS(I)*FAC(I)*CC                                            H  140
   10 CONTINUE                                                             H  150
      DO 50 I=1,NYR                                                        H  160
      DO 50 J=1,NX                                                         H  170
      DO 50 K=1,NY                                                         H  180
      FCON(I,J,K) = C(J,K)*CF(I)                                           H  190
   50 CONTINUE                                                             H  200
      RETURN                                                               H  210
      END                                                                  H  220
@FOR,IS MDGEN,MDGEN
      SUBROUTINE MDGEN                                                     I   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,     I   20
     *       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),        I   30
     *       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),     I   40
     *       IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,     I   50
     *       NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,     I   60
     *       P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11),    I   70
     *       UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26)   I   80
     *       ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,     I   90
     *       11)                                                           I  100
      DIMENSION SE10(7),SE30P(7),SL(7,6),SLV(6),XP(7)                      I  110
      DATA XP/.15,.17,.20,.26,.39,.48,.54/                                 I  120
      DATA SE10/.2,.185,.157,.117,.061,.028,.012/                           I  130
      DATA SE30P/.262,.237,.184,.119,.056,.023,.009/                        I  140
      DATA SLV/32.81,65.62,98.43,164.04,246.06,328.08/                     I  150
      DATA SL/59.06,49.21,39.37,32.81,26.25,22.97,16.69,98.43,82.02,       I  160
     *       68.90,59.06,52.49,45.93,39.37,134.51,111.55,95.14,82.02,      I  170
     *       72.18,65.62,55.77,203.41,170.60,144.36,127.95,114.83,         I  180
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     *        101.71,88.58,275.59,232.94,196.85,170.60,157.48,141.08,
     *        121.39,344.49,278.87,242.78,209.97,196.85,177.17,150.92/
      DO 50 I=1,NW
      DO 10 J=2,NXP1
      IF (DMS(I) .LE. X(J)) GO TO 20
   10 CONTINUE
   20 CONTINUE
      IF ((X(J)-DMS(I)) .GT. (DMS(I)-X(J-1))) J = J-1
      DO 30 K=2,NYP1
      IF (HMS(I) .LE. Y(K)) GO TO 40
   30 CONTINUE
   40 CONTINUE
      IF ((Y(K)-HMS(I)) .GT. (HMS(I)-Y(K-1))) K = K-1
   50 U(J,K) = WSC(I)
      ISC = SC
      IF (FWP .EQ. 0.0) PV = XP(ISC)
      CALL WIND
      DO 60 IP=1,NXP1
      DO 60 JP=1,NYP1
      U(IP,JP) = U(IP,JP)*1.4667
      V(IP,JP) = V(IP,JP)*1.4667
   60 CONTINUE
      XYZ = 0.0
      DO 70 K=1,8
      IF ((WAR(K) .EQ. 0.0) .AND. (WS(K) .EQ. 0.0)) GO TO 70
      XYZ = XYZ+1.0
      SSINE = SSINE+ABS(SIN(WAR(K)))
   70 CONTINUE
      SSINE = SSINE/XYZ
      DO 170 I=1,NX
      DO 170 J=1,NY
      IF (YC(J) .LE. 32.81) GO TO 80
      IF (YC(J) .GE. 98.43) GO TO 90
      SS = SE10(ISC)+(SE30P(ISC)-SE10(ISC))*(YC(J)-32.81)/(98.43-32.81)
      GO TO 100
   80 SS = SE10(ISC)
      GO TO 100
   90 SS = SE30P(ISC)
  100 CONTINUE
      IF (YC(J) .LE. SLV(1)) GO TO 140
      IF (YC(J) .GE. SLV(6)) GO TO 150
      DO 110 M=2,6
      IF (YC(J) .LT. SLV(M)) GO TO 120
      IF (YC(J) .EQ. SLV(M)) GO TO 130
  110 CONTINUE
  120 XLL = SL(ISC,M-1)+(SL(ISC,M)-SL(ISC,M-1))*(YC(J)-SLV(M-1))/(SLV(M)
     *        -SLV(M-1))
      GO TO 160
  130 XLL = SL(ISC,M)
      GO TO 160
  140 XLL = SL(ISC,1)
      GO TO 160
  150 XLL = SL(ISC,6)
  160 CONTINUE
```

```
      TW = SQRT(((U(I,J)+U(I+1,J))/SSINE)**2+(V(I,J)+V(I,J+1))**2)*0.5
      D(1,I,J) = 0.45*XLL*SS*TW
      IF (FD .NE. 0.0) D(1,I,J) = DV
  170 CONTINUE
      DO 270 I=1,NX
      DO 270 J=1,NY
      IF (YC(J) .LE. 32.81) GO TO 180
      IF (YC(J) .GE. 98.43) GO TO 190
      SS = SE10(ISC)+(SE30P(ISC)-SE10(ISC))*(YC(J)-32.81)/(98.43-32.81)
      GO TO 200
  180 SS = SE10(ISC)
      GO TO 200
  190 SS = SE30P(ISC)
  200 CONTINUE
      IF (YC(J) .LE. SLV(1)) GO TO 240
      IF (YC(J) .GE. SLV(6)) GO TO 250
      DO 210 M=2,6
      IF (YC(J) .LT. SLV(M)) GO TO 220
      IF (YC(J) .EQ. SLV(M)) GO TO 230
  210 CONTINUE
  220 XLL = SL(ISC,M-1)+(SL(ISC,M)-SL(ISC,M-1))*(YC(J)-SLV(M-1))/(SLV(M)
     .        -SLV(M-1))
      GO TO 260
  230 XLL = SL(ISC,M)
      GO TO 260
  240 XLL = SL(ISC,1)
      GO TO 260
  250 XLL = SL(ISC,6)
  260 CONTINUE
      TW = SQRT(((U(I,J)+U(I+1,J))/SSINE)**2+(V(I,J)+V(I,J+1))**2)*0.5
      D(2,I,J) = 0.45*XLL*SS*TW
      IF (FD .NE. 0.0) D(2,I,J) = DV
  270 CONTINUE
      DO 280 I=1,NX
      DO 280 J=1,NY
      IF (J .GT. IB(I)) GO TO 280
      V(I,J) = 0.0
  280 CONTINUE
      DO 290 I=1,NX
      DO 290 J=1,NY
      IF (J .GE. IB(I)) GO TO 290
      D(2,I,J) = 0.0
  290 CONTINUE
      DO 300 J=1,NY
      IF (J .GE. IB(1)) GO TO 300
      D(1,1,J) = 0.0
      U(1,J) = 0.0
  300 CONTINUE
      DO 310 I=2,NX
      DO 310 J=1,NY
      IF (J .GE. MAX0(IB(I-1),IB(I))) GO TO 310
      D(1,I,J) = 0.0
      U(I,J) = 0.0
  310 CONTINUE
```

```
      IX = IB(NL+1)                                                     I 1270
      IF (RH .EQ. Y(IX)) GO TO 330                                      I 1280
      L = NL+1                                                          I 1290
      M = NL+NRC                                                        I 1300
      DO 320 N=L,M                                                      I 1310
      D(2,N,NB+1) = 0.0                                                 I 1320
  320 V(N,NB+1) = 0.0                                                   I 1330
  330 CONTINUE                                                          I 1340
      CALL SOURCE                                                       I 1350
      RETURN                                                            I 1360
      END                                                               I 1370
@FOR,IS MIX,MIX
      SUBROUTINE MIX                                                    J   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,  J   20
     .       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),     J   30
     .       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),  J   40
     .       IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,  J   50
     .       NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,  J   60
     .       P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11), J   70
     .       UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26) J   80
     .       ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,  J   90
     .       11)                                                        J  100
      N1 = NL+1                                                         J  110
      N2 = NL+NRC                                                       J  120
      SUM = 0.                                                          J  130
      XNUM = 0.                                                         J  140
      DO 10 I=N1,N2                                                     J  150
      DO 10 J=1,NY                                                      J  160
      IF (S(I,J) .LT. 1.E-6) GO TO 10                                   J  170
      SUM = SUM+C(I,J)                                                  J  180
      XNUM = XNUM+1.0                                                   J  190
   10 CONTINUE                                                          J  200
      XYZ = SUM/XNUM                                                    J  210
      DO 20 I=N1,N2                                                     J  220
      DO 20 J=1,NY                                                      J  230
      IF (S(I,J) .LT. 1.E-6) GO TO 20                                   J  240
      C(I,J) = XYZ                                                      J  250
   20 CONTINUE                                                          J  260
      RETURN                                                            J  270
      END                                                               J  280
@FOR,IS PHI,PHI
      FUNCTION PHI (I,J)                                                K   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,  K   20
     .       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),     K   30
     .       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),  K   40
     .       IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,  K   50
     .       NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,  K   60
     .       P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11), K   70
     .       UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26) K   80
     .       ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,  K   90
     .       11)                                                        K  100
      I1 = MAX0(1,I-1)                                                  K  110
      I2 = MIN0(NXP1,I+1)                                               K  120
      J1 = MAX0(1,J-1)                                                  K  130
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```
      J2 = MINO(NYP1,J+1)                                               K  140
      D1 = P(I2,J)                                                      K  150
      D2 = P(I1,J)                                                      K  160
      D3 = P(I,J2)                                                      K  170
      D4 = P(I,J1)                                                      K  180
      IF (I .EQ. 1) D2 = 0.0                                            K  190
      IF (I .EQ. NXP1) D1 = P(I,J)+(P(I,J)-P(I1,J))*DXA(I)/DXA(I1)      K  200
      IF (J .EQ. NY) D3 = P(I,J)+(P(I,J)-P(I,J1))*DYA(J)/DYA(J1)        K  210
      XN1 = XK(I2,J)/(DX(I)*DXA(I))                                     K  220
      XN2 = XK(I,J)/(DX(I)*DXA(I1))                                     K  230
      XN3 = YK(I,J2)/(DY(J)*DYA(J))                                     K  240
      XN4 = YK(I,J)/(DY(J)*DYA(J1))                                     K  250
      IF (I .EQ. 1) XN2 = XK(I,J)/DX(I)**2                              K  260
      IF (J .EQ. 1) XN4 = YK(I,J)/DY(J)**2                              K  270
      PHI = (D1*XN1+D2*XN2+D3*XN3+D4*XN4)/(XN1+XN2+XN3+XN4)             K  280
      RETURN                                                            K  290
      END                                                               K  300
@FOR,IS PRINT,PRINT
      SUBROUTINE PRINT                                                  L   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,  L   20
     .       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),     L   30
     .       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),  L   40
     .       IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,  L   50
     .       NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,  L   60
     .       P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11), L   70
     .       UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26) L  80
     .       ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,  L   90
     .       11)                                                        L  100
      WRITE (6,30) (HEAD(I),I=1,12)                                     L  110
      WRITE (6,40) (IYR(I),CARS(I),FAC(I),I=1,NYR)                      L  120
      WRITE (6,50)                                                      L  130
      WRITE (6,60) (IYR(I),I=1,NYR)                                     L  140
      DO 10 I=1,NX                                                      L  150
      J = IB(I)                                                         L  160
      WRITE (6,70) XC(I),YC(J),(FCON(K,I,J),K=1,NYR)                    L  170
   10 CONTINUE                                                          L  180
      DO 20 K=1,NYR                                                     L  190
      WRITE (6,80) (HEAD(I),I=1,12),IYR(K)                              L  200
      DO 20 I=1,NX                                                      L  210
      WRITE (6,90) (FCON(K,I,J),J=1,NY)                                 L  220
   20 CONTINUE                                                          L  230
      RETURN                                                            L  240
   30 FORMAT (1H1,1X,12A6///)                                           L  250
   40 FORMAT (96X,4HYEAR,4X,4HCARS,4X,8HEMISSION/(96X,I4,1X,1PE9.3,1X,  L  260
     .       E9.3))                                                     L  270
   50 FORMAT (1X,9HCO IN PPM////)                                       L  280
   60 FORMAT (39X,1HX,9X,1HY,4X,4(6X,I4)/)                              L  290
   70 FORMAT (35X,1PE9.3,1X,E9.3,1X,4(1X,E9.3))                         L  300
   80 FORMAT (1H1,1X,12A6,10X,I4//)                                     L  310
   90 FORMAT (10(2X,1PE9.3))                                            L  320
      END                                                               L  330
@FOR,IS SOURCE,SOURCE
      SUBROUTINE SOURCE                                                 M   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,  M   20
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     .        DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),          M   30
     .        FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),       M   40
     .        IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,       M   50
     .        NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,       M   60
     .        P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11),      M   70
     .        UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26)     M   80
     .        ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,       M   90
     .        11)                                                             M  100
      IF (ICYCL .GT. 0) GO TO 20                                              M  110
      NLEFT = NL+1                                                            M  120
      NRIGHT = NL+NRC                                                         M  130
      N = NB+1                                                                M  140
      XNRC = NRC                                                              M  150
      DO 10 I=NLEFT,NRIGHT                                                    M  160
      S(I,N) = 1./(DX(NLEFT)*DY(N)*XNRC)                                      M  170
   10 CONTINUE                                                                M  180
      RETURN                                                                  M  190
   20 CONTINUE                                                                M  200
      DO 30 I=1,NX                                                            M  210
      DO 30 J=1,NY                                                            M  220
      C(I,J) = C(I,J)+DT*S(I,J)                                               M  230
   30 CONTINUE                                                                M  240
      RETURN                                                                  M  250
      END                                                                     M  260
@FOR,IS TGEN,TGEN
      SUBROUTINE TGEN                                                         N   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,        N   20
     .        DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),          N   30
     .        FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),       N   40
     .        IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,       N   50
     .        NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,       N   60
     .        P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11),      N   70
     .        UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26)     N   80
     .        ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,       N   90
     .        11)                                                             N  100
      DIMENSION XH(26)                                                        N  110
      DO 40 I=1,NXP1                                                          N  120
      DO 10 J=1,NTP                                                           N  130
      IF (X(I) .EQ. TD(J)) GO TO 20                                           N  140
      IF ((X(I) .GT. TD(J)) .AND. (X(I) .LT. TD(J+1))) GO TO 30               N  150
   10 CONTINUE                                                                N  160
      WRITE (6,150)                                                           N  170
      GO TO 140                                                               N  180
   20 CONTINUE                                                                N  190
      XH(I) = TH(J)                                                           N  200
      GO TO 40                                                                N  210
   30 CONTINUE                                                                N  220
      XH(I) = TH(J)+(X(I)-TD(J))/(TD(J+1)-TD(J))*(TH(J+1)-TH(J))              N  230
   40 CONTINUE                                                                N  240
      DO 130 I=1,NX                                                           N  250
      DO 50 K=1,NTP                                                           N  260
      IF ((X(I) .LT. TD(K)) .AND. (TD(K) .LT. X(I+1))) GO TO 70                N  270
      IF (TD(K) .GE. X(I+1)) GO TO 60                                         N  280
   50 CONTINUE                                                                N  290
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   60 CONTINUE                                                          N  300
      A1 = 0.5*(XH(I)+XH(I+1))*DX(I)                                    N  310
      GO TO 80                                                          N  320
   70 CONTINUE                                                          N  330
      A1 = 0.5*(XH(I)+TH(K))*(TD(K)-X(I))+0.5*(TH(K)+XH(I+1))*(X(I+1)-  N  340
            TD(K))                                                      N  350
   80 CONTINUE                                                          N  360
      A2 = 0.0                                                          N  370
      DO 90 J=1,NY                                                      N  380
      A3 = DY(J)*DX(I)                                                  N  390
      A2 = A2+A3                                                        N  400
      IF (A1 .EQ. A2) GO TO 100                                         N  410
      IF (A1 .LT. A2) GO TO 110                                         N  420
   90 CONTINUE                                                          N  430
      WRITE (6,160)                                                     N  440
      GO TO 140                                                         N  450
  100 CONTINUE                                                          N  460
      IB(I) = J+1                                                       N  470
      GO TO 130                                                         N  480
  110 CONTINUE                                                          N  490
      XYZ = (A2-A1)/A3                                                  N  500
      IF (XYZ .GT. 0.5) GO TO 120                                       N  510
      IB(I) = J+1                                                       N  520
      GO TO 130                                                         N  530
  120 IB(I) = J                                                         N  540
  130 CONTINUE                                                          N  550
  140 CONTINUE                                                          N  560
      RETURN                                                            N  570
  150 FORMAT (/////1X,16HBAD TERRAIN DATA)                              N  580
  160 FORMAT (/////1X,27HCAN'T FIND TERRAIN BOUNDARY)                   N  590
      END                                                               N  600
@FOR,IS TIMSTP,TIMSTP
      SUBROUTINE TIMSTP                                                 O   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,  O   20
     .       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),     O   30
     .       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),  O   40
     .       IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,  O   50
     .       NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,  O   60
     .       P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11), O   70
     .       UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26) O   80
     .       ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,  O   90
     .       11)                                                        O  100
      IF (DTF .GT. 0.0) GO TO 30                                        O  110
      DT = 1.E6                                                         O  120
      DTO = 1.E6                                                        O  130
      DT1 = 1.E6                                                        O  140
      DT2 = 1.E6                                                        O  150
      DT3 = 1.E6                                                        O  160
      DT4 = 1.E6                                                        O  170
      DO 10 I=1,NX                                                      O  180
      DO 10 J=1,NY                                                      O  190
      AA = 1./(D(1,I,J)/DX(I)**2+D(2,I,J)/DY(J)**2)                     O  200
      IF (AA .LE. 0.0) AA = 1.E6                                        O  210
      DTO = AMIN1(DTO,AA)                                               O  220
```

```
   10 CONTINUE                                                          O  230
      DO 20 I=1,NX                                                      O  240
      DO 20 J=1,NY                                                      O  250
      IF (U(I,J) .NE. 0.0) DT1 = ABS(DX(I)/U(I,J))                      O  260
      IF (U(I+1,J) .NE. 0.0) DT2 = ABS(DX(I)/U(I+1,J))                  O  270
      IF (V(I,J) .NE. 0.0) DT3 = ABS(DY(J)/V(I,J))                      O  280
      IF (V(I,J+1) .NE. 0.0) DT4 = ABS(DY(J)/V(I,J+1))                  O  290
      DT = AMIN1(DT,DT1,DT2,DT3,DT4)                                    O  300
   20 CONTINUE                                                          O  310
      DT = DT*0.25                                                      O  320
      DT = AMIN1(DT,DTO)                                                O  330
      GO TO 40                                                          O  340
   30 DT = DTF                                                          O  350
   40 CONTINUE                                                          O  360
      RETURN                                                            O  370
      END                                                               O  380
@FOR,IS WIND,WIND
      SUBROUTINE WIND                                                   P   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM,  P   20
     .       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),     P   30
     .       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8),  P   40
     .       IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE,  P   50
     .       NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR,  P   60
     .       P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11), P   70
     .       UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26) P   80
     .       ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26,  P   90
     .       11)                                                        P  100
      DO 10 I=1,NXP1                                                    P  110
      DO 10 J=1,NYP1                                                    P  120
      UD(I,J) = U(I,J)                                                  P  130
   10 CONTINUE                                                          P  140
      DO 20 I=1,NX                                                      P  150
      L = MAX0(1,I-1)                                                   P  160
      IBC(I) = MAX0(IB(I),IB(L))-1                                      P  170
   20 CONTINUE                                                          P  180
      DO 60 I=1,NX                                                      P  190
      DO 60 J=1,NY                                                      P  200
      IF (J .NE. (IBC(I)+1)) GO TO 30                                   P  210
      ZO = 0.5*DY(J)                                                    P  220
      HT = Y(J)                                                         P  230
   30 CONTINUE                                                          P  240
      IF (J .LE. IBC(I)) GO TO 40                                       P  250
      IF (J .EQ. NYP1) GO TO 40                                         P  260
      XK(I,J) = ((YC(J)-HT)/ZO)**PV                                     P  270
   40 CONTINUE                                                          P  280
      IF (I .EQ. NXP1) GO TO 60                                         P  290
      IF (J .GT. IB(I)) GO TO 50                                        P  300
      GO TO 60                                                          P  310
   50 CONTINUE                                                          P  320
      YK(I,J) = 1.                                                      P  330
   60 CONTINUE                                                          P  340
      IBC(NXP1)=IBC(NX)                                                 P  341
      DO 25 J=1,10                                                      P  342
      XK(NXP1,J)=XK(NX,J)                                               P  343
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   25 YK(NXP1,J)=YK(NX,J)                                              P  344
      DO 26 I=1,26                                                     P  345
      XK(I,NYP1)=XK(I,NY)                                              P  346
   26 YK(I,NYP1)=YK(I,NY)                                              P  347
      DO 70 J=1,NYP1                                                   P  350
      P(1,J) = DX(1)                                                   P  360
      DO 70 I=2,NXP1                                                   P  370
      P(I,J) = P(I-1,J)+DXA(I-1)                                       P  380
   70 CONTINUE                                                         P  390
      DO 100 I=1,NXP1                                                  P  400
      DO 80 J=1,NY                                                     P  410
      W(I,J) = PHI(I,J)                                                P  420
   80 CONTINUE                                                         P  430
      DO 90 J=1,NY                                                     P  440
      P(I,J) = 1.25*W(I,J)-0.25*P(I,J)                                 P  450
   90 CONTINUE                                                         P  460
  100 CONTINUE                                                         P  470
      DO 120 I=1,NXP1                                                  P  480
      DO 120 J=1,NY                                                    P  490
      IF (I .NE. 1) GO TO 110                                          P  500
      U(I,J) = PHI(I,J)/DX(I)*XK(I,J)                                  P  510
      GO TO 120                                                        P  520
  110 CONTINUE                                                         P  530
      U(I,J) = (PHI(I,J)-P(I-1,J))/DXA(I-1)*XK(I,J)                    P  540
  120 CONTINUE                                                         P  550
      DO 130 I=1,NXP1                                                  P  560
      DO 130 J=1,NYP1                                                  P  570
      IF (UD(I,J) .EQ. 0.0) GO TO 130                                  P  580
      U1 = U1+U(I,J)**2                                                P  590
      U2 = U2+U(I,J)*UD(I,J)                                           P  600
  130 CONTINUE                                                         P  610
      UAVG = U2/U1                                                     P  620
      DO 140 I=1,NXP1                                                  P  630
      DO 140 J=1,NYP1                                                  P  640
      U(I,J) = U(I,J)*UAVG                                             P  650
  140 CONTINUE                                                         P  660
      DO 150 I=1,NX                                                    P  670
      DO 150 J=1,NY                                                    P  680
      V(I,J+1) = V(I,J)+(U(I,J)-U(I+1,J))*DY(J)/DX(I)                  P  690
  150 CONTINUE                                                         P  700
      RETURN                                                           P  710
      END                                                              P  720
@FOR,IS XYGEN,XYGEN
      SUBROUTINE XYGEN                                                 Q   10
      COMMON C(25,10),CA,CARS(4),CN(25,10),CX(25,10),D(2,25,10),DB,DM, Q   20
     .       DMS(8),DT,DTF,DV,DX(26),DXA(26),DY(11),DYA(11),FAC(4),    Q   30
     .       FCON(4,25,10),FD,FGB,FINAL,FWP,GH,GL,HEAD(12),HMC,HMS(8), Q   40
     .       IB(25),IBC(26),ICYCL,IP,IYR(4),KILL,LSP,MAXCYC,NB,NCYCLE, Q   50
     .       NL,NLEFT,NRC,NRIGHT,NTP,NW,NX,NXM1,NXP1,NY,NYM1,NYP1,NYR, Q   60
     .       P(26,11),PV,RH,RW,S(25,10),SC,TD(26),TH(26),TIME,U(26,11), Q   70
     .       UD(26,11),V(26,11),W(26,11),WA(8),WAR(8),WS(8),WSC(8),X(26) Q   80
     .       ,XC(25),XK(26,11),XNX,XNXP1,XNY,XNYP1,Y(11),YC(10),YK(26, Q   90
     .       11)                                                       Q  100
      LOGICAL KILL,XRRAT,XLRAT,YTRAT,YBRAT,ZYX                         Q  110
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      IF (FGB .EQ. 0.0) GO TO 50                                        Q  120
      XYZ = RW*0.5                                                      Q  130
      XYZ1 = -XYZ                                                       Q  140
      DO 10 I=1,NXP1                                                    Q  150
      IF (X(I) .LT. XYZ1) NL = NL+1                                     Q  160
      IF ((X(I) .GE. XYZ1) .AND. (X(I) .LT. XYZ)) NRC = NRC+1           Q  170
   10 CONTINUE                                                          Q  180
      DO 20 J=1,NYP1                                                    Q  190
      IF (Y(J) .LT. RH) NB = NB+1                                       Q  200
   20 CONTINUE                                                          Q  210
      DO 30 I=1,NX                                                      Q  220
   30 DX(I) = X(I+1)-X(I)                                               Q  230
      DO 40 I=1,NY                                                      Q  240
   40 DY(I) = Y(I+1)-Y(I)                                               Q  250
      GO TO 580                                                         Q  260
   50 CONTINUE                                                          Q  270
      ZYX = .FALSE.                                                     Q  280
      NRC = RW/GL*XNX                                                   Q  290
      IF (NRC .LT. 2) NRC = 2                                           Q  300
      XNRC = NRC                                                        Q  310
      DXR = RW/XNRC                                                     Q  320
      DISL = ABS(TD(1))-RW*0.5                                          Q  330
      DISR = GL-DISL-RW                                                 Q  340
      XYZ = NX-NRC                                                      Q  350
      NL = DISL/(DISL+DISR)*XYZ                                         Q  360
      IF (NL .LT. 2) NL = 2                                             Q  370
      NR = NX-NL-NRC                                                    Q  380
      IF (NR .LT. 2) GO TO 60                                           Q  390
      GO TO 70                                                          Q  400
   60 NR = 2                                                            Q  410
      NL = NL-1                                                         Q  420
   70 CONTINUE                                                          Q  430
      XNL = NL                                                          Q  440
      XNR = NR                                                          Q  450
      DO 80 I=1,NRC                                                     Q  460
      J = I+NL                                                          Q  470
   80 DX(J) = DXR                                                       Q  480
      XYZ = XNL*DXR                                                     Q  490
      IF (DISL-XYZ) 90,150,90                                           Q  500
   90 CONTINUE                                                          Q  510
      XYZ1 = DISL/DXR                                                   Q  520
      FACTR = 0.5                                                       Q  530
      IF (DISL .GT. XYZ) FACTR = 1.5                                    Q  540
      FACO = 1.                                                         Q  550
  100 SUML = 0.0                                                        Q  560
      ICNT = ICNT+1                                                     Q  570
      DO 110 I=NL,1,-1                                                  Q  580
      DX(I) = DX(I+1)*FACTR                                             Q  590
  110 SUML = SUML+DX(I)                                                 Q  600
      IF (ABS(SUML-DISL) .LE. 0.1) GO TO 140                            Q  610
      IF (ICNT .LT. 50) GO TO 120                                       Q  620
      WRITE (6,680)                                                     Q  630
      KILL = .TRUE.                                                     Q  640
      GO TO 170                                                         Q  650
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  120 CONTINUE                                                          Q  660
      DFAC = ABS(FACTR-FACO)*0.5                                        Q  670
      FACO = FACTR                                                      Q  680
      IF (SUML .GT. DISL) GO TO 130                                     Q  690
      FACTR = FACTR+DFAC                                                Q  700
      GO TO 100                                                         Q  710
  130 FACTR = FACTR-DFAC                                                Q  720
      GO TO 100                                                         Q  730
  140 IF ((0.75 .LE. FACTR) .AND. (1.25 .GE. FACTR)) GO TO 170          Q  740
      XLRAT = .TRUE.                                                    Q  750
      XLFAC = FACTR                                                     Q  760
      ZYX = .TRUE.                                                      Q  770
      GO TO 170                                                         Q  780
  150 CONTINUE                                                          Q  790
      DO 160 I=1,NL                                                     Q  800
  160 DX(I) = DXR                                                       Q  810
  170 CONTINUE                                                          Q  820
      XYZ = XNR*DXR                                                     Q  830
      N1 = NL+NRC+1                                                     Q  840
      IF (DISR-XYZ) 180,240,180                                         Q  850
  180 CONTINUE                                                          Q  860
      XYZ1 = DISR/DXR                                                   Q  870
      NRM1 = NR-1                                                       Q  880
      ICNT = 0                                                          Q  890
      FACTR = 0.5                                                       Q  900
      IF (DISR .GT. XYZ) FACTR = 1.5                                    Q  910
      FACO = 1.                                                         Q  920
  190 SUMR = 0.0                                                        Q  930
      ICNT = ICNT+1                                                     Q  940
      DO 200 I=N1,NX                                                    Q  950
      DX(I) = DX(I-1)*FACTR                                             Q  960
  200 SUMR = SUMR+DX(I)                                                 Q  970
      IF (ABS(SUMR-DISR) .LE. 0.1) GO TO 230                            Q  980
      IF (ICNT .LT. 50) GO TO 210                                       Q  990
      WRITE (6,690)                                                     Q 1000
      KILL = .TRUE.                                                     Q 1010
      GO TO 300                                                         Q 1020
  210 CONTINUE                                                          Q 1030
      DFAC = ABS(FACTR-FACO)*0.5                                        Q 1040
      FACO = FACTR                                                      Q 1050
      IF (SUMR .GT. DISR) GO TO 220                                     Q 1060
      FACTR = FACTR+DFAC                                                Q 1070
      GO TO 190                                                         Q 1080
  220 FACTR = FACTR-DFAC                                                Q 1090
      GO TO 190                                                         Q 1100
  230 IF ((0.75 .LE. FACTR) .AND. (1.25 .GE. FACTR)) GO TO 260          Q 1110
      XRRAT = .TRUE.                                                    Q 1120
      XRFAC = FACTR                                                     Q 1130
      ZYX = .TRUE.                                                      Q 1140
      GO TO 260                                                         Q 1150
  240 CONTINUE                                                          Q 1160
      DO 250 I=N1,NX                                                    Q 1170
  250 DX(I) = DXR                                                       Q 1180
  260 CONTINUE                                                          Q 1190
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      X(1) = TD(1)                                                      Q 1200
      DO 270 I=2,NL                                                     Q 1210
  270 X(I) = X(I-1)+DX(I-1)                                             Q 1220
      X(NL+1) = -RW+0.5                                                 Q 1230
      DO 280 I=1,NRC                                                    Q 1240
      J = I+NL+1                                                        Q 1250
  280 X(J) = X(J-1)+DXR                                                 Q 1260
      NRM1 = NR-1                                                       Q 1270
      DO 290 I=1,NRM1                                                   Q 1280
      J = NL+NRC+1+I                                                    Q 1290
  290 X(J) = X(J-1)+DX(J-1)                                             Q 1300
      X(NXP1) = GL+TD(1)                                                Q 1310
  300 CONTINUE                                                          Q 1320
      DISB = RH                                                         Q 1330
      DIST = GH-RH-HMC                                                  Q 1340
      IF (RH .EQ. 0.0) GO TO 410                                        Q 1350
      IF (RH .GT. HMC) GO TO 310                                        Q 1360
      DY(1) = RH                                                        Q 1370
      DY(2) = HMC                                                       Q 1380
      NT = NY-2                                                         Q 1390
      NL = 3                                                            Q 1400
      GO TO 420                                                         Q 1410
  310 CONTINUE                                                          Q 1420
      IF (RH .LE. 1.5*HMC) NB = 1                                       Q 1430
      IF ((1.5*HMC .LT. RH) .AND. (2.5*HMC .GE. RH)) NB = 2             Q 1440
      IF ((2.5*HMC .LT. RH) .AND. (3.5*HMC .GE. RH)) NB = 3             Q 1450
      IF ((3.5*HMC .LT. RH) .AND. (5.0*HMC .GE. RH)) NB = 4             Q 1460
      IF (5.*HMC .LT. RH) NB = 5                                        Q 1470
      N1 = NB+2                                                         Q 1480
      NT = NY-NB-1                                                      Q 1490
      IF (NB .NE. 1) GO TO 320                                          Q 1500
      DY(1) = RH                                                        Q 1510
      DY(2) = HMC                                                       Q 1520
      GO TO 420                                                         Q 1530
  320 CONTINUE                                                          Q 1540
      DY(NB+1) = HMC                                                    Q 1550
      XNB = NB                                                          Q 1560
      XYZ = XNB*HMC                                                     Q 1570
      XYZ1 = DISB/HMC                                                   Q 1580
      IF (DISB-XYZ) 350,330,350                                         Q 1590
  330 CONTINUE                                                          Q 1600
      DO 340 I=1,NB                                                     Q 1610
  340 DY(I) = HMC                                                       Q 1620
      GO TO 420                                                         Q 1630
  350 CONTINUE                                                          Q 1640
      ICNT = 0                                                          Q 1650
      FACTR = 0.5                                                       Q 1660
      IF (DISB .GT. XYZ) FACTR = 1.5                                    Q 1670
      FACO = 1.                                                         Q 1680
  360 SUMB = 0.0                                                        Q 1690
      ICNT = ICNT+1                                                     Q 1700
      DO 370 I=NB,1,-1                                                  Q 1710
      DY(I) = DY(I+1)*FACTR                                             Q 1720
  370 SUMB = SUMB+DY(I)                                                 Q 1730
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      IF (ABS(SUMB-DISB) .LE. 0.1) GO TO 400                            Q 1740
      IF (ICNT .LT. 50) GO TO 380                                       Q 1750
      WRITE (6,700)                                                     Q 1760
      KILL = .TRUE.                                                     Q 1770
      GO TO 420                                                         Q 1780
  380 CONTINUE                                                          Q 1790
      DFAC = ABS(FACTR-FACO)*0.5                                        Q 1800
      FACO = FACTR                                                      Q 1810
      IF (SUMB .GT. DISB) GO TO 390                                     Q 1820
      FACTR = FACTR+DFAC                                                Q 1830
      GO TO 360                                                         Q 1840
  390 FACTR = FACTR-DFAC                                                Q 1850
      GO TO 360                                                         Q 1860
  400 CONTINUE                                                          Q 1870
      IF ((0.75 .LE. FACTR) .AND. (1.25 .GE. FACTR)) GO TO 420          Q 1880
      YBRAT = .TRUE.                                                    Q 1890
      ZYX = .TRUE.                                                      Q 1900
      YBFAC = FACTR                                                     Q 1910
      GO TO 420                                                         Q 1920
  410 CONTINUE                                                          Q 1930
      NB = 0                                                            Q 1940
      DY(1) = HMC                                                       Q 1950
      NT = NYM1                                                         Q 1960
      N1 = 2                                                            Q 1970
      DIST = GH-HMC                                                     Q 1980
  420 CONTINUE                                                          Q 1990
      XNT = NT                                                          Q 2000
      XYZ = XNT*HMC                                                     Q 2010
      XYZ1 = DIST/HMC                                                   Q 2020
      IF (DIST-XYZ) 450,430,450                                         Q 2030
  430 CONTINUE                                                          Q 2040
      DO 440 I=N1,NY                                                    Q 2050
  440 DY(I) = HMC                                                       Q 2060
      GO TO 520                                                         Q 2070
  450 CONTINUE                                                          Q 2080
      ICNT = 0                                                          Q 2090
      FACTR = 0.5                                                       Q 2100
      IF (DIST .GT. XYZ) FACTR = 1.5                                    Q 2110
      FACO = 1.                                                         Q 2120
  460 SUMT = 0.0                                                        Q 2130
      ICNT = ICNT+1                                                     Q 2140
      DO 470 I=N1,NY                                                    Q 2150
      DY(I) = DY(I-1)*FACTR                                             Q 2160
  470 SUMT = SUMT+DY(I)                                                 Q 2170
      IF (ABS(SUMT-DIST) .LE. 0.1) GO TO 500                            Q 2180
      IF (ICNT .LT. 50) GO TO 480                                       Q 2190
      WRITE (6,710)                                                     Q 2200
      KILL = .TRUE.                                                     Q 2210
      GO TO 670                                                         Q 2220
  480 CONTINUE                                                          Q 2230
      DFAC = ABS(FACTR-FACO)*0.5                                        Q 2240
      FACO = FACTR                                                      Q 2250
      IF (SUMT .GT. DIST) GO TO 490                                     Q 2260
      FACTR = FACTR+DFAC                                                Q 2270
```

```
      GO TO 460                                                         Q 2280
      GO TO 460                                                         Q 2290
  490 FACTR = FACTR-DFAC                                                Q 2300
      GO TO 460                                                         Q 2310
  500 CONTINUE                                                          Q 2320
      IF ((0.75 .LE. FACTR) .AND. (1.25 .GE. FACTR)) GO TO 510          Q 2330
      YTRAT = .TRUE.                                                    Q 2340
      ZYX = .TRUE.                                                      Q 2350
      YTFAC = FACTR                                                     Q 2360
  510 CONTINUE                                                          Q 2370
  520 CONTINUE                                                          Q 2380
      Y(1) = 0.                                                         Q 2390
      IF (NB .LE. 1) GO TO 540                                          Q 2400
      DO 530 I=2,NB                                                     Q 2410
  530 Y(I) = Y(I-1)+DY(I-1)                                             Q 2420
      Y(NB+1) = RH                                                      Q 2430
      Y(NB+2) = RH+HMC                                                  Q 2440
      GO TO 560                                                         Q 2450
  540 CONTINUE                                                          Q 2460
      IF (RH .EQ. 0.0) GO TO 550                                        Q 2470
      Y(2) = RH                                                         Q 2480
      Y(3) = RH+HMC                                                     Q 2490
      GO TO 560                                                         Q 2500
  550 CONTINUE                                                          Q 2510
      Y(2) = HMC                                                        Q 2520
  560 CONTINUE                                                          Q 2530
      N2 = NB+3                                                         Q 2540
      DO 570 I=N2,NY                                                    Q 2550
  570 Y(I) = Y(I-1)+DY(I-1)                                             Q 2560
      Y(NYP1) = GH                                                      Q 2570
      IF ( .NOT. ZYX) GO TO 580                                         Q 2580
      WRITE (6,720)                                                     Q 2590
      IF (XLRAT) WRITE (6,730) XLFAC                                    Q 2600
      IF (XRRAT) WRITE (6,740) XRFAC                                    Q 2610
      IF (YBRAT) WRITE (6,750) YBFAC                                    Q 2620
      IF (YTRAT) WRITE (6,760) YTFAC                                    Q 2630
      WRITE (6,770)                                                     Q 2640
  580 CONTINUE                                                          Q 2650
      DO 590 I=1,NX                                                     Q 2660
  590 DX(I) = X(I+1)-X(I)                                               Q 2670
      DO 600 I=1,NY                                                     Q 2680
  600 DY(I) = Y(I+1)-Y(I)                                               Q 2690
      DY(NYP1) = DY(NY)                                                 Q 2700
      DX(NXP1) = DX(NX)                                                 Q 2710
      DO 610 J=1,NY                                                     Q 2720
      YC(J) = (Y(J)+Y(J+1))*0.5                                         Q 2730
  610 CONTINUE                                                          Q 2740
      DO 620 I=1,NX                                                     Q 2750
      XC(I) = (X(I)+X(I+1))*0.5                                         Q 2760
  620 CONTINUE                                                          Q 2770
      DO 630 I=1,NXM1                                                   Q 2780
      DXA(I) = 0.5*(DX(I)+DX(I+1))                                      Q 2790
  630 CONTINUE                                                          Q 2800
      DXA(NX) = DX(NX)                                                  Q 2810
      DXA(NXP1) = DXA(NX)
```

```
      DO 640 J=1,NYM1                                                   Q 2820
      DYA(J) = 0.5*(DY(J)+DY(J+1))                                      Q 2830
  640 CONTINUE                                                          Q 2840
      DYA(NY) = DY(NY)                                                  Q 2850
      DYA(NYP1) = DYA(NY)                                               Q 2860
C     SINCE TERRAIN AND ZONE DIMENSIONS MAY DIFFER BECAUSE OF           Q 2870
C     ROUNDOFF ERRORS (BUT NOT REAL DIFFERENCES), FORCE TERRAIN         Q 2880
C     DIMENSIONS TO ZONE DIMENSIONS IF WITHIN A FACTOR OF 1 PART        Q 2890
C     IN 10**7.  THIS SECTION PRESENT ONLY DUE TO PERVERSITY OF COMPUTER Q 2900
      DO 650 I=1,NXP1                                                   Q 2910
      DO 650 K=1,NTP                                                    Q 2920
      IF (ABS(X(I)-TD(K)) .LT. (1.E-7*X(I))) TD(K) = X(I)               Q 2930
  650 CONTINUE                                                          Q 2940
      DO 660 J=1,NYP1                                                   Q 2950
      DO 660 K=1,NTP                                                    Q 2960
      IF (ABS(Y(J)-TH(K)) .LT. (1.E-7*Y(J))) TH(K) = Y(J)               Q 2970
  660 CONTINUE                                                          Q 2980
  670 CONTINUE                                                          Q 2990
      RETURN                                                            Q 3000
  680 FORMAT (1X,                                                       Q 3010
     .        66HZONE SIZE RATIO TO LEFT OF ROADWAY EXCEEDS 2.0, CAN'T OB Q 3020
     .TAIN RATIO)                                                       Q 3030
  690 FORMAT (1X,                                                       Q 3040
     .        67HZONE SIZE RATIO TO RIGHT OF ROADWAY EXCEEDS 2.0, CAN'T O Q 3050
     .BTAIN RATIO)                                                      Q 3060
  700 FORMAT (1X,                                                       Q 3070
     .        61HZONE SIZE RATIO BELOW ROADWAY EXCEEDS 2.0, CAN'T OBTAIN Q 3080
     .RATIO)                                                            Q 3090
  710 FORMAT (1X,                                                       Q 3100
     .        65HZONE SIZE RATIO ON TOP OF ROADWAY EXCEEDS 2.0, CAN'T OBT Q 3110
     .AIN RATIO)                                                        Q 3120
  720 FORMAT (1H1//////////45X,33HTHE FOLLOWING ZONE RATIOS ARE BAD///) Q 3130
  730 FORMAT (45X,37HX CELLS TO LEFT OF ROADWAY      RATIO=,1PE13.7)    Q 3140
  740 FORMAT (45X,38HX CELLS TO RIGHT OF ROADWAY     RATIO=,1PE13.7)    Q 3150
  750 FORMAT (45X,32HY CELLS BELOW ROADWAY      RATIO=,1PE13.7)         Q 3160
  760 FORMAT (45X,32HY CELLS ABOVE ROADWAY      RATIO=,1PE13.7)         Q 3170
  770 FORMAT (//////////25X,                                            Q 3180
     .        76HTHE CALCULATION WILL CONTINUE, BUT THE RESULTS MUST BE V Q 3190
     .IEWED WITH SUSPICION//////////)                                   Q 3200
      END                                                               Q 3210
```

PART B

EXPLOR INPUT AND OUTPUT

INTRODUCTION

In this section the required input of the EXPLOR code is shown. The meanings of the variables are given and restrictions on the allowed values described. Some variables have default values, so that if the user chooses not to specify them, these preselected values are employed. Given the geometrical and meteorological data, up to four sets of traffic variables (number of cars and emission factors) can be calculated in a single problem. Interpretation of the output is also discussed.

INPUT DECK

The form of the input deck is shown below. The user is reminded to include a blank card if he is not specifying any values on a particular card, in order to keep the proper data sequence.

Variable	Format
(HEAD(I),I=1,12)	12A6
GH,GL,RH,RW,HMC,SC,FGB	8E10.4
FWP,PV,FD,DV,DM,DTF	8E10.4
NTP,IP,NYR,MAXCYC	10I5
(IYR(I),I=1,NYR)	10I5
(DMS(I),I=1,8)	8E10.4
(HMS(I),I=1,8)	8E10.4

Variable	Format
(WS(I),I=1,8)	8E10.4
(WA(I),I=1,8)	8E10.4
(TD(I),I=1,NTP)	8E10.4
(TH(I),I=1,NTP)	8E10.4
(X(I),I=1,NXP1) Only if FGB > 0	8E10.4
(Y(I),I=1,NYP1) Only if FGB > 0	8E10.4
(CARS(I),FAC(I),I=1,NYR	8E10.4

An additional problem can be run by following the above cards with an execute card, e.g.,

@XQT for an 1108

and an additional data deck. The procedure may be repeated as many times as desired.

MEANINGS OF INPUT VARIABLES

The meanings of the above variables are now listed. Where applicable, default values are given in parentheses.

Variable	Meaning and Default Value
HEAD	Header card, consisting of any alphanumeric characters. This line is used as identification and is printed at the head of each page of output.
GH	Grid height, the height of the problem in feet. If too large a number is chosen the ratio of cell sizes will be too large for an accurate calculation (200 feet).
GL	Grid length, the length of the problem in feet. If too large a value is chosen the ratio of cell sizes will be too large for an accurate calculation (1000 feet).
RH	Road height in feet. Somewhere in the grid there must be a terrain height of zero. RH is the height of the road above that level. If the road height is greater than the terrain height at that point a bridge or viaduct is simulated (0 feet).

Variable	Meaning and Default Value
RW	Road width in feet. The center of the road is at X = 0 (100 feet).
HMC	Height of the mixing cell in feet. Even when there is no mixing this value is used in the generator as the height of the first cell above the road and must not be zeroed (10 feet).
SC	Stability class. 1=A, 2=B,..., 7=G (4).
FGB	Force grid boundaries (i.e., force the values of x and y to those specified on input cards) if greater than zero (0).
FWP	Force wind profile if not equal to zero. The wind profile is defined as $$u/u_o = (y/y_o)^p$$ where p depends on the stability class. If FWP $\neq$ 0, the value of p is taken to be PV, specified below (0).
PV	Profile value. This is the value assigned to the exponent described above if FWP $\neq$ 0 (0).
FD	Force diffusivities. The code automatically calculates diffusivities but if FD is not equal to zero a constant value, specified below, is assigned to all cells (0).
DV	Diffusivity value. The value of the diffusivity ($1/\text{feet}^2$) for all cells if FD $\neq$ 0 (0).
DM	Delete mixing if not equal to zero. If there is no mixing the pollutant concentration is allowed to vary over the roadway. Mixing evenly distributes the pollutant one cell high across the freeway (0).
DTF	Delta time forced. Instead of having the code calculate the time step, a non-zero value for DTF becomes the Δt used by the code. Too large a value will result in instabilities and meaningless results (0).
NTP	Number of terrain points. The terrain data is input as a series of sets of terrain positions and heights. The number of these sets must be input in order to read the data correctly.

Variable	Meaning and Default Value
IP	Pollutant being studied. One value is currently available (1). 1 = CO
NYR	Number of years being done this problem, maximum of four. This is the number of car-emission factor data sets to be read. These data sets generally, but not always, refer to traffic conditions for different years (1).
MAXCYC	Maximum cycle to which the problem will run. If zero, the code will set MAXCYC to the minimum required to achieve steady state conditions (0).
IYR	The years being evaluated. IYR is used as a heading to identify data in the output but has no computational value. IYR may be left blank or contain any fixed point number of five or less digits.
DMS	Distance to the meteorological station in feet from the road center. Each wind speed must be specified at a point some distance from the road center and at some height. This point is called the meteorological station (0 feet).
HMS	Height of the meteorological station in feet above the zero point in the terrain data. Zero is not an allowed value (0 feet).
WS	Wind speed in mph. At least one wind speed must be specified per problem (0 mph).
WA	Wind angle in degrees. An angle must be specified for each wind speed. 0° is parallel to the freeway and is not allowed (90°).
TD	Terrain distance in feet from the roadway center. Every terrain point must be specified by a distance from the road center (negative to the left, the direction from which the wind is coming) and some height. TD(1) determines the left hand boundary of the problem and must be negative. The final terrain point must be at or greater than the value of [GL + TD(1)].
TH	Terrain height in feet. Every terrain distance must have an associated terrain height. At least one height must be zero and is used as a reference height for the problem.

Variable	Meaning and Default Value
X	X boundaries in feet if they are being manually input. Roadway cells must have the same widths (ΔX's). Use these cards if and only if FGB > 0.
Y	Y boundaries in feet if they are being manually input. Use these cards if and only if FGB > 0.
CARS	Number of cars for each set of traffic data (1).
FAC	Emission factor in grams/mile/car for each set of traffic data (1).

COMMENTS ON GENERATING FLAGS

In specifying input a number of problems may be encountered. If a critical input value is wrong or missing the code will print a message describing the error and proceed to the next calculation, if any.

Another type of message may also be encountered, which states that the zoning ratios are bad. This message is printed if the ratio of the dimensions of two adjacent zones is less than 0.75 or greater than 1.25. These criteria are imposed by numerical stability considerations. The limits chosen are somewhat arbitrary and have a safety factor built in so that valid results can be obtained even if the specified limits are exceeded. If they are, however, the results should be checked very carefully. If the ratio exceeds 2.0, the calculation will terminate because of a failure in the iteration procedure used in the generation of the problem.

OUTPUT

The first page of the output consists of a listing of the input variables plus various quantities such as the x and y boundaries, the wind angle in radians, and the right angle component of the wind. Titles are printed and this page is self explanatory.

On the second page is printed the traffic input data plus the ground level concentrations for each set of traffic data. The x and y values printed are for the center of the first cell above the terrain.

The third and following pages list the concentrations for each cell, for each set of traffic data. In this print, which is rotated clockwise 90° from the real zoning, the vertical direction is from left to right and the horizontal direction is from top to bottom. If the problem is not for level terrain, terrain features may be recognized by zero concentrations at the left of the page.

Examples of pages one to three follow.

```
B16C / HARBOR FREEWAY AT 146 / CUT I / 8-2 / 16-17

X (DISTANCE)
-2.000000+02 -1.427795+02 -9.600000+01 -5.760000+01 -1.920000+01  1.920000+01  5.760000+01  9.600000+01  1.338469+02  1.711486+02
 2.079130+02  2.441476+02  2.798607+02  3.150592+02  3.497507+02  3.839425+02  4.176417+02  4.508556+02  4.835910+02  5.158549+02
 5.476541+02  5.789952+02  6.098848+02  6.403296+02  6.703357+02  7.000000+02

DX (DELTA X)
 5.722046+01  4.677954+01  3.840000+01  3.040000+01  3.840000+01  3.840000+01  3.840000+01  3.784687+01  3.730172+01  3.676441+01
 3.623484+01  3.571291+01  3.519849+01  3.469147+01  3.419177+01  3.369926+01  3.321305+01  3.273542+01  3.226389+01  3.179916+01
 3.134111+01  3.088966+01  3.044472+01  3.000618+01  2.966427+01

Y (HEIGHT)
 0.000000     1.000000+01  2.146973+01  3.462519+01  4.971415+01  6.702076+01  8.687098+01  1.096386+02  1.357525+02  1.657044+02
 2.000000+02

DY (DELTA Y)
 1.000000+01  1.146973+01  1.315546+01  1.508896+01  1.730662+01  1.985022+01  2.276766+01  2.611388+01  2.995191+01  3.429557+01

GH= 2.000000+02   GL= 9.000000+02   RH= 0.000000   RW= 1.920000+02   HMC= 1.000000+01   SC= 1.000000+00   NIP=   6
FWP= 0.000000     FD= 0.000000     DM= 0.000000    DTF= 0.000000     MAXCYC=     0   FGB= 0.000000
CAR DATA      YEAR    CARS     EMISSION
              1972  1.148+04   2.230+01

POLLUTANT  1  WHERE I=CO

DMS (DISTANCE TO METEOROLOGICAL STATION)
 6.000000+02  0.000000     0.000000     0.000000     0.000000     0.000000     0.000000     0.000000

HMS (HEIGHT OF METEOROLOGICAL STATION)
 5.500000+01  0.000000     0.000000     0.000000     0.000000     0.000000     0.000000     0.000000

WS (WIND SPEED)
 5.750000+00  0.000000     0.000000     0.000000     0.000000     0.000000     0.000000     0.000000

WA (WIND ANGLE)
 2.250000+01  0.000000     0.000000     0.000000     0.000000     0.000000     0.000000     0.000000

TD (TERRAIN DISTANCE)
-2.000000+02 -1.430000+02 -9.600000+01  9.600000+01  1.430000+02  7.000000+02

TH (TERRAIN HEIGHT)
 2.200000+01  2.200000+01  0.000000     0.000000     2.200000+01  2.200000+01

WAR (WIND ANGLE, RADIANS)
 3.926925-01

WSC (WIND SPEED COMPONENT)
 2.200395+00
```

PAGE ONE

B16C / HARBOR FREEWAY AT 146 / CUT I / 8-2 / 16-17

YEAR	CARS	EMISSION
1972	1.148+04	2.230+01

CO IN PPM

X	Y	1972
-1.714+02	2.805+01	6.920-02
-1.194+02	1.573+01	3.326-03
-7.680+01	5.000+00	1.981+00
-3.840+01	5.000+00	1.981+00
-9.537-07	5.000+00	1.981+00
3.840+01	5.000+00	1.981+00
7.680+01	5.000+00	1.981+00
1.149+02	1.573+01	1.361+00
1.525+02	2.805+01	9.361-01
1.895+02	2.805+01	7.466-01
2.260+02	2.805+01	6.186-01
2.620+02	2.805+01	5.237-01
2.975+02	2.805+01	4.496-01
3.324+02	2.805+01	3.897-01
3.668+02	2.805+01	3.404-01
4.008+02	2.805+01	2.992-01
4.342+02	2.805+01	2.646-01
4.672+02	2.805+01	2.354-01
4.997+02	2.805+01	2.105-01
5.318+02	2.805+01	1.892-01
5.633+02	2.805+01	1.711-01
5.944+02	2.805+01	1.554-01
6.251+02	2.805+01	1.420-01
6.553+02	2.805+01	1.305-01
6.852+02	2.805+01	1.215-01

PAGE TWO