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Tests of an Urban Meteorological-Pollutant Model Using CO Validation Data in the Los Angeles Metropolitan Area Volume II, Fortran Program and Input/Output Specification

Office of Research and Monitoring
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Tests of an Urban Meteorological-Pollutant Model Using CO Validation Data in the Los Angeles Metropolitan Area Volume II, Fortran Program and Input/Output Specification

by

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1.1 Vertical and Horizontal Grids

The vertical grid at each horizontal grid point is shown in Figure 1 below, with the notation used for the height indices. This grid is identical for each grid point in the horizontal array. A sample 5×5 horizontal grid is shown in Figure 2.

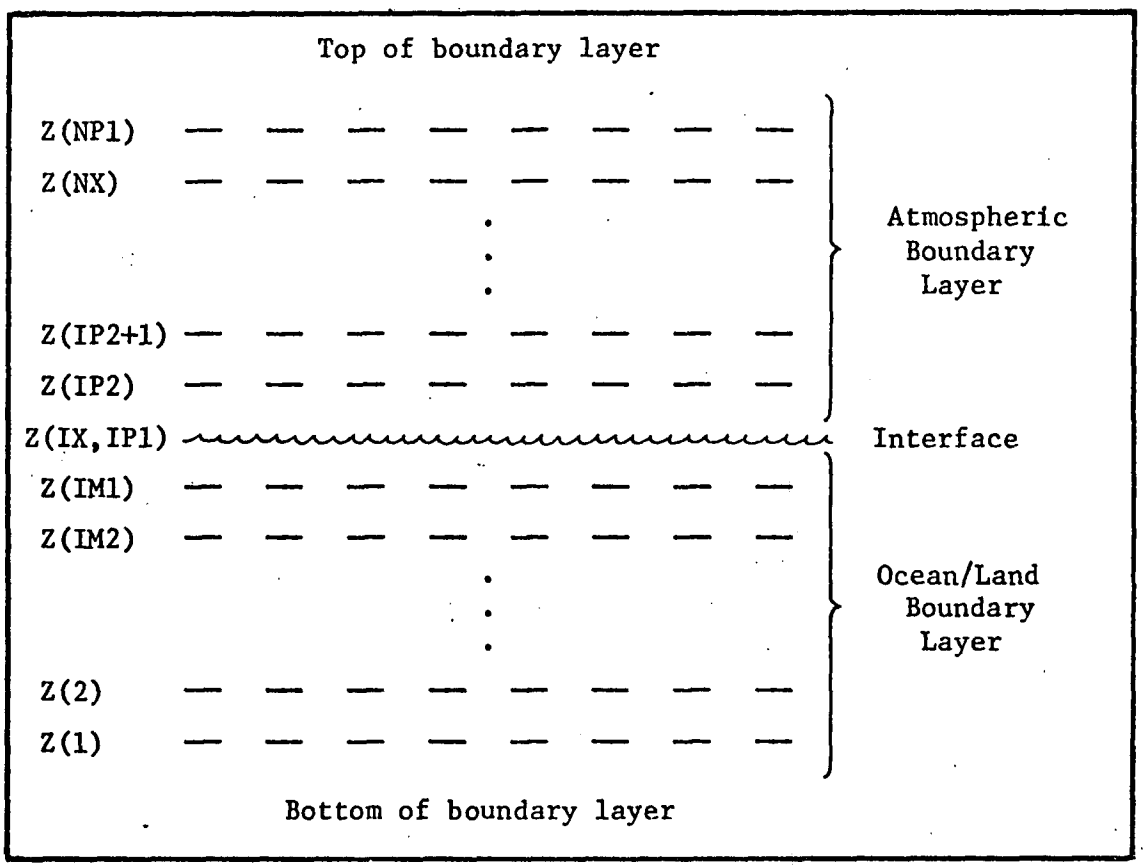
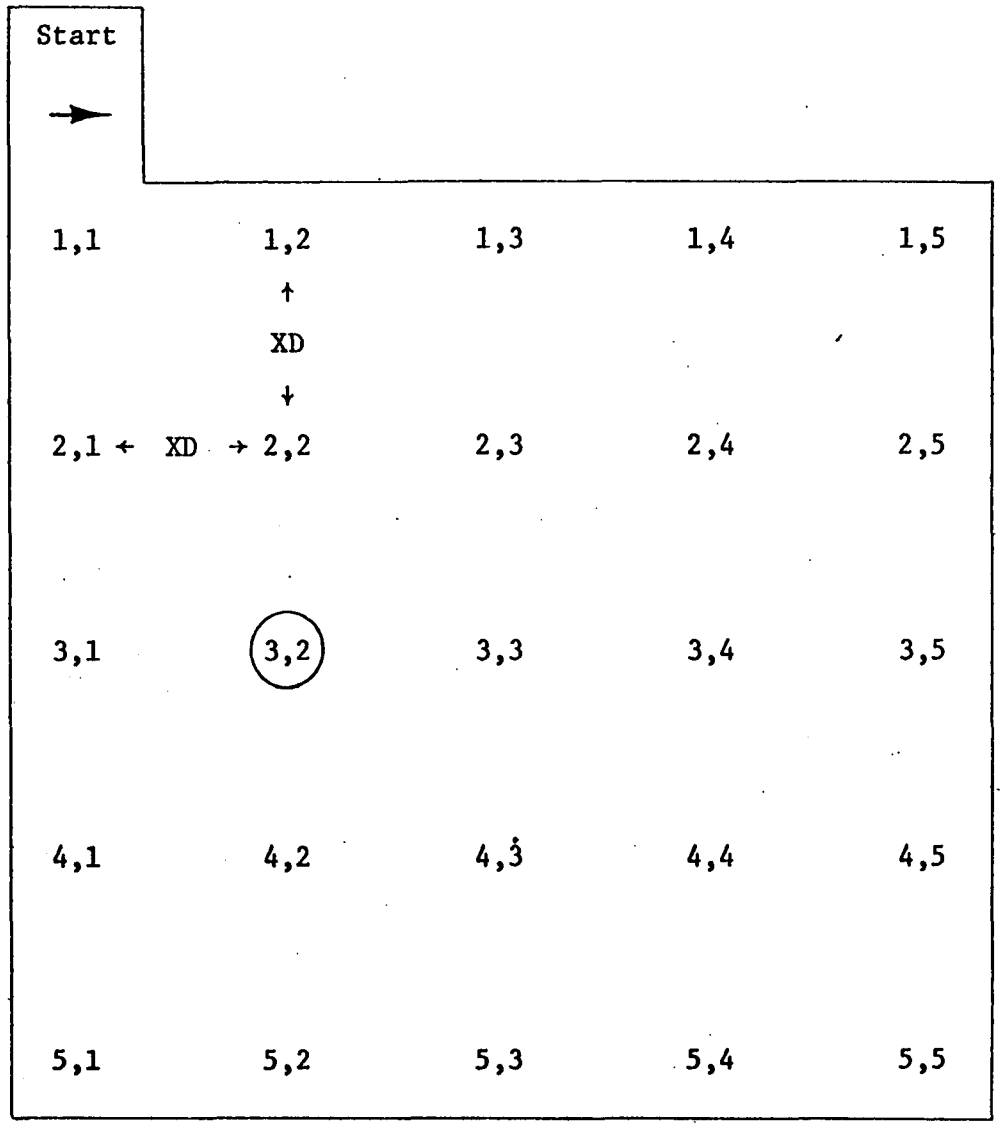


Figure 1. Notation Used in Height Indices. All height indices are referred to the bottom grid level in the ocean/land (Z(1) in the diagram above). There are two grid levels (Z(IX) = Z(IP1) = 0 cm) defined at the interface. Z(IX) = 0 is the water/land interface and Z(IP1) = 0 is the air interface.



XD = 12.874752 km

Figure 2. 5 × 5 Sample Horizontal Grid Network. The routine called TEMPRT can be optioned to printout any and/or all of the grid points in the grid areas. The circled point indicates the initial profiles input point which can be anywhere in the grid area and not necessarily at a given grid point.

1.2 Input Deck Setup

The input for each simulation is given by the following card sets. Units are given and the notation, n.d., implies nondimensional.

— — —

CARD TYPE (number ( ) of cards in set)

Type Number	Format	Columns	Program Symbols	Program Designates
1(1)	18A4	1-72	CØM	Comment Card.
2(1)	14I5	1-5	NX	Number of levels in the boundary layer minus one ($NX \leq 29$).
		6-10	IX	Height index at the interface ($IX \geq 4$)(n.d.).
		11-15	NT	Number of time steps.
		16-20	IMAX	Number of horizontal grid points (x-direction).
		21-25	JMAX	Number of horizontal grid points (y-direction).
		26-30	NTIME	-1: No meteorological input as a function of time. 0: Meteorological input.*
		31-35	NVAR6	Not used.
		36-40	ITESTP	Interval time step for printout (n.d.).
		41-45	IPØL	Pollutants present (0,1,2) (n.d.).

The following card is only used when columns 26-30, Card 2, is 0.

2M(1)	14I5	1-5	NVCHS(1)	+1: u and v wind and water current components are specified. 0: Not specified.

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* This option has not been fully tested.

		9-10	NVCHS(2)	+1: Temperature and specific humidity are specified. 0: Not specified.
		14-15	NVCHS(3)	Not used.
		19-20	NVCHS(4)	+1: Interface temperature is specified.* 0: Not specified.
3(1)	6F12.4	1-12	DT	Time step (min).
		13-24	XD	Horizontal grid spacing (km).
		25-36	DECLX	Declination (deg).
		37-48	DCHG	Daily declination change (deg).
		49-60	XIIN	Input grid point (x-coordinate)(n.d.).
		61-72	XJIN	Input grid point (y-coordinate)(n.d.).
4(1)	6F12.4	1-12	PHIBOT	Latitude at southwestern grid point (deg).
		13-24	HWEST	Initial local hour angle at western grid boundary (deg).
		25-36	EM	Infrared emissivity of the surface (n.d.).
		37-48	ZW	Height of the vertical grid level to be used in the computation of the wave dimensions. This height is 19.5m or the lowest grid level above 19.5m (cm).
		49-60	RTIME	Time step for radiation computation (min).
5(N/6)	6F12.4	1-12 ⋮ 61-72	Z_j(j=1,N)	Distance of the vertical grid levels from the interface in centimeters ($N \leq 30$). Values below interface indicated by minus.

* Not completed.

Cards 6-11 assume the initial values to be at the horizontal grid point, XIIN, XJIN given on Card 3.

6(N/6)	6F12.4	1-12 ⋮ 61-72	U_j(j=1,N)	Initial values of eastward wind or current component (cm/sec). Values of U(IX) and U(IP1) must be equal.
7(N/6)	6F12.4	1-12 ⋮ 61-72	V_j(j=1,N)	Initial values of northward wind or current component (cm/sec). Values of V(IX) and V(IP1) must be equal.
8(N/6)	6F12.4	1-12 ⋮ 61-72	T_j(j=1,N)	Initial values of the atmospheric and oceanic temperatures (°K). Values of T(IX) and T(IP1) must be equal.
9(N/6)	6F12.4	1-12 ⋮ 61-72	W_j(j=1,N)	Initial values of oceanic salinity (g/kg), N=1, IX; and values of atmospheric humidity (g/kg), N=IP1, NP1. In most cases, W(IX) and W(IP1) will not have numerically equal values.
10(N/6)	6F12.4	1-12 ⋮ 61-72	$PP12_j$(j=1,N)	Initial values of pollutant 1 ($\mu g/m^3$). Values from 1 to IP1 are not used.
11(N/6)	6F12.4	1-12 ⋮ 61-72	$PP22_j$(j=1,N)	Initial values of pollutant 2 ($\mu g/m^3$). Values from 1 to IP1 are not used.

Cards 12-15 are information relating to the initial and peripheral horizontal gradients. The card set consisting of Cards 12-15 are repeated for each of the following parameters in the order in which they appear:

j = 1 Oceanic and atmospheric - u-gradients (cm/sec/cm)
2 Oceanic and atmospheric - v-gradients (cm/sec/cm)
3 Oceanic and atmospheric temperature gradients (°K/cm)
4 Oceanic salinity and atmospheric humidity gradients (g/kg/cm)
5 Pollutant 1 gradients ($\mu g/m^3$/cm)
6 Pollutant 2 gradients ($\mu g/m^3$/cm).

NOTE: The horizontal gradients at the interface should be repeated if the subsurface and the atmospheric horizontal gradients are different at the interface. Whenever there is only one input level, the horizontal gradient is assumed to be constant at all height levels.

12(1)	14I5	1-5	K_j	Number of grid levels at which gradients are input for appropriate parameter where j on cards 12,13,14, 15 is defined on bottom of previous page ($K \leq 30$).
13(N/6)	6E12.5	1-12 ⋮ 61-72	ZI(i) $(i=1,K_j)$	Height (cm) of input horizontal gradient levels in ascending order. A minus sign indicates values below the interface.
14(N/6)	6E12.5	1-12 ⋮ 61-72	ZDIX(i) $(i=1,K_j)$	x-horizontal gradients in ascending order. Units are defined above.
15(N/6)	6E12.5	1-12 ⋮ 61-72	ZDIY(i) $(i=1,K_j)$	y-horizontal gradients in ascending order. Units are defined above.
16(1)	4F10.2	1-10	SØAB	Solar absorption coefficient (km^{-1}).
		11-20	SØSC	Solar backscatter coefficient (km^{-1}).
		21-30	XNØ	Infrared absorption coefficient (km^{-1}).
		31-40	CØCØB	Mie initialization factor (g air/10^{10}g pollutant). A constant that depends on the density and specific volume of an aerosol distribution.
17(1)	14I5	1-5	NLAP	Number of levels above NP1 in the atmospheric sounding for input (n.d.) (≤ 20).
		6-10	NPU	Indicator of the reference level for pressure computations (see input card type 20)(0,1).

NOTE: Cards are repeated NLAP times.

18(NLAP)	4F10.2	1-10	PA	Pressure (mb).
		11-20	TA	Temperature (°K).
		21-30	QA	Humidity (g/kg).
		31-40	CØB	0.

The first set of cards, 30M to 33M, are input here only when columns 26 to 30, Card 2, is 0 (see Card 30M). The following cards (19-28) are repeated for each horizontal grid point in the order 1,1; 1,2; ... 2,1 ... as indicated in Figure 2.

19(1)	14I5	1-5	NTFØR	Number of cloud input cards (n.d.)($\leq$ 10).
		6-10	NCL	Number of cloud layers (n.d.)($\leq$ 4).
		11-15	NTCUV	Number of geostrophic wind current component input cards (n.d.)($\leq$ 20).
		16-20	IPØI	Number of pollutants source types at this grid point (n.d.)(0,1,2).
		21-25	IGØNY	Water/land option indicator (-2 = coastal corner, -1 = coastal, 0 = water, 1 = land.
		26-30	ISSI1	Number of input time steps used for pollutant 1 (n.d.) (if IPØI=1,2)($\leq$ 20).
		31-35	ISSI2	Number of input time steps used for pollutant 2 (n.d.) (if IPØI=2)($\leq$ 20).
20(1)	4F10.2	1-10	PSFA	Pressure at surface (mb) NPU=0; or pressure at upper boundary (mb) NPU=1.
		11-20	XLAM	Wavelength of the characteristic turbulent wave ($-Z_0$ if land)(cm).
		21-30	DEL	Steepness of the characteristic turbulent wave (0 if land)(n.d.).

20a(1)	6E12.4	1-12	SLØPX	Slope of the land surface at the interface in the x-direction.
		13-24	SLØPY	Slope of the land surface at the interface in the y-direction.
		25-36	HEIGHT	Height of land or depth of water from an absolute reference surface (e.g., mean sea level) land elevation positive, water depth negative (m).
		37-48	ETAINX	Elevation of water surface at open boundaries (N-S boundaries, cm).
		49-60	ETAINY	Elevation of water surface at open boundaries (E-W boundaries, cm).
		61-72	IANV	See below.

IANV = 0 For coastal corner (IGØNY = -2)
For water (IGØNY = 0)
For land (IGØNY = +1)

= 1 For a coastal station (IGØNY = -1) which lies parallel to the latitude (EAST-WEST DIRECTED).

= 2 For a coastal station (IGØNY = -1) which lies perpendicular to the latitude (NORTH-SOUTH DIRECTED).

NOTE: In the following card set, linear interpolation in time is used to compute the geostrophic winds and currents at each time step from the input values. When only one value is input, the values are assumed constant.

21(NTCUV) (I5,4F10.2,2A4)

1-5	ICUV	Input time step for geostrophic wind current (n.d.).
6-15	XØCU	Eastward component of geostrophic current at Z(IX) (cm/sec).
16-25	XØCV	Northward component of geostrophic current at Z(IX)(cm/sec).
26-35	XACU	Eastward component of geostrophic wind at Z(NP1) (cm/sec).

36-45	XACV	Northward component of geostrophic wind at Z(NP1) (cm/sec).
46-53	T1,T2	Not used in program. Used to identify station in deck and printout.

NOTE: The following card set is included only when NCL on Card 19 is not equal to zero. Linear interpolation is used to compute the cloud amounts at each level and the rainfall rate at each time step from the clouds and rainfall rate specified at the input time steps. When only one time step is input, the values are held constant.

22(NTFØR) (I4,I2,F6.2,5(I3,F4.1,F4.0))

1-4	ISTEP	Input time step for clouds (n.d.)($\leq$ 10).
5-6	NXN	Number of cloud layers (n.d.)($\leq$ 4).
7-12	RAINI	Rainfall rate (cm/sec).
13-15	LLCI	Index for the grid level at which cloud layer occurs.
16-20	ECLI	Cloud amount at level (tenths).
21-24	TCLI	Cloud type at level (1, ... 9).*

Repeated for NXN levels as needed.

25-27	LLCI	Level 2
28-32	ECLI	Amount 2
33-36	TCLI	Type 2
37-39	LLCI	Level 3
40-44	ECLI	Amount 3
45-48	TCLI	Type 3
49-51	LLCI	Level 4
52-56	ECLI	Amount 4
57-60	TCLI	Type 4.

---

*Cloud type is defined as

1) Fog	4) Cumulus	7) Alto Cumulus
2) Stratus	5) Cumulonimbus	8) Cirrus
3) Strato Cumulus	6) Alto Stratus	9) Cirro Stratus

NOTE: Include Cards 23 and 24 only when IGØNY on Card 19 is 1 (i.e. land).

23(1)	7F10.2	1-10	SRS	Surface albedo (n.d.) ($0 \leq r \leq 1$).
		11-20	RØW	Surface density (g/cm^3) (n.d.).
		21-30	CW	Surface specific heat (n.d.) (cal/cm/sec).
		31-40	XMQ	Moisture parameter (n.d.) ($0 \leq m \leq 1$).
		41-50	RADMX	Artificial heat source due to combustion by man (n.d.).
24(1)	7F10.2	1-10	XKT_i(i=1,IM1)	Thermal diffusivity for soil layers (cm^2/sec).

Cards 25 to 27 are included only when IPØI on Card 19 is 1 or 2. When IPØI is 2, the set is repeated for the second pollutant source.

NOTE: Linear interpolation in time is used to compute the pollutant source at each time step from input values identified on the following cards (25 and 26). If one value is used, the value is constant.

25(1)	14I5	1-5 ⋮ 65-70	ITS1	Time step for input pollutant source (n.d.). There are ISSI1 (Card 19) values in the first set and ISSI2 in the second set, if IPØ1=2.
26(1)	7F10.2	1-10 ⋮ 61-70	SØU1	Strength of pollutant source emissions ($\mu g/m^2/sec$) for pollutant 1 in the first set and pollutant 2 if the second set is used.
27(1)	6F10.2	1-10 ⋮ 51-60	SH1(1-6)	Fractional source emission at each height level from the interface to the 5th atmospheric level for pollutant 1 (2 if second set) (n.d.).

NOTE: Include Card 28 only when IGØNY = 1 (i.e. land).

28(1)	6F12.4	1-12 ⋮ 61-72	YY(I,3)	Temperatures in the soil at each level (1 to IP1).
29(1)	6E12.4	1-12	YY(I,5)	Pollutants for individual stations (I = IX,NP1). See IPØL (Card type 2). 0: none read. 1: set (1) read YY(I,5). 2: set (2) read YY(I,6).

The following are included only when columns 26-30, Card 2 is 0, and the card set 30-33 repeated for each input time step; i.e., specified meteorological variables are input at all time steps. The first card set, 30M to 33M will be input after Card 18. All other sets follow Card 29.

30M(1)	14I5	1-5	NTIME	Time step for input variable.
		10	K	Number of input gradient levels for each.

The following cards are repeated for each level i = 1,NP1 . Only the input variables need be specified.

31M(1)	7F10.2	1-10	VARIN(i,1)	Input value at NTIME for u-component (cm/sec).
		11-20	VARIN(i,2)	Input value at NTIME for v-component (cm/sec).
		21-30	VARIN(i,3)	Input value at NTIME for temperature (°K).
		31-40	VARIN(i,4)	Input value at NTIME for specific humidity (g/kg).

The following set of 2 cards each are read for each level that there is a gradient. There are "K" sets of cards. Include Card 1 when NVCHS(1) = 1 (see Card 2M).

32M(1)	7F10.2	1-10	Height of gradient (cm).
		11-20	u-gradient in x-direction.
		21-30	u-gradient in y-direction.
		31-40	v-gradient in x-direction.
		41-50	v-gradient in y-direction.

Include following in each set when NVCHS(2) = 1 . See card 2M.

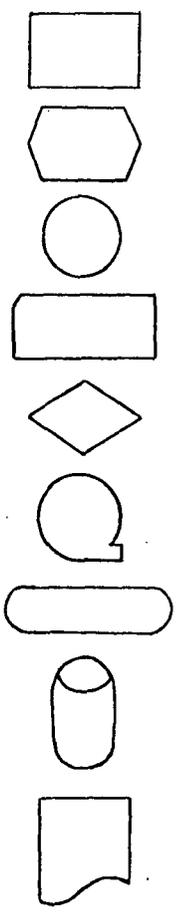
33M(1)	7F10.2	1-10	Height gradient (cm).
		11-20	Temperature gradient in the x-direction.
		21-30	Temperature gradient in the y-direction.
		31-40	Specific humidity gradient in the x-direction.
		41-50	Specific humidity gradient in the y-direction.

The set of cards (30M - 33M) is repeated at each input time step until the time step on 30M (NTIME) is greater or equal to the last time step of the simulation (NT on Card 2).

2.0 MAIN PROGRAM: RIGID LID Version

This section contains a flow diagram (Figure 3) which shows the operations in the numerical model MAIN Program, RIGID LID version, for the atmosphere-ocean planetary boundary layer with land option and pollutants. Following the flow diagram is its accompanying program listing.

The symbols used in the diagram are, for the most part, those which have become standard flow chart symbols. The explanation of the symbols is as follows:



Program steps.

Subroutine call.

Content self-explained.

Punched cards (input).

Decision on symbol content.

Magnetic tape (output).

Multiple entrance branch.

Disk (temporary storage).

Printed (output).

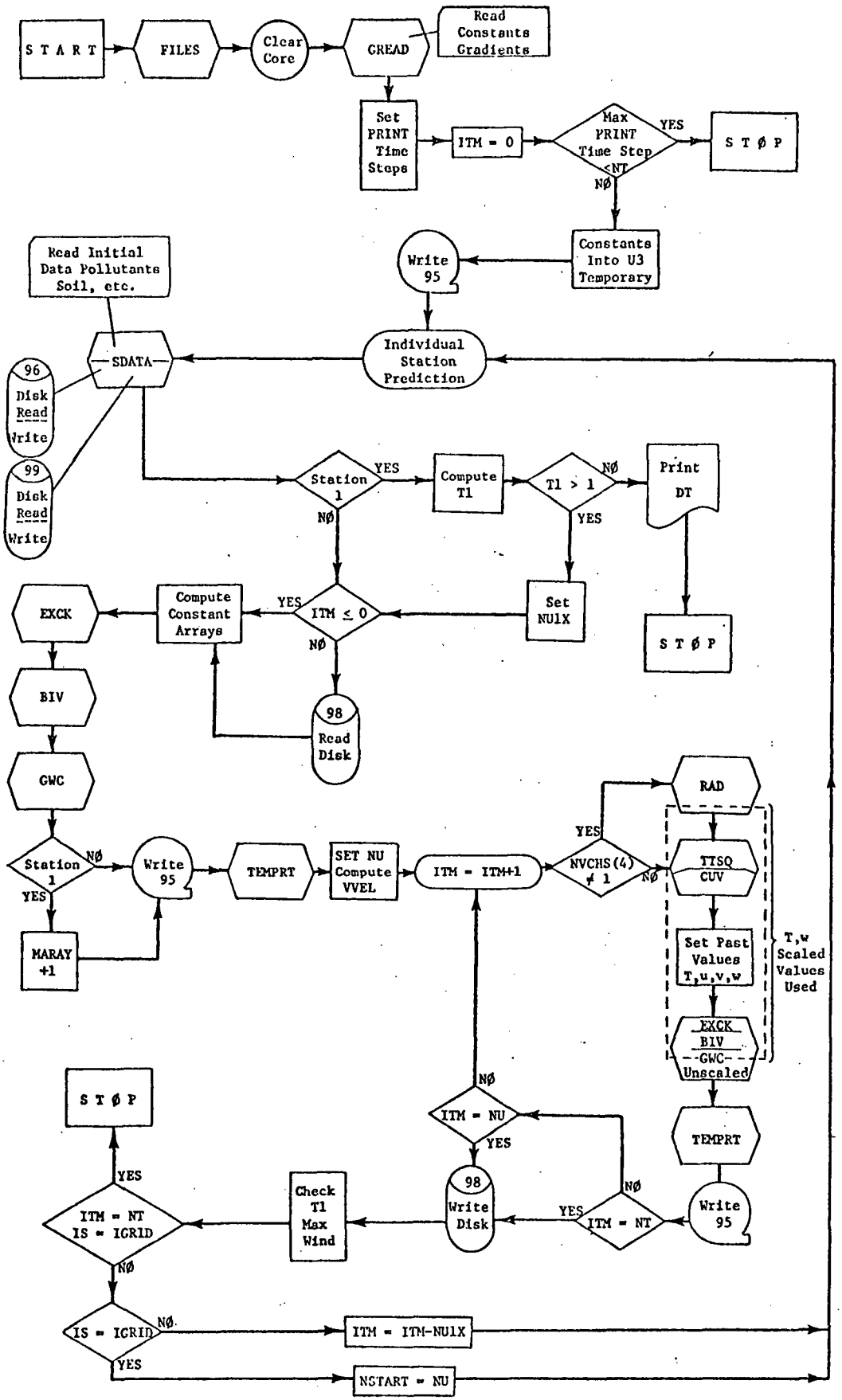


Figure 3. Flow Diagram MAIN Program, RIGID LID Version: Air-sea-land interaction model.

RIGID LID Program Listing

```
C       MAIN PROGRAM AIR-SEA INTERACTION  WITH  LAND OPTION                    MAIN000
C  1972 VERSION      TAPE OUTPUT  AT YOU GO                                    MAIN001
       INTEGER RDRUM,SDRUM,TDRUM                                               MAIN002
       DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PQ12           MAIN003
      1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3          MAIN004
      2   ,WO,WSC,XKT,XYY,YY,GTO                                              MAIN005
COMMON-DOUBLE PRECISION NOT ON DISK OR RESTART                                 MAIN006
       COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)              MAIN007
      1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)           MAIN008
      2   ,TT3(30),W3(30),SST                                                 MAIN009
COMMON-FOR PRINT ONLY                                                          MAIN010
       COMMON R1(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,     MAIN011
      1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE     MAIN012
      2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2                   MAIN013
COMMON-FOR RESTART AND PRINTOUT                                                MAIN014
       COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL                     MAIN015
      1   ,XLAM,RSUM(15),B1,B2                                                 MAIN016
COMMON-NEEDED FOR RESTART ONLY                                                 MAIN017
       COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)          MAIN018
      1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)        MAIN019
      2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2         MAIN020
      3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)       MAIN021
      4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)              MAIN022
      5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF                    MAIN023
      6   ,PHIR,GD2,ISTR,SOSC,SCAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV               MAIN024
COMMON-OTHER THAN DOUBLE PRECISION-PRINT OR RESTART                            MAIN025
      7   ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)     MAIN026
       COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)            MAIN027
      1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)          MAIN028
      2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)       MAIN029
       COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                            MAIN030
       COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6         MAIN031
      1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3           MAIN032
      2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME        MAIN033
      3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2          MAIN034
      4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2                 MAIN035
      5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                        MAIN036
       COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL           MAIN037
      1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                          MAIN038
       COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20          MAIN039
      2     , T13,T14,T15,T16,XD1,YD1                                          MAIN040
      3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                             MAIN041
       COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II      MAIN042
       COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)           MAIN043
      1 , I1IHT,I2IHT,I3IHT,I4IHT                                             MAIN044
       DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)                MAIN045
       EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))           MAIN046
      1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))                  MAIN047
       COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                            MAIN048
       COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                            MAIN049
       COMMON /GRDNTS / GXY(30,12),PGXY(30,12),CGXY(30,12)                     MAIN050
       DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)           MAIN051
      1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)                    MAIN052
      2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)                    MAIN053
      3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)                   MAIN054
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```
     4  ,CP2X(30),CP2Y(30)                                                    MAIN055
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))                   MAIN056
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))                    MAIN057
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))                    MAIN058
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))                    MAIN059
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))                   MAIN060
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))                  MAIN061
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))                  MAIN062
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))                  MAIN063
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))                  MAIN064
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))                  MAIN065
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))                  MAIN066
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))                  MAIN067
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))                  MAIN068
C   UNITS 99,96 FOR YY TO STORE FOR COMPUTATION OF GRADIENTS--DIRECT ACC     MAIN069
C   UNIT  98  FOR RESTART VARIABLES -- DIRECT ACCESS                         MAIN070
C   UNIT  95  STORAGE FILE FOR PRINT -- TAPE OR DISK SEQUENTIAL              MAIN071
      DOUBLE PRECISION XT1,XTIME                                             MAIN072
      DIMENSION ZEROCM(2)     ,YIN(1)                                        MAIN073
      EQUIVALENCE (ZEROCM(1),XYY(1,1,1))  , (U2(1),YIN(1))                   MAIN074
      DO 555 I=1,6167                                                        MAIN075
  555 ZEROCM(I) = 0.                                                         MAIN076
      CALL FILES                                                             MAIN077
      SDRUM = 99                                                             MAIN078
      RDRUM = 96                                                             MAIN079
      NWSYY = 180*2 + 12                                                     MAIN080
C     TIMES 2 FOR DOUBLE PRECISION ONLY                                      MAIN081
      IXTRA = 1                                                              MAIN082
      NCR = 1358                                                             MAIN083
      NCS =  594                                                             MAIN084
      TDEL = 0.                                                              MAIN085
      IK = 0                                                                 MAIN086
C     COMPUTE GRADIENTS   AND READ IN DATA FOR THE GRID                      MAIN087
      CALL GREAD                                                             MAIN088
      I = 0                                                                  MAIN089
      DO 702 J=1,20                                                          MAIN090
      ITIMES(J) = I                                                          MAIN091
  702 I = I+ITESTP                                                           MAIN092
      ITM = 0                                                                MAIN093
      IF (ITIMES(20).LT.NT) GO TO 80                                         MAIN094
      NSTART = 0                                                             MAIN095
C     INDIVIDUAL STATION PREDICTION FILE 1                                   MAIN096
      XDT1 = XD/110.8 * 1.E-5                                                MAIN097
      SAVE = 0.01                                                            MAIN098
      U3(1) = NCS                                                            MAIN099
      U3(2) = JMAX                                                           MAIN100
      U3(3)= IMAX                                                            MAIN101
      U3(4) = IPOL+11                                                        MAIN102
      U3(5) = NP1                                                            MAIN103
      U3(6) = IX                                                             MAIN104
      U3(7) = DT                                                             MAIN105
      DO 703 I=1,20                                                          MAIN106
  703 U3(I+7) = ITIMES(I)                                                    MAIN107
      U3(28) = XD * 1.E-5                                                    MAIN108
      WRITE (95     ) (Z(I),I=1,NCS)                                         MAIN109
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```
   41 DO 98 NS=1,JMAX                                                    MAIN110
      DO 98 MS=1,IMAX                                                    MAIN111
      IS = (NS-1) * IMAX + MS                                            MAIN112
      CALL SDATA                                                         MAIN113
      IF (IS.GT.1) GO TO 90                                              MAIN114
      T1 = TDEL /(1.424214*DT)                                           MAIN115
      PRINT 335,ITM,DT,T1                                                MAIN116
      IF (T1-1.)1112,1112,336                                            MAIN117
 1112 PRINT 31                                                           MAIN118
      GO TO 80                                                           MAIN119
  336 NU1X = T1                                                          MAIN120
      IF(ITM+NU1X.GT.NT)NU1X = NT-ITM                                    MAIN121
      IF(NTIME.GT.0.AND.ITM+NU1X.GT.NTIME)NU1X = NTIME-ITM               MAIN122
      NUX = NSTART + NU1X                                                MAIN123
   90 IF(ITM.LE.0) GO TO 47                                              MAIN124
C     READ FILE 1 FOR RESTART                                            MAIN125
      READ (98'IS) (XKU(I),I=1,NCR)                                      MAIN126
      IGONY = IGOGO-3                                                    MAIN127
   47 IF (NTIME.LT.0.OR.IGET.NE.ITM) GO TO 319                           MAIN128
      XM = MS                                                            MAIN129
      YM = NS                                                            MAIN130
      XD1 = XD*(XIIN-XM)                                                 MAIN131
      YD1 =-XD*(XJIN-YM)                                                 MAIN132
      XT1= NTIME-IGET                                                    MAIN133
      XTIME = 1./XT1                                                     MAIN134
      DO 315 I=1,NP1                                                     MAIN135
      IF (NVCHS(1).NE.1)  GO TO 312                                      MAIN136
C  COMPUTE NEW INPUT U3,V3                                               MAIN137
      U3(I)  = VARIN(I,1)-GNV(I,2)*YD1-GNV(I,1)*XD1                      MAIN138
      V3(I)  = VARIN(I,2)-GNV(I,4)*YD1-GNV(I,3)*XD1                      MAIN139
      U1(I) = U2(I)-XTIME*(U3(I)-U2(I))                                  MAIN140
      V1(I) = V2(I)-XTIME*(V3(I)-V2(I))                                  MAIN141
  312 IF (NVCHS(2).NE.1) GO TO 315                                       MAIN142
      TT3(I) = VARIN(I,3)-GNV(I,6)*YD1-GNV(I,5)*XD1-TTO(I)               MAIN143
      W3 (I) = VARIN(I,4)-GNV(I,8)*YD1-GNV(I,7)*XD1-WO(I)                MAIN144
      TT1(I)= TT2(I)-XTIME*(TT3(I)-TT2(I))                               MAIN145
      W1 (I)= W2 (I)-XTIME*(W3 (I)-W2(I))                                MAIN146
  315 CONTINUE                                                           MAIN147
  319 DO 2000 I=1,NX                                                     MAIN148
      DTO(I)=TTO(I+1)-TTO(I)                                             MAIN149
      TBO(I)=(TTO(I+1)+TTO(I))/2.                                        MAIN150
      WBO(I)=(WO(I+1)+WO(I))/2.                                          MAIN151
      IF(I-IX)88,2000,88                                                 MAIN152
   88 DWO(I) = WO(I+1)-WO(I)                                             MAIN153
      GTO(I)=DTO(I)/DZ(I)                                                MAIN154
      GWO(I)=DWO(I)/DZ(I)                                                MAIN155
 2000 CONTINUE                                                           MAIN156
      H3 = 0.                                                            MAIN157
C     INEWC = INEW                                                       MAIN158
      IRAT = IMARA                                                       MAIN159
      IF(ITM.GE.1) GO TO 49                                              MAIN160
      I1IHT = 2                                                          MAIN161
      I2IHT= 2                                                           MAIN162
      I3IHT = 2                                                          MAIN163
      I4IHT= 2                                                           MAIN164
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   35 CALL EXCK                                                          MAIN165
      H = H * .017453293                                                 MAIN166
      RSUM(15) = XKT(NX)                                                 MAIN167
      RSUM(14) = XKT(1)                                                  MAIN168
   40 CALL BIV                                                           MAIN169
   45 CALL GWC                                                           MAIN170
C     STORE INITIAL TIME STEP DATA FOR ALL STATIONS FOR PRINT FILE 3     MAIN171
      IF (IS.GT.1) GO TO 46                                              MAIN172
      MARAY(IXTRA) = MARAY(IXTRA)+1                                      MAIN173
      PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)                          MAIN174
   46 WRITE (95) (RI(I),I=1,NCS)                                         MAIN175
      CALL TEMPRT                                                        MAIN176
      PRINT 101,ETA2,DELZ,XETA2,YETA2,CU(IX),CV(IX),IHT,IGOGO            MAIN177
   49 NU = NUX                                                           MAIN178
  857 IF(IGONY.GT.0) GO TO 202                                           MAIN179
      IF(IHT.GT.1) GO TO 201                                             MAIN180
      SUM2 = (CUX(IX)+CVY(IX))*(DZ(IM1)/2.)                              MAIN181
      DO 209 I=2,IX                                                      MAIN182
      K=IX-I+1                                                           MAIN183
      SUM2 = SUM2 + (CUX(K)+CVY(K))*(DZ(K-1)+DZ(K))/2.                   MAIN184
  209 VVEL(K) = SUM2                                                     MAIN185
      VVEL(IX)=0.                                                        MAIN186
      IF(ITM.GT.1) GO TO 202                                             MAIN187
      ETA2 = 0.                                                          MAIN188
      DELZ = 0.                                                          MAIN189
      SLOPX= 0.                                                          MAIN190
      SLOPY= 0.                                                          MAIN191
      GO TO 202                                                          MAIN192
  201 DO 267 I=1,IX                                                      MAIN193
  267 VVEL(I) = 0.0                                                      MAIN194
      SUM1 = 0.                                                          MAIN195
      IIHT = IHT                                                         MAIN196
      IF(IGONY.EQ.-2) IIHT = 2                                           MAIN197
      DO 200 K=IIHT,IM1                                                  MAIN198
      SUM1 = SUM1 - (CUX(K) + CVY(K))*(DZ(K-1) + DZ(K))/2.               MAIN199
      VVEL(K) = SUM1                                                     MAIN200
  200 CONTINUE                                                           MAIN201
      VVEL(IX) = SUM1 - (CUX(IX) + CVY(IX))*(DZ(IM1)/2.)                 MAIN202
      VVEL(IP1) = VVEL(IX)                                               MAIN203
      ETA2 = ETA1 + VVEL(IX)*DT                                          MAIN204
      DELZ = ETA2 - ETA1                                                 MAIN205
      IF(ABS(ETA2).GT.500..AND .IGOGO.NE.1) GO TO 206                    MAIN206
      GO TO 205                                                          MAIN207
  206 PRINT 207,ETA2                          ,DELZ,VVEL(IX),ITM,IS,IGOGO MAIN208
  207 FORMAT(1X,'THE WATER SURFACE ELEVATION ETA2 IS',F12.3,/             MAIN209
     1' DELZ = ',F12.3                                                   MAIN210
     2/' VVEL(IX) = ',F12.3/' ITM = ',I10/' IS = ',I10/' IGOGO = ',I10)  MAIN211
      GO TO 99                                                           MAIN212
  205 SUM1 = VVEL(IP1)                                                   MAIN213
      DO 208 I=IP2,NP1                                                   MAIN214
      SUM1 = SUM1 - (CUX(I) + CVY(I))*(DZ(I-1) + DZ(I))/2.               MAIN215
      VVEL(I) = SUM1                                                     MAIN216
  208 CONTINUE                                                           MAIN217
      VVEL(NX) = SUM1 - (CUX(NX) + CVY(NX))*(DZ(NP1)/2.)                 MAIN218
      GO TO 50                                                           MAIN219
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202 VVEL(IP1) = 0.0                                                    MAIN220
    VVEL(IP2) =                                - (CUX(IP2)+ CVY(IP2))* MAIN221
   1((DZ(IP1) + DZ(IP2))/2.)                                           MAIN222
    SUM1 = VVEL(IP2)                                                   MAIN223
    DO 203 K=IP3,NP1                                                   MAIN224
    SUM1 = SUM1 - (CUX(K) + CVY(K))*((DZ(K-1) + DZ(K))/2.)             MAIN225
    VVEL(K) = SUM1                                                     MAIN226
203 CONTINUE                                                           MAIN227
    VVEL(NX) = SUM1 - (CUX(NX)+ CVY(NX))*(DZ(NP1)/2.)                  MAIN228
 50 ITM=ITM+1                                                          MAIN229
    IF(IGONY.EQ.1) DELZ=0.0                                            MAIN230
    IF(NVCHS(4).NE.1) CALL RAD                                         MAIN231
    CALL TTSQ                                                          MAIN232
    IF (NTIME.LT.0) GO TO 117                                          MAIN233
    DO 116I=1,NP1                                                      MAIN234
    IF (NVCHS(1).NE.1) GO TO 114                                       MAIN235
    U3(I) = 2.*U2(I) - U1(I)                                           MAIN236
    V3(I) = 2.*V2(I) - V1(I)                                           MAIN237
114 IF(NVCHS(2).NE.1)GO TO 116                                         MAIN238
    W3(I) =  2.*W2(I)-W1(I)                                            MAIN239
    TT3(I) = 2.*TT2(I)-TT1(I)                                          MAIN240
116 CONTINUE                                                           MAIN241
    IF (NVCHS(1).EQ.1)  GO TO 52                                       MAIN242
117 GO TO (112,111,111,112),IGOGO                                      MAIN243
111 I1 = 1                                                             MAIN244
    II=2                                                               MAIN245
    IT=IM2                                                             MAIN246
    I2=IM3                                                             MAIN247
    I3=IM1                                                             MAIN248
129 I5 = IT -   IHT + 1                                                MAIN249
    IF(  IHT.GT.2) GO TO 131                                           MAIN250
    I5 = IM3                                                           MAIN251
    I1 = 1                                                             MAIN252
    II = 2                                                             MAIN253
131 CALL CUV                                                           MAIN254
    IF(IGONY.EQ.0) GO TO 121                                           MAIN255
113 IF(IANV.GT.1) GO TO 118                                            MAIN256
    DO 119 I=IHT,IX                                                    MAIN257
    V3(I) = 0.0                                                        MAIN258
119 CONTINUE                                                           MAIN259
    GO TO 112                                                          MAIN260
118 DO 120 I=IHT,IX                                                    MAIN261
    U3(I) = 0.0                                                        MAIN262
120 CONTINUE                                                           MAIN263
    GO TO 112                                                          MAIN264
121 IF(IHT.EQ.1) GO TO 112                                             MAIN265
    IF(I2IHT.LE.IHT) GO TO 123                                         MAIN266
    IIHT = I2IHT-1                                                     MAIN267
    DO 124 I= IHT, IIHT                                                MAIN268
124 U3(I) = 0.0                                                        MAIN269
123 IF(I3IHT.LE.IHT)GO TO 112                                          MAIN270
    IIHT = I3IHT-1                                                     MAIN271
    DO 125 I= IHT, IIHT                                                MAIN272
125 V3(I)= 0.0                                                         MAIN273
112 I1 = IP1                                                           MAIN274
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      II=IP2                                                            MAIN275
      IT=NM1                                                            MAIN276
      I2=NM2                                                            MAIN277
      I3=NX                                                             MAIN278
      I5=IA                                                             MAIN279
      CALL CUV                                                          MAIN280
      GO TO (51,52),LY                                                  MAIN281
   51 DTA = 2.*DTA                                                      MAIN282
      DTA2 = 2.*DTA2                                                    MAIN283
      C5 = 1.5                                                          MAIN284
      C6 = 2.                                                           MAIN285
      GD2 = .5                                                          MAIN286
      LY=2                                                              MAIN287
   52 CONTINUE                                                          MAIN288
      DO 54 I=1,NP1                                                     MAIN289
      TT1(I) = TT2(I)                                                   MAIN290
      U1(I) = U2(I)                                                     MAIN291
      V1(I) = V2(I)                                                     MAIN292
      W1(I) = W2(I)                                                     MAIN293
      TT2(I) = TT3(I)                                                   MAIN294
      U2(I) = U3(I)                                                     MAIN295
      V2(I) = V3(I)                                                     MAIN296
      W2(I) = W3(I)                                                     MAIN297
      PP11(I) = PP12(I)                                                 MAIN298
      PP21(I) = PP22(I)                                                 MAIN299
      PP12(I) = PP13(I)                                                 MAIN300
      PP22(I) = PP23(I)                                                 MAIN301
   54 CONTINUE                                                          MAIN302
      ETA1 = ETA2                                                       MAIN303
      IF(NVCHS(4).EQ.1) XT2 = TT3(IX)                                   MAIN304
      TT2(IX) = XT2                                                     MAIN305
      TT2(IP1) = XT2                                                    MAIN306
      CALL EXCK                                                         MAIN307
      CALL BIV                                                          MAIN308
      CALL GWC                                                          MAIN309
   65 IF(ITM-ICK)94,70,70                                               MAIN310
   70 ICK = ICK+ ITESTP                                                 MAIN311
      RSUM(14) = XKT(1)                                                 MAIN312
      RSUM(15) = XKT(NX)                                                MAIN313
      IF (IS.GT.1) GO TO 701                                            MAIN314
      MARAY(IXTRA) = MARAY(IXTRA)+1                                     MAIN315
      PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)                         MAIN316
  701 CALL TEMPRT                                                       MAIN317
      PRINT 101,ETA2,DELZ,XETA2,YETA2,CU(IX),CV(IX),IHT,IGOGO           MAIN318
  101 FORMAT(//'  ETA2 =',E18.8,/'  DELZ =',E18.8,/'  XETA2 =',E18.8,/' MAIN319
     1 YETA2 =',E18.8,/'  CU(IX) =',E18.8,/'  CV(IX) =',E18.8,/'  IHT =' MAIN320
     2,I10,/'  IGOGO =',I10)                                            MAIN321
      WRITE (95) (RI(I),I=1,NCS)                                        MAIN322
   94 IF(ITM.EQ.NT) GO TO 97                                            MAIN323
      IF(ITM.NE.NU) GO TO 50                                            MAIN324
C     STORING COMPUTED VALUES ON DRUM FOR RESTART OF EACH GRID STATION A MAIN325
      WRITE (98'IS) (XKU(I),I=1,NCR)                                    MAIN326
      DO 59 I=1,NP1                                                     MAIN327
      T1 = U2(I)**2+V2(I)**2                                            MAIN328
      IF (T1) 59,59,159                                                 MAIN329
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  159 T1 = SQRT(T1)                                                        MAIN330
      IF (T1.GT.SAVE)  SAVE = T1                                           MAIN331
   59 CONTINUE                                                             MAIN332
      TDEL = XD/SAVE                                                       MAIN333
C    WRITE YY ON DISK USING DIRECT ACCESS                                  MAIN334
      IGOG = IGOGO                                                         MAIN335
      WRITE (SDRUM'IS) (YIN(I),I=1,NWSYY)                                  MAIN336
   97 IF(ITM.EQ.NT.AND.IS.EQ.IGRID) GO TO 80                               MAIN337
      IF(IS.EQ.IGRID) GO TO 98                                             MAIN338
      ITM = ITM - NU1X                                                     MAIN339
   98 CONTINUE                                                             MAIN340
C    SWITCH FILE UNITS FOR RESTART                                         MAIN341
      I = RDRUM                                                            MAIN342
      RDRUM = SDRUM                                                        MAIN343
      SDRUM = I                                                            MAIN344
      IF(MARAY(IXTRA).NE.0) IXTRA = IXTRA + 1                              MAIN345
      NSTART = NU                                                          MAIN346
      GO TO 41                                                             MAIN347
   80 PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)                            MAIN348
      END FILE 95                                                          MAIN349
      REWIND 95                                                            MAIN350
   99 STOP                                                                 MAIN351
   31 FORMAT ('1RUN STOPPED--NEW DT NEEDED')                               MAIN352
  132 FORMAT ('1TIME STEP STARTING = ',I5,' VALUES IN MARAY =',I5/' MARA   MAIN353
     1Y IS',20I4)                                                          MAIN354
  335 FORMAT (' ITM',I6,',DT',E12.4,',T1',E12.4)                           MAIN355
      END                                                                  MAIN356
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      SUBROUTINE GREAD                                                  GREAD000
      INTEGER RDRUM,SDRUM,TDRUM                                         GREAD001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     GREAD002
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    GREAD003
     2   ,WO,WSC,XKT,XYY,YY,GTO                                         GREAD004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        GREAD005
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      GREAD006
     2   ,TT3(30),W3(30),SST                                           GREAD007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,GREAD008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CEGREAD009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             GREAD010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               GREAD011
     1   ,XLAM,RSUM(15),B1,B2                                          GREAD012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    GREAD013
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  GREAD014
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   GREAD015
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  GREAD016
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        GREAD017
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              GREAD018
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         GREAD019
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)GREAD020
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      GREAD021
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    GREAD022
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) GREAD023
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      GREAD024
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   GREAD025
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     GREAD026
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  GREAD027
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    GREAD028
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           GREAD029
     5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                   GREAD030
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     GREAD031
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                     GREAD032
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    GREAD033
     2    ,  T13,T14,T15,T16,XD1,YD1                                    GREAD034
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                        GREAD035
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II GREAD036
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     GREAD037
     1 , I1IHT,I2IHT,I3IHT,I4IHT                                        GREAD038
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          GREAD039
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     GREAD040
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             GREAD041
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      GREAD042
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      GREAD043
      COMMON /GRDNTS / GXY(30,12),PGXY(30,12),CGXY(30,12)               GREAD044
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     GREAD045
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               GREAD046
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               GREAD047
     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              GREAD048
     4  ,CP2X(30),CP2Y(30)                                            GREAD049
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))             GREAD050
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))              GREAD051
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))              GREAD052
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))              GREAD053
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))             GREAD054
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      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))                GREAD055
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))                GREAD056
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))                GREAD057
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))                GREAD058
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))                GREAD059
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))                GREAD060
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))                GREAD061
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))                GREAD062
      DIMENSION ZI(30),ZDIX(30),ZDIY(30),ARPRT(18)                         GREAD063
      EQUIVALENCE (A(1),ZI(1)),(B(1),ZDIX(1)),(C(1),ZDIY(1))               GREAD064
      DATA ARPRT /4HU CO,4HMPON,4HENT ,4HV CO,4HMPOM,4HENT ,4HTEMP,4HERAGREAD065
     1T ,4HURE ,   4HSALI,4HN./H,4HUMID,4HPOLL,4HUTAN,4HT 1 ,4HPOLL,4HUTGREAD066
     2AN,4HT 2 /                                                          GREAD067
      READ 100, (COM(I),I=1,18)                                           GREAD068
      PRINT 101,(COM(I),I=1,18)                                           GREAD069
      ROA = .001                                                          GREAD070
      READ 110, NX,IX,NT,IMAX,JMAX,NTIME,NVAR6,ITESTP,IPOL                GREAD071
      DO 2I=1,5                                                           GREAD072
    2 NVCHS(I) = 0                                                        GREAD073
      IF(NTIME.GE.0)READ110,(NVCHS(I),I=1,5)                              GREAD074
      IGRID = JMAX * IMAX                                                 GREAD075
      PRINT 111, NX,IX,NT,IGRID                                           GREAD076
C     IGRID IS THE NUMBER OF STATIONS IN THIS MODEL GRID NETWORK          GREAD077
      READ 119,DT,XD,DECLX,DCHG,XIIN,XJIN                                 GREAD078
      DECL = DECLX* .017453293                                            GREAD079
      DCHG = DCHG * .017453293                                            GREAD080
      READ 119,PHIBOT,HWEST,EM,ZW,RTIME                                   GREAD081
      H = HWEST * .017453293                                              GREAD082
    3 PRINT 112, XIIN,XJIN,PHIBOT,DT,XD                                   GREAD083
      DT = DT*60.                                                         GREAD084
      PRINT 1212, RTIME                                                   GREAD085
      IF(RTIME.LE.0.) RTIME = DT/60.                                      GREAD086
  700 IMARA = RTIME/DT*60.  +.5                                           GREAD087
      XD = XD * 1.E5                                                      GREAD088
      NP1=NX+1                                                            GREAD089
      IS = 0                                                              GREAD090
      IP1 = IX+1                                                          GREAD091
C     INITIAL STATION DATA INPUT   Z,  T,  U,  V,  W                      GREAD092
      READ 119,(Z(I),I=1,NP1)                                             GREAD093
      DO 6 J=1,6                                                          GREAD094
      READ 119, (YY(I,J),I=1,NP1)                                         GREAD095
    6 CONTINUE                                                            GREAD096
      DO 230 I=5,6                                                        GREAD097
      DO 230 N=1,NP1                                                      GREAD098
  230 YY(N,I) = YY(N,I) / ROA / 100.                                      GREAD099
C     COMPUTE PERIPHERAL GRADIENTS                                        GREAD100
      DO 420  K=1,6                                                       GREAD101
      READ 110,IZ1                                                        GREAD102
      READ 120, (ZI(I),I=1,IZ1)                                           GREAD103
      READ 120, (ZDIX(I),I=1,IZ1)                                         GREAD104
      READ 120, (ZDIY(I),I=1,IZ1)                                         GREAD105
      K2 = 3*K                                                            GREAD106
      K1 = K2-2                                                           GREAD107
      PRINT 123, (ARPRT(I),I=K1,K2),(ZI(I),I=1,IZ1)                       GREAD108
      PRINT 121, (ZDIX(I),I=1,IZ1)                                        GREAD109
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      PRINT 122, (ZDIY(I),I=1,IZ1)                                      GREAD110
      DO 418 I=1,NP1                                                    GREAD111
      T1 = Z(I)                                                         GREAD112
      IF (I-IX) 417,416,417                                             GREAD113
  416 T1 = T1-.00001                                                    GREAD114
      GO TO 1418                                                        GREAD115
  417 IF (I-IP1) 1418,2418,1418                                         GREAD116
 2418 T1 = T1+.00001                                                    GREAD117
 1418 CALL XINEAR (T1,Z1,2,IZ1,L,ZDIX,GXY(I,K),ZDIY,GXY(I,K+6)          GREAD118
     1  ,T4,T4,T4,T4)                                                  GREAD119
      IF(K.LE.4) GO TO 231                                              GREAD120
      GXY(I,K) = GXY(I,K) / ROA / 100.                                  GREAD121
      GXY(I,K+6) = GXY(I,K+6) / ROA / 100.                              GREAD122
  231 PGXY(I,K) = GXY(I,K)                                              GREAD123
      CGXY(I,K) = GXY(I,K)                                              GREAD124
      PGXY(I,K+6) = GXY(I,K+6)                                          GREAD125
      CGXY(I,K+6) = GXY(I,K+6)                                          GREAD126
  418 CONTINUE                                                          GREAD127
  420 CONTINUE                                                          GREAD128
      READ 119,SOAB,SOSC,XNO,COCOB                                      GREAD129
      PRINT 119,SOAB,SOSC,XNO,COCOB                                     GREAD130
      IY = IP1                                                          GREAD131
      NP2=NX+2                                                          GREAD132
      NM1=NX-1                                                          GREAD133
      NM2=NX-2                                                          GREAD134
      IP2=IX+2                                                          GREAD135
      IP3=IX+3                                                          GREAD136
      IM1=IX-1                                                          GREAD137
      IM2=IX-2                                                          GREAD138
      IM3 = IX-3                                                        GREAD139
      I4=1                                                              GREAD140
      IA=NM1-IP1                                                        GREAD141
      EX2=-1./2.                                                        GREAD142
      EX3 = 1./3.                                                       GREAD143
      EX6 = -1./6.                                                      GREAD144
      XNV = .5                                                          GREAD145
      XNT = 1.5                                                         GREAD146
      BETV = 10.                                                        GREAD147
      BETT = 10./3.                                                     GREAD148
      DT2 = 2.*DT                                                       GREAD149
      G = 980.                                                          GREAD150
      CP = .239                                                         GREAD151
      PI = 3.1415927                                                    GREAD152
      GAM = .98E-4                                                      GREAD153
      GAM2 = 2.*GAM                                                     GREAD154
      ALF = -3.                                                         GREAD155
      XK1 = .4                                                          GREAD156
      XK2=.14                                                           GREAD157
      RALF = -1./ALF                                                    GREAD158
      RC = RALF/7.                                                      GREAD159
      T2 = (1. + ALF*RC)**2                                             GREAD160
      T3 = RC**EX3                                                      GREAD161
      CC = 3.*T3*T2                                                     GREAD162
      T4 = 3./CC                                                        GREAD163
      C32 = T4**(-.5)                                                   GREAD164
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      T4 = T4**1.5                                                      GREAD165
      XK12 = XK1**2                                                     GREAD166
      SH = XK12*T4                                                      GREAD167
      HKK = SH*XK2**2/XK12                                              GREAD168
      HK2 = SH/XK12                                                     GREAD169
      HKK=HKK*10.                                                       GREAD170
      CPP=-CP*1.0E06                                                    GREAD171
      SIG=1.354E-12                                                     GREAD172
      AW=1000.*G                                                        GREAD173
      AR=2.87E+06                                                       GREAD174
      NTOP=NLAP+NP1                                                     GREAD175
      ATC = .001                                                        GREAD176
      SK = 0.86933E-06                                                  GREAD177
      PI2 = PI * 2.                                                     GREAD178
      DELH = (DT/86400.) * PI2                                          GREAD179
    1 PDECL  = DECL / .017453293                                        GREAD180
      PDCHG = DCHG  / .017453293                                        GREAD181
      PRINH = H     / .017453293                                        GREAD182
      PRINT 126,PDECL,PDCHG,EM,PRINH                                    GREAD183
      DO 117 I=1,NX                                                     GREAD184
      T1 = (Z(I) + Z(I+1))/2.                                           GREAD185
      ZA(I) = ABS(T1)                                                   GREAD186
      DZ(I) = Z(I+1) - Z(I)                                             GREAD187
  117 CONTINUE                                                          GREAD188
      DO 23K=1,IM1                                                      GREAD189
      I=IM1-K+1                                                         GREAD190
   23 DS(K)   = ZA(I)-ZA(I+1)                                           GREAD191
      DS(IX)  = ABS(Z(1)) - ZA(1)                                       GREAD192
      DO 715 I=IP1,NP1                                                  GREAD193
      TE=Z(I)-ZW                                                        GREAD194
      IF (TE)715,10,715                                                 GREAD195
   10 IZW=I                                                             GREAD196
      GO TO 132                                                         GREAD197
  715 CONTINUE                                                          GREAD198
      PRINT 1000,  (Z(I),I=1,NP1),ZW                                    GREAD199
      CALL EXIT                                                         GREAD200
  132 IZW1=IZW-1                                                        GREAD201
      T20=ALOG(Z(IZW)/Z(IZW1))                                          GREAD202
      A1 = ALOG(1950.  /Z(IZW1))/T20                                    GREAD203
      A2 = ALOG(Z(IZW)/1950.  )/T20                                     GREAD204
   99 RETURN                                                            GREAD205
  100 FORMAT(18A4)                                                      GREAD206
  101 FORMAT(1X18A4///)                                                 GREAD207
  110 FORMAT(14I5)                                                      GREAD208
  111 FORMAT (4H NX=,I3/4H IX=,I3/4H NT=,I3/7H GRID =,I3)               GREAD209
  112 FORMAT (11H  XIIN   = F10.4/11H   XJIN  = F10.4/11H PHI     = F8.2GREAD210
     1/11H DELTA T = F6.1/10H DISTANCE=,F7.2)                           GREAD211
  119 FORMAT(6F12.4)                                                    GREAD212
  120 FORMAT (6E12.5)                                                   GREAD213
  121 FORMAT ('0X-GRAD    ',6E12.5)                                     GREAD214
  122 FORMAT ('0Y-GRAD    ',6E12.5)                                     GREAD215
  123 FORMAT ('0',3A4,' GRADIENTS--INPUT VALUES'/' HEIGHTS(M)',11F10.2) GREAD216
  126 FORMAT(13H DECLINATION ,E12.4/8H CHANGE ,E12.4/ 36H INFRARED EMISSGREAD217
     1IVITY OF THE SURFACE ,E12.4/12H HOUR ANGLE ,E12.4)                GREAD218
 1000 FORMAT(1H1,'   ZW VALUE IS INCORRECT--- HEIGHT ARRAY FOLLOWS'//  GREAD219
     1  (6F12.4))                                                      GREAD220
 1212 FORMAT ('0TIME STEP FOR RADIATION IS',F10.2,' MINUTES')           GREAD221
      END                                                               GREAD222
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      SUBROUTINE RAD                                                    RAD000
C     SUBROUTINE TO COMPUTE TEMPERATURE CHANGES DUE TO RADIATION        RAD001
      INTEGER RDRUM,SDRUM,TDRUM                                         RAD002
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     RAD003
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    RAD004
     2   ,WO,WSC,XKT,XYY,YY,GTO                                         RAD005
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        RAD006
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      RAD007
     2   ,TT3(30),W3(30),SST                                            RAD008
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,RAD009
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE RAD010
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             RAD011
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               RAD012
     1   ,XLAM,RSUM(15),B1,B2                                           RAD013
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    RAD014
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  RAD015
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   RAD016
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  RAD017
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        RAD018
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              RAD019
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         RAD020
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18) RAD021
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      RAD022
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    RAD023
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) RAD024
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      RAD025
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   RAD026
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     RAD027
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  RAD028
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    RAD029
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           RAD030
     5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                   RAD031
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     RAD032
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                     RAD033
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    RAD034
     2     ,  T13,T14,T15,T16,XD1,YD1                                   RAD035
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                        RAD036
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II RAD037
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     RAD038
     1 , I1IHT,I2IHT,I3IHT,I4IHT                                        RAD039
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          RAD040
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     RAD041
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             RAD042
      DIMENSION DTR(50)                                                 RAD043
      EQUIVALENCE (DTR(1),C(1))                                         RAD044
  213 FORMAT ('0INITIAL PRES AND QS'/(1X2F15.5))                        RAD045
  106 NCL = NCLI                                                        RAD046
      IF(ITM.LT.ISTEP(1)) NCL=0                                         RAD047
      CX = 1.                                                           RAD048
      RAINX = 0.                                                        RAD049
      IF(NCL)1108,1108,116                                              RAD050
  116 CALL LINEAR (ITM,ISTEP,1,NTFOR, L,RAINI,RAINX,T4,T4,T4,T4,T4,T4)  RAD051
      NCL = NXN(L)                                                      RAD052
      DO 934 I=1,NCL                                                    RAD053
      CALL LINEAR(ITM,ISTEP,1,NTFOR,L,ECLI(1,I),EC(I),T4,T4,T4,T4,T4,T4) RAD054
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      TCL(I) = TCLI(L,I)                                                    RAD055
  934 LLC(I) = LLCI(L,I)                                                    RAD056
      CX = 1. -EC(NCL)                                                      RAD057
 1108 LLC(NCL+1) = 61                                                       RAD058
      DO 107I=IM1,NP1                                                       RAD059
      TA(I)=TT2(I)                                                          RAD060
      QA(I)=W2(I)                                                           RAD061
      COB(I) = PP12(I)*COCOB                                                RAD062
  107 CONTINUE                                                              RAD063
C  FOLLOWING RECOMUTES EMISSIUIY H2O,CO2 ATEACH STATION WHEN XD.GT.50KM     RAD064
 1407 ICOM = -1                                                             RAD065
      IF (XD.GT. 50.E5) GO TO 112                                           RAD066
      IF(IS.NE.1) GO TO 1507                                                RAD067
  112 INEWC = INEWC+1                                                       RAD068
      IF (INEWC-INEW) 1507,1505,1505                                        RAD069
 1505 INEWC = 0                                                             RAD070
      ICOM = 1                                                              RAD071
 1507 CONTINUE                                                              RAD072
 1408 C1 = 3.7943/PA(IP1)                                                   RAD073
C  COMPUTE PATH LENGTHS,ST4,QS                                             RAD074
      TTW = TW                                                              RAD075
      DO 104 L=IP1,NP1                                                      RAD076
      K=L-IX                                                                RAD077
      IF (ICOM) 501,501,702                                                 RAD078
  702 DUW(K)=(PA(L)-PA(L+1))*(QA(L)+QA(L+1))/G/2.                           RAD079
      TTW = TTW+DUW(K)                                                      RAD080
C   CARBON DIOXIDE ASSUMED AT 320 PPM                                       RAD081
      COA(K) = .4148239*(PA(L)-PA(L+1))                                     RAD082
  501 IF (IPOL) 499,499,709                                                 RAD083
  499 CGA(K) = 0.                                                           RAD084
      PAAB(K) = 0.                                                          RAD085
      PASA(K) = 0.                                                          RAD086
      GO TO 502                                                             RAD087
  709 T8  = (COB(L)+COB(L+1))/2.*DZ(L)*1.E-5                                RAD088
      CGA(K) = T8*1.66*XNO                                                  RAD089
      PAAB(K) = T8*SOAB                                                     RAD090
      PASA(K) = T8*SOSC                                                     RAD091
  502 ST4(L) = SIG*TA(L)**4                                                 RAD092
      DST4(L) = SIG*((TA(L)+TA(L+1))/2.)**4                                 RAD093
      CXPA = 3.7943/PA(L)                                                   RAD094
      TEX = 3.0 + 7.5 *(TA(L)-273.16)/(TA(L)-35.66)                         RAD095
      QS(L) = CXPA * 10.0**TEX                                              RAD096
  104 CONTINUE                                                              RAD097
      KA = NP1-IX   +1                                                      RAD098
      IF (ICOM.EQ.1) CALL INFRAI(DUW,COA,KA,NATAL)                          RAD099
      IF (ITM-1) 212,212,297                                                RAD100
  212 PRINT 213, (PA(I),QS(I),          I=IY,NP1)                           RAD101
C  *** SOLAR RADIATION COMPUTATIONS                                         RAD102
  297 T3 = COS(H)                                                           RAD103
      T4 = COS(DECL)                                                        RAD104
      T6 = SIN(DECL)                                                        RAD105
      T5 = SPH*T6+CPH*T3*T4                                                 RAD106
      COSZ = T5                                                             RAD107
      H = H + DELH                                                          RAD108
      IF(H.LE.PI) GO TO 2                                                   RAD109
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      H = H-PI2                                                          RAD110
      DECL= DECL+ DCHG                                                   RAD111
      PDECL = DECL/.017453293                                            RAD112
      PRINT 299,ITM,PDECL                                                RAD113
  299 FORMAT(//' MIDNIGHT OCCURS AT TIME STEP',I5,' NEW DECLINATION IS'  RAD114
     1,E12.4)                                                            RAD115
    2 IF(T5)5,5,19                                                       RAD116
    5 CRS = 0.                                                           RAD117
      TE = 0.                                                            RAD118
      RH = 0.                                                            RAD119
      TOUPRA = 0.                                                        RAD120
      DO 6I=1,NP1                                                        RAD121
    6 DTDT(I) = 0.                                                       RAD122
      GO TO 99                                                           RAD123
   19 N1 = NP1 - IX                                                      RAD124
      CALL SOLAR2 (N1 ,PA(IY),DUW,PASA,PAAB,EC,TCL,LLC,COSZ,DTDT(IY),    RAD125
     1 CRS,TE,TOUPRA,NATAL)                                              RAD126
      GO TO (86,86,86,1414), IGOGO                                       RAD127
   86 SINZ = SQRT(1.-COSZ*COSZ)                                          RAD128
      SRS = -.0139 + .0467 * (SINZ/COSZ)                                 RAD129
      SRS = AMIN1(1.,SRS)                                                RAD130
      SRS = AMAX1(.03,SRS)                                               RAD131
 1414 CONTINUE                                                           RAD132
      RAI(IX) = CRS * (1.-SRS)                                           RAD133
      TOUPRA = TOUPRA + CRS*SRS                                          RAD134
      RH = RAI(IX)                                                       RAD135
      IF(IGONY.GT.0) GO TO 99                                            RAD136
 6843 SECZ = 1./COSZ                                                     RAD137
      IF(SECZ.GT.10.) SECZ = 10.                                         RAD138
      IF(RAI(IX).LE.1.0E-30) RAI(IX) = 0.0                               RAD139
      DO 25 M=2,IX                                                       RAD140
      I = IX-M+2                                                         RAD141
      T2 = ZA(I-1)/100.                                                  RAD142
      CALL KAPPA(T2,AK)                                                  RAD143
      IF(RAI(I).LT.1.0E-20) RAI(I)=0.0                                   RAD144
      T100 = -AK*ZA(I-1)*SECZ/100.                                       RAD145
      IF(T100.LE.-40.0) T100 = -40.0                                     RAD146
      RAI(I-1) = RAI(IX)*EXP(T100)                                       RAD147
   25 DTR(I) = RAI(I) - RAI(I-1)                                         RAD148
      DTR(1) = RAI(1)                                                    RAD149
      DO 27I=1,IM1                                                       RAD150
      M=IX-I+1                                                           RAD151
   27 DTDT(I) = DTR(I) / DS(M)                                           RAD152
      RH = RAI(IX) - RAI(IM1)                                            RAD153
C  INFRARED SURFACE FLUX                                                 RAD154
   99 CALL INFRA (1,DST4(IP1),ST4(IP1),LLC,EC,DTT,PA(IP1),RA,RB,CGA)     RAD155
      RAA = RA(1) + RADMX                                                RAD156
      RSUM(6) = DT*RA(1) + RSUM(6)                                       RAD157
C  *** HEAT BALANCE                                                      RAD158
      LOOP = 0                                                           RAD159
      TG1= TA(IP1)                                                       RAD160
      IF(TG1- 273.16)855,855,860                                         RAD161
  855 XLT = 677.                                                         RAD162
      GO TO 861                                                          RAD163
  860 XLT = 597.3 - 0.57*(TG1-273.16)                                    RAD164
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  861 T5 = 1. / (EM * SIG)                                              RAD165
      IF(RAINX.GT.0) GO TO 862                                          RAD166
      TRW = TA(IP1)                                                     RAD167
      GO TO 865                                                         RAD168
  862 TWBAR = 0.                                                        RAD169
      NC = 0                                                            RAD170
C     RAINFALL THROUGH LAYER COMPUTATION                                RAD171
      DO 864I=IP2,NP1                                                   RAD172
      ZWS = Z(I)                                                        RAD173
      IF(ZW.GT.ZWS.AND.ZWS.GT.0.) GO TO 863                             RAD174
      SN = NC                                                           RAD175
      TRW = TWBAR/SN                                                    RAD176
      GO TO 865                                                         RAD177
  863 NC = NC+1                                                         RAD178
      TWBAR = TWBAR + (TA(I)-XLT*1.E-03/CP * (QS(I)-QA(I)))             RAD179
  864 CONTINUE                                                          RAD180
  865 ET1 = -.001 * ROA * XKT(IP1)                                      RAD181
      N = 1                                                             RAD182
      AT1 = -ROA * CP * XKT(IP1)                                        RAD183
      ST1 = ROW * CW * XKT(IM1)                                         RAD184
  532 CONTINUE                                                          RAD185
      ET = ET1 * ((W2(IP2) - W2(IP1)) / Z(IP2))                         RAD186
      AT = AT1 * ((TA(IP2) - TA(IP1)) / DZ(IP1)  + GAM )                RAD187
      ST = ST1 * ((TA(IP1) - TA(IM1)) / DZ(IM1))                        RAD188
C     RAIN EFFECT TERM  -PT-                                            RAD189
      PT = .935*RAINX*(TRW-TA(IP1))                                     RAD190
      T4 = T5 *(RH + RAA - AT - ST -XLT*ET + PT)                        RAD191
      IF(T4)74,74,870                                                   RAD192
   74 IF(LOOP)75,75,203                                                 RAD193
   75 PRINT 150,ITM,ET,AT,ST,XLT, RAA ,RH,SRS                           RAD194
      TG3 = TG1/2.                                                      RAD195
      GO TO 871                                                         RAD196
  870 TG3 = T4**.25                                                     RAD197
  871 GO TO (199,200,200),N                                             RAD198
  199 N = 2                                                             RAD199
      DET1 = TG3-TG1                                                    RAD200
      TG = TG3                                                          RAD201
      IF(ABS(DET1)-ATC)882,882,181                                      RAD202
  200 DET2 = TG3-TG2                                                    RAD203
      IF(ABS(DET2)-ATC)105,105,186                                      RAD204
  105 TG = (TG2+TG3)/2.                                                 RAD205
      GO TO 882                                                         RAD206
  186 IF(ABS(DET1)-ATC)882,882,1106                                     RAD207
 1106 IF(DET1)191,882,192                                               RAD208
  191 IF(DET2)193,193,184                                               RAD209
  192 IF(DET2)184,193,193                                               RAD210
  184 N=3                                                               RAD211
      GO TO 203                                                         RAD212
  193 TG1 = TG2                                                         RAD213
      GO TO (199,202,203),N                                             RAD214
  202 TG = TG3                                                          RAD215
      DET1 = DET2                                                       RAD216
      GO TO 181                                                         RAD217
  203 DET1 = DET1/2.                                                    RAD218
      TG = TG1 + DET1                                                   RAD219
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  181 LOOP = LOOP + 1                                                    RAD220
      TG2 = TG                                                           RAD221
      IF(LOOP-25)884,884,97                                              RAD222
  884 TEX = 3.0 + 7.5 * (TG-273.16) / (TG-35.66)                         RAD223
      QSG = C1*10.0**TEX                                                 RAD224
      W2(IP1) = QSG*XMQ+(1.-XMQ)*W2(IP2)                                 RAD225
      TA(IP1) = TG                                                       RAD226
      GO TO 532                                                          RAD227
  882 CONTINUE                                                           RAD228
      IF (W2(IP1).GT.QSG) W2(IP1) = QSG                                  RAD229
      GO TO 404                                                          RAD230
   97 PRINT 151,ITM,ET,AT,ST,XLT, RAA ,RH,SRS ,TG                        RAD231
  150 FORMAT(15H  IN TIME STEP ,I3,' T**4 INITIALLY COMPUTED LESS THAN Z RAD232
     XERO'//'VALUES OF ET,AT,ST,XLT, RAA ,RH AND SRS FOLLOW'/7E12.4)     RAD233
  151 FORMAT(15H  IN TIME STEP ,I3,' AFTER 25 ITERATIONS T(Z=0) DID NOT  RAD234
     XCONVERGE TO WITHIN THE SPECIFIED TOLERANCE'//'VALUES OF ET,AT,ST,X RAD235
     XLT, RAA ,RH, SRS,TG FOLLOW',/8E12.4)                               RAD236
  404 IX1 = IX+2                                                         RAD237
  405 II = NP1-IX                                                        RAD238
C  *** INFRARED ATMOSPHERIC COOLING                                      RAD239
      CALL INFRA(NX,DST4(IP1),ST4(IP1),LLC,EC,DTT,PA(IP1),RA,RB,CGA)     RAD240
 1607 DO 1621 I=IX1,NP1                                                  RAD241
      L = I-IX                                                           RAD242
 1621 DT1(I) = DTDT(I)+DTT(L)                                            RAD243
      DO 4999K=1,IM1                                                     RAD244
 4999 DT1(K) = DTDT(K)                                                   RAD245
      TSC(IX) =   TG    - TTO(IP1)                                       RAD246
      TSC(IP1) = TSC(IX)                                                 RAD247
      TEX = 3.0 + 7.5 * (TG-273.16) / (TG-35.66)                         RAD248
      QSG = C1*10.0**TEX                                                 RAD249
      W2(IP1) = QSG                                                      RAD250
      W2(IP1)=W2(IP1)*XMQ+(1.-XMQ)*W2(IP2)                               RAD251
      WSC(IP1) = W2(IP1)-WO(IP1)                                         RAD252
C  RADIATION AND HEAT BALANCE SUMS                                       RAD253
      RSUM(1) = RSUM(1) + DT * ET * XLT                                  RAD254
      RSUM(2) = RSUM(2) + DT * AT                                        RAD255
      RSUM(3) = RSUM(3) + DT * ST                                        RAD256
      RSUM(4) = RSUM(4) + DT * PT                                        RAD257
      RSUM(5) = RSUM(5) + DT * RH                                        RAD258
      RSUM(7) = RSUM(7) + DT * RADMX                                     RAD259
      RSUM(8) = RSUM(8) + DT * TG**4 * SIG * EM                          RAD260
      RSUM(9) = RSUM(9)+DT*(TE-TOUPRA)                                   RAD261
      K = NP1-IX+1                                                       RAD262
      RSUM(10)= RSUM(10)+DT*(RA(K)-RB(K))                                RAD263
      XT2 = TSC(IX)                                                      RAD264
      RANS = RA(K) * 1.E3                                                RAD265
      RABNS= RB(K) * 1.E3                                                RAD266
      RABS = RB(1) * 1.E3                                                RAD267
      CRNS = TE * 1.E3                                                   RAD268
      TRAUS= (RB(K)-RA(K) + CRS*SRS) * 1.E3                              RAD269
      DO 5000  I=1,NP1                                                   RAD270
      TT2(I)=TSC(I)                                                      RAD271
 5000 W2(I)=WSC(I)                                                       RAD272
      HAI = AT                                                           RAD273
      HSI= ST                                                            RAD274
      CE = ET - RAINX                                                    RAD275
      RETURN                                                             RAD276
      END                                                                RAD277
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      SUBROUTINE EXCK                                                    EXCK000
      INTEGER RDRUM,SDRUM,TDRUM                                          EXCK001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12      EXCK002
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3     EXCK003
     2   ,WO,WSC,XKT,XYY,YY,GTO                                          EXCK004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)         EXCK005
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)       EXCK006
     2   ,TT3(30),W3(30),SST                                             EXCK007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2, EXCK008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE EXCK009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2              EXCK010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL                EXCK011
     1   ,XLAM,RSUM(15),B1,B2                                            EXCK012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)     EXCK013
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)   EXCK014
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2    EXCK015
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)   EXCK016
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)         EXCK017
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF               EXCK018
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV          EXCK019
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18) EXCK020
      COMMON U3(30),V3(30),TBO(30),WBO(30),CK0(30),CSW(30),PSS(30)       EXCK021
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)     EXCK022
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)  EXCK023
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                       EXCK024
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6    EXCK025
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3      EXCK026
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME   EXCK027
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2     EXCK028
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2            EXCK029
     5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                    EXCK030
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL      EXCK031
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                      EXCK032
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20     EXCK033
     2     , T13,T14,T15,T16,XD1,YD1                                     EXCK034
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                         EXCK035
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II  EXCK036
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)       EXCK037
     1 , I1IHT,I2IHT,I3IHT,I4IHT                                         EXCK038
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)           EXCK039
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))      EXCK040
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))              EXCK041
      DOUBLE PRECISION AA(9)                                             EXCK042
C     PST  AND  PSS  TABLES FOR TALOP  REPLACED BY -AA-                  EXCK043
      DATA AA/0.79701864,0.131710842E-03,-0.611831499E-07,.588194023E-01 EXCK044
     X,-0.25310441E-02,0.287971530E-05,-0.811465413E-02,0.389187483E-04, EXCK045
     X.47660041E-04/                                                     EXCK046
 3000 DO 1  I=1,NP1                                                      EXCK047
      IF (DABS(U2(I)).LT.( 1.E-35))  U2(I)=0.                            EXCK048
      IF (DABS(V2(I)).LT.( 1.E-35))  V2(I)=0.                            EXCK049
   86 T1=U2(I)**2 + V2(I)**2                                             EXCK050
      WS(I) = SQRT(T1)                                                   EXCK051
    1 CONTINUE                                                           EXCK052
      IF(XLAM)106,105,106                                                EXCK053
  105 W9=WS(IZW)*A1+WS(IZW1)*A2                                          EXCK054
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  401 HBAR=1.54165E-04*(W9**2)                                          EXCK055
      H3=1.39536*HBAR                                                   EXCK056
  405 T23 = SQRT(G)                                                     EXCK057
  403 DO 100  I=1,NP1                                                   EXCK058
      T21=HBAR/(DEL*2.*PI)                                              EXCK059
      IF(T21)1001,1001,1002                                             EXCK060
 1001 CSW(I)=0.                                                         EXCK061
      GO TO 100                                                         EXCK062
 1002 T22=1./SQRT(T21)                                                  EXCK063
      T24=-ZA(I)*2.*PI*DEL/HBAR                                         EXCK064
      IF (T24+75.) 300,301,301                                          EXCK065
  300 CSW(I)=0.                                                         EXCK066
      GO TO 100                                                         EXCK067
  301 CSW(I)=T23*T22*EXP(T24)*DEL                                       EXCK068
  100 CONTINUE                                                          EXCK069
      TK=XK2**2                                                         EXCK070
  407 DO 101  I=1,IM1                                                   EXCK071
      T25=ZA(I)+HBAR/2.                                                 EXCK072
      CK0(I)=TK*(T25**2)                                                EXCK073
  101 CONTINUE                                                          EXCK074
  409 DO 102  I=IP1,NX                                                  EXCK075
      T26 = ZA(I)+HBAR/2.                                               EXCK076
      CK0(I)=XK12*(T26**2)                                              EXCK077
  102 CONTINUE                                                          EXCK078
  411 XKU(IP1)=CK0(IP1)*CSW(IP1)                                        EXCK079
      XKT(IP1)=XKU(IP1)                                                 EXCK080
      XKU(IM1)=CK0(IM1)*CSW(IM1)                                        EXCK081
      XKT(IM1)=XKU(IM1)                                                 EXCK082
  106 J2=IM2                                                            EXCK083
      IMA =   IHT - 1                                                   EXCK084
      IF(IMA.EQ.0) IMA=1                                                EXCK085
      IIPP1 = IP1-IMA  + 1                                              EXCK086
      GO TO(412,413,413,412),IGOGO                                      EXCK087
  412 IMA = IP1                                                         EXCK088
      IIPP1 = IP1                                                       EXCK089
      J2 = NX                                                           EXCK090
  413 DO 41 J=IMA,IP2,IIPP1                                             EXCK091
      DO 40 I=J,J2                                                      EXCK092
      T1 = (U2(I+1) - U2(I))/DZ(I)                                      EXCK093
      IF (ABS(T1) .LT.(1.E-35))  T1 = 0.                                EXCK094
  131 T1 = T1**2                                                        EXCK095
  132 T2 = (V2(I+1) - V2(I))/DZ(I)                                      EXCK096
      IF (ABS(T2) .LT.(1.E-35))  T2 = 0.                                EXCK097
  141 T2 = T2**2                                                        EXCK098
  142 T3 = T1 + T2                                                      EXCK099
      XCS =  SQRT(T3)                                                   EXCK100
      IF (I.EQ.1) CSOUT(1) = XCS                                        EXCK101
      IF (I.EQ.NX)CSOUT(2) = XCS                                        EXCK102
      TB =  (TT2(I+1)+TT2(I))/2.+TBO(I)                                 EXCK103
      T6 = XCS   + CSW(I)                                               EXCK104
      T7 = T6**2                                                        EXCK105
      T6 = CK0(I)*T6                                                    EXCK106
      CL =  (TT2(I+1)-TT2(I))/DZ(I)                                     EXCK107
    3 IF(I-IX)6,40,4                                                    EXCK108
C  ATMOSPHERIC                                                          EXCK109
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    4 CL = CL+GAM+GTO(I)+.00061*TB*((W2(I+1)-W2(I))/DZ(I)+GWO(I))          EXCK110
      T7 = TB*T7                                                          EXCK111
      T11= G*CL/TB                                                        EXCK112
      T12 = HK2*CK0(I)                                                    EXCK113
      TEST = RALF                                                         EXCK114
      GO TO 8                                                             EXCK115
C  OCEANIC                                                                EXCK116
    6 SB = (W2(I+1)+W2(I))/2.+WBO(I)                                      EXCK117
      TTB= TB-273.16                                                      EXCK118
      PST(I) = AA(4)+2.*AA(7)*TTB+AA(5)*SB    +3.*AA(9)*TTB**2 +          EXCK119
     X 2.*AA(8)*SB    *TTB + AA(6)*SB    **2                             EXCK120
      PSS(I) = AA(1)+AA(5)*TTB+2.*AA(2)*SB    +AA(8)*TTB**2+2.*AA(6)*     EXCK121
     X SB    *TTB + 3.*AA(3)*SB    **2                                    EXCK122
      IF (SB.LE.0)  PSS(I)=0.                                             EXCK123
      T4 = PST(I)*CL+PST(I)*GTO(I)                                        EXCK124
      T5 = PSS(I)*(W2(I+1) - W2(I))/DZ(I)+PSS(I)*GWO(I)                   EXCK125
      CL = -.001*(T4+T5)                                                  EXCK126
      T11 = G*CL                                                          EXCK127
      TEST = 1.E16                                                        EXCK128
      T12 = HK2 * ZDL2(I)                                                 EXCK129
    8 IF(T7)1003,1003,1004                                                EXCK130
 1003 IF (CL) 35,19,10                                                    EXCK131
 1004 IF (CL) 1030,19,1031                                                EXCK132
   19 RI(I) = 0.                                                          EXCK133
      GO TO 15                                                            EXCK134
C     CHECK MAGNITUDE OF CL(I)/T7 TO RESTRICT OVERFLOW EXCEPTION          EXCK135
 1030 CLL1 = ABS(CL)                                                      EXCK136
      CLL=ALOG10(CLL1)                                                    EXCK137
      GO TO 1032                                                          EXCK138
 1031 CLL  = ALOG10(CL)                                                   EXCK139
 1032 T7L=ALOG10(T7)                                                      EXCK140
      CHECK1 = CLL-T7L                                                    EXCK141
      IF(CHECK1-13.)1024,10,10                                            EXCK142
 1024 RI(I)= G*CL/T7                                                      EXCK143
      IF(RI(I)-TEST)15,15,10                                              EXCK144
   10 RI(I) = TEST                                                        EXCK145
   15 IF(RI(I))25,20,20                                                   EXCK146
C  RI G.T. ZERO                                                           EXCK147
   20 IF(I-IX)21,21,22                                                    EXCK148
C  OCEANIC                                                                EXCK149
   21 EV = BETV                                                           EXCK150
      ET = BETT                                                           EXCK151
      XV = -XNV                                                           EXCK152
      XT = -XNT                                                           EXCK153
      GO TO 23                                                            EXCK154
C  ATMOSPHERIC                                                            EXCK155
   22 EV = ALF                                                            EXCK156
      ET = ALF                                                            EXCK157
      XV = 2.                                                             EXCK158
      XT = 2.                                                             EXCK159
   23 T8 = (1. + EV*RI(I))**XV                                            EXCK160
      T9 = (1. + ET*RI(I))**XT                                            EXCK161
      XKU(I) = T6*T8                                                      EXCK162
      XKT(I) = T6*T9                                                      EXCK163
      GO TO 40                                                            EXCK164
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   25 IF(RI(I) + RC)35,35,30                                        EXCK165
C  RI G.T. -RC, AND L.T. ZERO                                       EXCK166
   30 T10 = 1. - ALF*RI(I)                                          EXCK167
      XKU(I) = T6/T10**2                                            EXCK168
      XKT(I) = XKU(I)/T10                                           EXCK169
      GO TO 40                                                      EXCK170
C  RI L.E. -RC                                                       EXCK171
   35 T11 = ABS(T11)                                                EXCK172
      XKT(I) = T12*SQRT(T11)                                        EXCK173
      IF(T7)1006,1006,1007                                          EXCK174
 1006 XKU(I)=0.                                                     EXCK175
      GO TO 40                                                      EXCK176
 1007 T13 = ABS(RI(I))                                              EXCK177
      T13 = T13**EX6                                                EXCK178
      XKU(I) = XKT(I)*C32*T13                                       EXCK179
   40 CONTINUE                                                      EXCK180
      J2=NX                                                         EXCK181
   41 CONTINUE                                                      EXCK182
C  SET LIMITS ON ATMOSPHIC   K                                       EXCK183
      T13 = 1.E7                                                    EXCK184
      TEST = XLAM**2                                                EXCK185
      IF(IGONY.LT.1) TEST = H3**2                                   EXCK186
  415 DO 60 I=IP1,NX                                                EXCK187
      IF (ZA(I).GE.(1.E4)) TEST=1.E4                                EXCK188
      IF (XKU(I).LT.TEST)  XKU(I) = TEST                            EXCK189
      IF (XKT(I).LT.TEST)  XKT(I) = TEST                            EXCK190
      IF (XKT(I).GT.T13)   XKT(I) = T13                             EXCK191
      IF (XKU(I).GT.T13)   XKU(I) = T13                             EXCK192
   60 CONTINUE                                                      EXCK193
C     SET LIMITS ON OCEANIC K                                       EXCK194
 1009 DO 1013  I=1,IM1                                              EXCK195
      IF(XKT(I)-.0014)1011,1011,1017                                EXCK196
 1017 IF(XKU(I)-.014) 1012,1012,1013                                EXCK197
 1011 XKT(I)=.0014                                                  EXCK198
 1012 XKU(I)=.0140                                                  EXCK199
 1013 CONTINUE                                                      EXCK200
   99 RETURN                                                        EXCK201
      END                                                           EXCK202
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      SUBROUTINE BIV                                                    BIV000
      INTEGER RDRUM,SDRUM,TDRUM                                         BIV001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     BIV002
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    BIV003
     2   ,WO,WSC,XKT,XYY,YY,GTO                                         BIV004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        BIV005
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      BIV006
     2   ,TT3(30),W3(30),SST                                           BIV007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,BIV008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE BIV009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             BIV010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               BIV011
     1   ,XLAM,RSUM(15),B1,B2                                          BIV012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    BIV013
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  BIV014
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   BIV015
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  BIV016
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        BIV017
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              BIV018
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         BIV019
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18) BIV020
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      BIV021
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    BIV022
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) BIV023
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      BIV024
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   BIV025
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     BIV026
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  BIV027
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,P1,GAM,GAM2    BIV028
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           BIV029
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                  BIV030
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     BIV031
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                    BIV032
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    BIV033
     2     ,  T13,T14,T15,T16,XD1,YD1                                   BIV034
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                       BIV035
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II BIV036
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     BIV037
     1 , I1IHT,I2IHT,I3IHT,I4IHT                                        BIV038
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          BIV039
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     BIV040
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             BIV041
C *******              ***** BIV    ******              *******          BIV042
      T41 = TT2(IP1) - 273.16 + TTO(IP1)                                BIV043
      T21 = TT2(IP1) -  35.66 + TTO(IP1)                                BIV044
      T31 = 3.0   + 7.5  *T41/T21                                       BIV045
      QSG = C1*10.**T31                                                 BIV046
C     COMPUTE  W  SCALE FACTORS AT INTERFACE IN INITIAL TIME STEP       BIV047
      IF (ITM-1) 1,2,2                                                  BIV048
    1 IF (IGONY) 111,111,112                                            BIV049
  111 WO(IP1) = QSG                                                     BIV050
  112 W2(IP1) =0.0                                                      BIV051
      DWO(IP1)=WO(IP2)-WO(IP1)                                          BIV052
      GWO(IP1)=DWO(IP1)/Z(IP2)                                          BIV053
      GO TO 11                                                          BIV054
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    2 W2(IP1)=QSG*XMQ+(1.-XMQ)*(W2(IP2)+WO(IP2))-WO(IP1)                BIV055
   11 IF(DEL)20,40,20                                                  BIV056
C  SEC.  3.3.1                                                        BIV057
   20 T1 = ROA*XKU(IP1) / DZ(IP1)                                      BIV058
      T2 = ROW*XKU(IM1) / DZ(IM1)                                      BIV059
      T3 = T1*U2(IP2) + T2*U2(IM1)                                     BIV060
      T4 = T1*V2(IP2) + T2*V2(IM1)                                     BIV061
      T5 = T1 + T2                                                     BIV062
      U2(IX) = T3/T5                                                   BIV063
      V2(IX) = T4/T5                                                   BIV064
      GO TO (60,61,64,60),IGOGO                                        BIV065
   61 IF(IANV.EQ.1) GO TO 62                                           BIV066
      U2(IX)= 0.0                                                      BIV067
      U2(IP1) = U2(IX)                                                 BIV068
      V2(IP1) = V2(IX)                                                 BIV069
      GO TO 70                                                         BIV070
   62 V2(IX) = 0.0                                                     BIV071
      V2(IP1) = V2(IX)                                                 BIV072
      U2(IP1) = U2(IX)                                                 BIV073
      GO TO 70                                                         BIV074
   60 U2(IX) =0.0                                                      BIV075
      U2(IP1) = 0.0                                                    BIV076
      V2(IX) = 0.0                                                     BIV077
      V2(IP1) = 0.0                                                    BIV078
      GO TO 70                                                         BIV079
   64 U2(IP1) = U2(IX)                                                 BIV080
      V2(IP1) = V2(IX)                                                 BIV081
   70 T10 = U2(IX)**2 + V2(IX)**2                                      BIV082
      WS(IX) = SQRT(T10)                                               BIV083
      WS(IP1) = WS(IX)                                                 BIV084
 1001 T8 = 1. - (W2(IM1) + WO(IM1)) * 1.E-3                           BIV085
      IF(ITM.EQ.0) CE = 0.                                             BIV086
      CF=W2(IM1)*CE/T8+WO(IM1)*CE/T8                                   BIV087
      T9 = +CF/ROW/XKT(IM1)                                            BIV088
   30 W2(IX) = T9 * DZ(IM1) + W2(IM1) - DWO(IM1)                       BIV089
      IF(ITM-1)32,99,99                                                BIV090
   32 WO(IX) = T9 * DZ(IM1) + WO(IM1)                                  BIV091
      W2(IX) = 0.0                                                     BIV092
      DWO(IM1) = WO(IX) - WO(IM1)                                      BIV093
      GWO(IM1) = DWO(IM1) /(-Z(IM1))                                   BIV094
   31 GO TO 99                                                         BIV095
C  SEC.  3.3.2                                                        BIV096
   40 CONTINUE                                                         BIV097
      T3 = B1 + SQRT(ROA/ROW) * B2                                     BIV098
      T4 = WS(IP2) - WS(IM1)                                           BIV099
      IF(XLAM) 41,41,42                                                BIV100
   41 UST = WS(IP2)/ B1                                                BIV101
      GO TO ( 141,141,141,142),IGOGO                                   BIV102
  142 WS(IX) = 0.                                                      BIV103
      GO TO 43                                                         BIV104
  141  WS(IX) = WS(IM1) + SQRT(ROA/ROW) * UST * B2                     BIV105
      GO TO 43                                                         BIV106
   42 UST = T4/T3                                                      BIV107
      WS(IX) = WS(IP2)-UST*B1                                          BIV108
   43 WS(IP1) = WS(IX)                                                 BIV109
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      T5 = WS(IP2) - WS(IX)                                                  BIV110
      T6 = T5/T4                                                             BIV111
      U2(IX) = U2(IP2) - (U2(IP2) - U2(IM1))*T6                              BIV112
      V2(IX) = V2(IP2) - (V2(IP2) - V2(IM1))*T6                              BIV113
      IF(IGONY.EQ.0) GO TO 44                                                BIV114
      U2(IX) = 0.                                                            BIV115
      V2(IX) = 0.                                                            BIV116
   44 U2(IP1) = U2(IX)                                                       BIV117
      V2(IP1) = V2(IX)                                                       BIV118
      QST = (W2(IP2) - W2(IP1))/B1+DWO(IP1)/B1                               BIV119
      T7 = ABS(UST)                                                          BIV120
      IF(ITM.EQ.0) RAINX=0.                                                  BIV121
      CE =(-ROA*T7*QST/1000.)-RAINX                                          BIV122
      T8 = 1. - (W2(IM1) + WO(IM1)) * 1.E-3                                  BIV123
      CF = W2(IM1)*CE/T8+WO(IM1)*CE/T8                                       BIV124
      XKU(IP1) = UST**2 * DZ(IP1) / WS(IP2)                                  BIV125
      XKT(IP1) = XKU(IP1)                                                    BIV126
      IF(IGONY.GT.0) GO TO 99                                                BIV127
   49 XKU(IM1) = UST**2 * DZ(IM1) / ABS(WS(IX)-WS(IM1)) * (ROA/ROW)          BIV128
      XKT(IM1) = XKU(IM1)                                                    BIV129
      SST = CF/SQRT(ROW*ROA)/T7                                              BIV130
   50 W2(IX) = W2(IM1) + SST*B2 - DWO(IM1)                                   BIV131
   51 IF(ITM-1)52,99,99                                                      BIV132
   52 WO(IX) = CF/ROW/XKT(IM1)*DZ(IM1)+WO(IM1)                               BIV133
      W2(IX) = 0.0                                                           BIV134
      DWO(IM1) = WO(IX) - WO(IM1)                                            BIV135
      GWO(IM1) = DWO(IM1) /(-Z(IM1))                                         BIV136
   99 IF (IPOL-1) 999,992,990                                                BIV137
  990 CALL LINEAR (ITM,ITS2,1,ISSI2,L,SOU2,T2,T4,T4,T4,T4,T4,T4)             BIV138
      SH2(20) = T2                                                           BIV139
      T2 = SH2(1) * T2                                                       BIV140
      PP22(IP1) = T2*DZ(IP1)/XKT(IP1)/ROA+PP22(IP2)                          BIV141
  992 CALL LINEAR (ITM,ITS1,1,ISSI1,L,SOU1,T1,T4,T4,T4,T4,T4,T4)             BIV142
      SH1(20) = T1                                                           BIV143
      T1 = SH1(1) * T1                                                       BIV144
      PP12(IP1) = T1*DZ(IP1)/XKT(IP1)/ROA+PP12(IP2)                          BIV145
  999 RETURN                                                                 BIV146
C *******              ***** CTW    ******              *******               BIV147
      ENTRY CTW(X1,X2,X3,XO)                                                 BIV148
C     COMPUTE COEFFICIENTS FOR T,W IN ATMOSPHERE OR OCEAN                    BIV149
      DOUBLE PRECISION Z1,Z2,Z3,AD,AAD,AAAD                                  BIV150
      DOUBLE PRECISION X1,X2,X3,XO,CX                                        BIV151
      DIMENSION X1(1),X2(1),X3(1),XO(1)                                      BIV152
      A(I1)=0.                                                               BIV153
      Z1=DT2/(DZ(II)+DZ(I1))                                                 BIV154
      Z2=XKT(I1)/DZ(I1) + 0.5*VVEL(II)                                       BIV155
      Z3=XKT(II)/DZ(II) - 0.5*VVEL(II)                                       BIV156
      C(I1)=-Z1*Z3                                                           BIV157
      B(I1)=C5+Z1*(Z3+Z2)                                                    BIV158
      AD=C6*X2(II)+Z2*Z1*(X2(I1)+XO(II))-GD2*(X1(II))                        BIV159
      AAD=DT*FA(II)                                                          BIV160
      AAAD=(B(I1)-C5)*XO(II)+C(I1)*XO(II+1)                                  BIV161
      D(I1)=AD+AAD-AAAD                                                      BIV162
      DO210  J=II,IT                                                         BIV163
      Z1=DT2/(DZ(J+1)+DZ(J))                                                 BIV164
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      Z2=XKT(J)/DZ(J)   + 0.5*VVEL(J+1)                                  BIV165
      Z3=XKT(J+1)/DZ(J+1) - 0.5*VVEL(J+1)                                BIV166
      A(J)=-Z1*Z2                                                        BIV167
      C(J)=-Z1*Z3                                                        BIV168
      B(J)=C5+Z1*(Z3+Z2)                                                 BIV169
      D(J)=C6*X2(J+1)-GD2*X1(J+1)+DT*FA(J+1)                             BIV170
      D(J)=D(J)-(A(J)*XO(J)+(B(J)-C5)*XO(J+1)+C(J)*XO(J+2))              BIV171
  210 CONTINUE                                                           BIV172
      D(IT)=D(IT)+Z1*Z3*(X2(IT+2)+XO(IT+2))+C(IT)*XO(IT+2)               BIV173
      C(IT)=0.                                                           BIV174
      CST(I1)=-C(I1)/B(I1)                                               BIV175
      DST(I1)=D(I1)/B(I1)                                                BIV176
      DO211 J=I1,I2                                                      BIV177
      Z1=A(J)*CST(J-1)+B(J)                                              BIV178
      CST(J)=-C(J)/Z1                                                    BIV179
      Z2=D(J)-A(J)*DST(J-1)                                              BIV180
  211 DST(J) = Z2/Z1                                                     BIV181
      Z1=D(IT)-A(IT)*DST(I2)                                             BIV182
      Z2=A(IT)*CST(I2)+B(IT)                                             BIV183
      X3(I3)=Z1/Z2                                                       BIV184
      IF(IGONY.GT.0) GO TO 212                                           BIV185
      IF (IHT.EQ.1) GO TO 212                                            BIV186
      IIHT = IHT -1                                                      BIV187
      DO 256 I=1,IIHT                                                    BIV188
  256 X3(I) = 0.                                                         BIV189
  212 DO221 J=I4,I5                                                      BIV190
      NR=IT-J                                                            BIV191
      CX = CST(NR) * X3(NR+2)                                            BIV192
  221 X3(NR+1) = CX + DST(NR)                                            BIV193
      RETURN                                                             BIV194
      END                                                                BIV195
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      SUBROUTINE TEMPRT                                                 TMPRT000
      INTEGER RDRUM,SDRUM,TDRUM                                         TMPRT001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     TMPRT002
     1    ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3   TMPRT003
     2    ,WO,WSC,XKT,XYY,YY,GTO                                        TMPRT004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        TMPRT005
     1    ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)     TMPRT006
     2    ,TT3(30),W3(30),SST                                           TMPRT007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,TMPRT008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CETMPRT009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2            TMPRT010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               TMPRT011
     1    ,XLAM,RSUM(15),B1,B2                                          TMPRT012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    TMPRT013
     1    ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30) TMPRT014
     2    ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2  TMPRT015
     3    ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10) TMPRT016
     4    ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)       TMPRT017
     5    ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF             TMPRT018
     6    ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV        TMPRT019
     7   ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)TMPRT020
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      TMPRT021
     1    ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)   TMPRT022
     2    ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) TMPRT023
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      TMPRT024
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   TMPRT025
     1   ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3    TMPRT026
     2   ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME TMPRT027
     3   ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    TMPRT028
     4   ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           TMPRT029
     5   ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                  TMPRT030
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     TMPRT031
     1    ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                    TMPRT032
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    TMPRT033
     2     ,  T13,T14,T15,T16,XD1,YD1                                   TMPRT034
     3   ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                      TMPRT035
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II TMPRT036
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     TMPRT037
     1 , I11HT,I21HT,I31HT,I41HT                                        TMPRT038
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          TMPRT039
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     TMPRT040
     1   ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))            TMPRT041
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      TMPRT042
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      TMPRT043
      COMMON /GRDNTS / GXY(30,12),PGXY(30,12),CGXY(30,12)               TMPRT044
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     TMPRT045
     1   ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)              TMPRT046
     2   ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)              TMPRT047
     3   ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)             TMPRT048
     4   ,CP2X(30),CP2Y(30)                                             TMPRT049
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))             TMPRT050
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))               TMPRT051
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))               TMPRT052
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))               TMPRT053
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))              TMPRT054
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))             TMPRT055
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))             TMPRT056
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))             TMPRT057
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))             TMPRT058
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      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))                TMPRT059
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))                TMPRT060
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))                TMPRT061
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))                TMPRT062
      IF(ITM.LE.1)ICTR = 0                                                 TMPRT063
      ICTR = ICTR + 1                                                      TMPRT064
      IF(ICTR.LT.1)GO TO 888                                               TMPRT065
      ICTR = 0                                                             TMPRT066
      PRINT 1, ITM,NS,MS                                                   TMPRT067
    1 FORMAT ('1TIME STEP',I5,' FOR STATION',2I5)                          TMPRT068
      GO TO (550,551,552,553),IGOGO                                        TMPRT069
  550 PRINT 554                                                            TMPRT070
      GO TO 501                                                            TMPRT071
  554 FORMAT(1H+,40X,'(COASTAL CORNER STATION)')                           TMPRT072
  551 PRINT 555                                                            TMPRT073
      GO TO 501                                                            TMPRT074
  555 FORMAT(1H+,40X,'(COASTAL STATION)')                                  TMPRT075
  552 PRINT 556                                                            TMPRT076
      GO TO 501                                                            TMPRT077
  556 FORMAT(1H+,40X,'(WATER STATION)')                                    TMPRT078
  553 PRINT 557                                                            TMPRT079
  557 FORMAT(1H+,40X,'(LAND STATION)')                                     TMPRT080
  501 PRINT 4                                                              TMPRT081
      DO 10 IP=1,NP1                                                       TMPRT082
      PRINT 2, Z(IP),U2(IP),V2(IP),TT2(IP),W2(IP),XKT(IP),PP12(IP),        TMPRT083
     1  VVEL(IP),DT1(IP)                                                   TMPRT084
   10 CONTINUE                                                             TMPRT085
      PRINT 13, RANS,RABNS,RABS,RAA,CRNS,CRS,TOUPRA                        TMPRT086
   13 FORMAT(/'       RANS                RABNS                RABS       TMPRT087
     1    RAA                 CRNS                CRS                TOUPRA'/ TMPRT088
     2  7E18.8)                                                           TMPRT089
      PRINT 14, SRS,CE,CF,HAI,HSI,H3,TRAUS                                 TMPRT090
   14 FORMAT(/'       SRS                 CE                  CF         TMPRT091
     1    HAI                 HSI                 H3                 TRAUS '/ TMPRT092
     2  7E18.8)                                                           TMPRT093
      PRINT 15, (RSUM(I),I=1,8)                                            TMPRT094
   15 FORMAT(/'       LE                  A                   S                  P TMPRT095
     1           R(1-A)              RA                  MAN                T2**4TMPRT096
     2 '/ 8E16.6)                                                         TMPRT097
    4 FORMAT(//'  HEIGHT        U2                  V2                  TEMP      TMPRT098
     1  W2              XKT             PP1             VVEL            DT1 '/)TMPRT099
    2 FORMAT(9E14.5)                                                     TMPRT100
  888 RETURN                                                             TMPRT101
      ENTRY TEMGRA                                                       TMPRT102
      PRINT 5                                                            TMPRT103
    5 FORMAT(' THE FOLLOWING ARE COMPUTED GRADIENTS FOR RESTART'/'     PTMPRT104
     1UX           PUY             PVX             PVY             PTX      TMPRT105
     2  PTY             PWX             PWY        HEIGHT'/)              TMPRT106
      DO 6 I=1,NP1                                                       TMPRT107
      PRINT 7, PUX(I),PUY(I),PVX(I),PVY(I),PTX(I),PTY(I),PWX(I),PWY(I), TMPRT108
     1 Z(I)                                                              TMPRT109
    6 CONTINUE                                                           TMPRT110
      PRINT 778                                                          TMPRT111
      DO 777 I=1,NP1                                                     TMPRT112
      PRINT 7,CUX(I),CUY(I),CVX(I),CVY(I),CTX(I),CTY(I),CWX(I),CWY(I)    TMPRT113
     1,Z(I)                                                              TMPRT114
  777 CONTINUE                                                           TMPRT115
  778 FORMAT ('0CENTERED GRADIENTS')                                     TMPRT116
    7 FORMAT(8E14.5,F8.0)                                                TMPRT117
      RETURN                                                             TMPRT118
      END                                                                TMPRT119
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      SUBROUTINE TTSQ                                                   TTSQ0000
C     COMPUTE FCN  A  AND SET INDICES                                   TTSQ0001
      INTEGER RDRUM,SDRUM,TDRUM                                         TTSQ0002
      DOUBLE PRECISION Z1,Z2                                            TTSQ0003
      DOUBLE PRECISION AZER(36)                                         TTSQ0004
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     TTSQ0005
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    TTSQ0006
     2   ,WO,WSC,XKT,XYY,YY,GTO                                         TTSQ0007
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        TTSQ0008
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      TTSQ0009
     2   ,TT3(30),W3(30),SST                                           TTSQ0010
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2, TTSQ0011
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE TTSQ0012
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             TTSQ0013
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               TTSQ0014
     1   ,XLAM,RSUM(15),B1,B2                                           TTSQ0015
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    TTSQ0016
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  TTSQ0017
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   TTSQ0018
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  TTSQ0019
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        TTSQ0020
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              TTSQ0021
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         TTSQ0022
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18) TTSQ0023
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      TTSQ0024
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    TTSQ0025
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)  TTSQ0026
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      TTSQ0027
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   TTSQ0028
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     TTSQ0029
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  TTSQ0030
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2     TTSQ0031
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           TTSQ0032
     5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                   TTSQ0033
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     TTSQ0034
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                     TTSQ0035
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    TTSQ0036
     2    ,  T13,T14,T15,T16,XD1,YD1                                    TTSQ0037
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                        TTSQ0038
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II TTSQ0039
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     TTSQ0040
     1 , I1IHT,I2IHT,I3IHT,I4IHT                                       TTSQ0041
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          TTSQ0042
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     TTSQ0043
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             TTSQ0044
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      TTSQ0045
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      TTSQ0046
      COMMON /GRDNTS / GXY(30,12),PGXY(30,12),CGXY(30,12)               TTSQ0047
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     TTSQ0048
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               TTSQ0049
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               TTSQ0050
     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              TTSQ0051
     4  ,CP2X(30),CP2Y(30)                                             TTSQ0052
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))             TTSQ0053
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))               TTSQ0054
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      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))                TTSQ055
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))                TTSQ056
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))               TTSQ057
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))              TTSQ058
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))              TTSQ059
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))              TTSQ060
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))              TTSQ061
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))              TTSQ062
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))              TTSQ063
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))              TTSQ064
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))              TTSQ065
C *******              ***** TTSQ   ******            *******             TTSQ066
      IF (ITM.GT.1)GO TO 18                                              TTSQ067
      DO117 I=1,36                                                       TTSQ068
  117 AZER(I) =0.                                                        TTSQ069
   18 IF(NVCHS(2).EQ.1)GO TO 41                                          TTSQ070
C     T--OCEAN                                                           TTSQ071
      DO110  J=2,IM1                                                     TTSQ072
      Z1=U2(J)*PTX(J)+V2(J)*PTY(J)                                       TTSQ073
      FA(J)=-Z1+DT1(J)                                                   TTSQ074
  110 CONTINUE                                                           TTSQ075
      I1=1                                                               TTSQ076
      II=2                                                               TTSQ077
      IT=IM2                                                             TTSQ078
      I2=IM3                                                             TTSQ079
      I3=IM1                                                             TTSQ080
      I4=1                                                               TTSQ081
      IF(IGONY.EQ.1) GO TO 146                                           TTSQ082
      I5 = IT-  IHT+1                                                    TTSQ083
      IF(IHT.GT.2) GO TO 131                                             TTSQ084
  146 I5 = IM3                                                           TTSQ085
      I1 = 1                                                             TTSQ086
      II = 2                                                             TTSQ087
  131 CALL CTW(TT1,TT2,TT3,TTO)                                          TTSQ088
      IF(IGONY.EQ.1) GO TO 145                                           TTSQ089
C     W=S  OCEAN                                                         TTSQ090
      DO130 J=2,IM1                                                      TTSQ091
      Z1=U2(J)*PWX(J)+V2(J)*PWY(J)                                       TTSQ092
      FA(J)=-Z1                                                          TTSQ093
  130 CONTINUE                                                           TTSQ094
      CALL CTW(W1,W2,W3,WO)                                              TTSQ095
C     W=Q  ATMOSPHERE                                                    TTSQ096
  145 DO140 J=IP2,NX                                                     TTSQ097
      Z1=U2(J)*PWX(J)+V2(J)*PWY(J)                                       TTSQ098
      FA(J)=-Z1                                                          TTSQ099
  140 CONTINUE                                                           TTSQ100
   41 I1 = IP1                                                           TTSQ101
      II=IP2                                                             TTSQ102
      IT=NM1                                                             TTSQ103
      I2=NM2                                                             TTSQ104
      I3=NX                                                              TTSQ105
      I5=IA                                                              TTSQ106
      IF(NVCHS(2).EQ.1)GO TO 22                                          TTSQ107
      CALL CTW(W1,W2,W3,WO)                                              TTSQ108
C     T--ATMOSPHERE                                                      TTSQ109
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      DO120 J=IP2,NX                                                    TTSQ110
      Z1=U2(J)*PTX(J)+V2(J)*PTY(J)                                      TTSQ111
      Z2=GAM2/(DZ(J)+DZ(J-1))*(XKT(J)-XKT(J-1))                         TTSQ112
      Z3=U2(J)*SLOPX+V2(J)*SLOPY                                        TTSQ113
      FA(J)=-Z1+Z2+DT1(J) - VVEL(J) * GAM-Z3*GAM                        TTSQ114
  120 CONTINUE                                                          TTSQ115
      CALL CTW(TT1,TT2,TT3,TTO)                                         TTSQ116
   22 IF(IPOL-1)169,164,161                                             TTSQ117
  161 DO162 J=IP2,NX                                                    TTSQ118
      Z1 = U2(J)*XP2(J)+V2(J)*PP2Y(J)                                   TTSQ119
      Z2 = 0.                                                           TTSQ120
      IF ((J-IX).GT.6) GO TO 162                                        TTSQ121
      Z2 = SH2(20)*SH2(J-IX) /(Z(J+1)-Z(J-1))*2./ROA                    TTSQ122
  162 FA(J) = -Z1+Z2                                                    TTSQ123
      CALL CTW (PP21,PP22,PP23,AZER)                                    TTSQ124
  164 DO165 J=IP2,NX                                                    TTSQ125
      Z1 = U2(J)*XP1(J)+V2(J)*PP1Y(J)                                   TTSQ126
      Z2 = 0.                                                           TTSQ127
      IF ((J-IX).GT.6) GO TO 165                                        TTSQ128
      Z2 = SH1(20)*SH1(J-IX) /(Z(J+1)-Z(J-1))*2./ROA                    TTSQ129
  165 FA(J) = -Z1+Z2                                                    TTSQ130
      CALL CTW (PP11,PP12,PP13,AZER)                                    TTSQ131
  169 CONTINUE                                                          TTSQ132
      RETURN                                                            TTSQ133
C *******              ***** GWC    ******             *******          TTSQ134
      ENTRY GWC                                                         TTSQ135
C     COMPUTE GEOSTROPHIC WINDS AND CURRENTS                            TTSQ136
      DIMENSION SX(30),SY(30)                                           TTSQ137
      EQUIVALENCE (A(1),SX(1)),(B(1),SY(1))                             TTSQ138
C     STORE SCALED T AND W TEMPORARILY                                  TTSQ139
  371 DO3100  I=1,NP1                                                   TTSQ140
      TSC(I)=TT2(I)                                                     TTSQ141
      WSC(I)=W2(I)                                                      TTSQ142
C     COMPUTE UNSCALED T AND W FOR GWC,RAD,STOR                         TTSQ143
      TT2(I)=TT2(I)+TTO(I)                                              TTSQ144
 3100 W2(I)=W2(I)+WO(I)                                                 TTSQ145
      DO 310I=IP3,NX                                                    TTSQ146
      T1 = DZ(I-1)/TT2(I)**2                                            TTSQ147
      T101 = (TT2(I+1)+TT2(I)) / 2.                                     TTSQ148
      T101 = T101 - (TT2(I)+TT2(I-1)) / 2.                              TTSQ149
      T101 = T101 / ((DZ(I)+DZ(I-1))/2.)                                TTSQ150
      SX(I) = (CTX(I) - T101 * SLOPX) * T1                              TTSQ151
      SY(I) = (CTY(I) - T101 * SLOPY) * T1                              TTSQ152
  310 CONTINUE                                                          TTSQ153
      T1 = DZ(NX)/TT2(NP1)**2                                           TTSQ154
      XCTX = CTX(NP1) - ((TT2(NP1) - TT2(NX))/DZ(NX))*SLOPX             TTSQ155
      YCTY = CTY(NP1) - ((TT2(NP1) - TT2(NX))/DZ(NX))*SLOPY             TTSQ156
      SX(NP1) = T1*XCTX                                                 TTSQ157
      SY(NP1) = T1*YCTY                                                 TTSQ158
      CALL LINEAR (ITM,ICUV,4,NTCUV,J,XOCU,CU(IX),XOCV,CV(IX),XACU,     TTSQ159
     1   CU(NP1),XACV,CV(NP1))                                          TTSQ160
      CUT = CU(NP1)/TTO(NP1)                                            TTSQ161
      CVT = CV(NP1)/TTO(NP1)                                            TTSQ162
      DO330 J=IP2,NX                                                    TTSQ163
      SUMX = 0.                                                         TTSQ164
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      SUMY = 0.                                                          TTSQ165
  315 J1=J+1                                                             TTSQ166
      DO320 I=J1,NP1                                                     TTSQ167
      SUMX = SUMX + SX(I)                                                TTSQ168
      SUMY = SUMY + SY(I)                                                TTSQ169
  320 CONTINUE                                                           TTSQ170
      T1 = GSF*TT2(J)                                                    TTSQ171
      TX = T1*SUMX                                                       TTSQ172
      TY = T1*SUMY                                                       TTSQ173
      CU(J) = CUT*TT2(J) + TY                                            TTSQ174
      CV(J) = CVT*TT2(J) - TX                                            TTSQ175
  330 CONTINUE                                                           TTSQ176
      GO TO (399,  1,1,399), IGOGO                                       TTSQ177
    1 IF(IHT.GT.1) GO TO 850                                             TTSQ178
      XETA2 = CV(IX)/GSF                                                 TTSQ179
      YETA2 =-CU(IX)/GSF                                                 TTSQ180
      GO TO 851                                                          TTSQ181
  850 CV(IX) = GSF * XETA2                                               TTSQ182
      CU(IX) = -GSF * YETA2                                              TTSQ183
  851 DO340 I=2,IX                                                       TTSQ184
      T3 =(CTY(I) + CTY(I-1))/2.                                         TTSQ185
      T4 =(CWY(I) + CWY(I-1))/2.                                         TTSQ186
      T1 = PST(I-1)*T3 + PSS(I-1)*T4                                     TTSQ187
      T5 = (CTX(I) + CTX(I-1))/2.                                        TTSQ188
      T6 = (CWX(I) + CWX(I-1))/2.                                        TTSQ189
      T2 = PST(I-1)*T5 + PSS(I-1)*T6                                     TTSQ190
      SX(I) = .001*T2*DZ(I-1)                                            TTSQ191
      SY(I) = .001*T1*DZ(I-1)                                            TTSQ192
  340 CONTINUE                                                           TTSQ193
      DO350 K=2,IX                                                       TTSQ194
      I=IX-K+1                                                           TTSQ195
      SUMX = 0.                                                          TTSQ196
      SUMY = 0.                                                          TTSQ197
      DO345 J=I,IM1                                                      TTSQ198
      SUMX = SUMX + SX(J+1)                                              TTSQ199
      SUMY = SUMY + SY(J+1)                                              TTSQ200
  345 CONTINUE                                                           TTSQ201
      CU(I) = CU(IX) + GFR*SUMY                                          TTSQ202
      CV(I) = CV(IX) - GFR*SUMX                                          TTSQ203
  350 CONTINUE                                                           TTSQ204
  399 RETURN                                                             TTSQ205
C *******              ***** CUV    ******            *******            TTSQ206
      ENTRY CUV                                                          TTSQ207
C     COMPUTE U AND V COEFFICIENTS FOR GAUSSIAN ELIMINATION SCHEME       TTSQ208
      A(I1) = 0.                                                         TTSQ209
      Z1 = DT2/(DZ(I1) + DZ(II))                                         TTSQ210
      Z2 = XKU(I1)/DZ(I1)                                                TTSQ211
      Z3 = XKU(II)/DZ(II)                                                TTSQ212
      BR(I1) = C5 + Z1*(Z3 + Z2)                                         TTSQ213
      BG     = -DTSF                                                     TTSQ214
      C(I1) = -Z1*Z3                                                     TTSQ215
      IF(I1-1) 111,111,12                                                TTSQ216
  111 IF(IHT.EQ.1) GO TO 11                                              TTSQ217
   35 IIHT = IHT -1                                                      TTSQ218
      DO 36 I=1,IIHT                                                     TTSQ219
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      U3(I) = 0.                                                        TTSQ220
   36 V3(I) = 0.                                                        TTSQ221
      GO TO 13                                                          TTSQ222
   11 U3(I1) = U2(I1) + DTSF * (V2(I1)-CV(I1))                          TTSQ223
      V3(I1) = V2(I1) + DTSF * (CU(I1)-U2(I1))                          TTSQ224
      GO TO 13                                                          TTSQ225
   12 U3(IT+2) = CU(IT+2)                                               TTSQ226
      V3(IT+2) = CV(IT+2)                                               TTSQ227
   13 Z4 = C6 * U2(II) - DTSF * CV(II) - GD2 * U1(II)                   TTSQ228
     1 - DT * (U2(II) * PUX(II) + V2(II) * PUY(II))                     TTSQ229
      Z5 = Z1*Z2*U2(I1)                                                 TTSQ230
      Z6 = C6*V2(II) + DTSF*CU(II) - GD2*V1(II)                         TTSQ231
     1 - DT * (U2(II) * PVX(II) + V2(II) * PVY(II))                     TTSQ232
      Z7 = Z1*Z2*V2(I1)                                                 TTSQ233
      F(I1,1) = Z4 + Z5                                                 TTSQ234
      F(I1,2) = Z6 + Z7                                                 TTSQ235
      DO 30 I=II,IT                                                     TTSQ236
      Z1 = DT2/(DZ(I) + DZ(I+1))                                        TTSQ237
      Z2 = XKU(I)/DZ(I) + 0.5*VVEL(I+1)                                 TTSQ238
      Z3 = XKU(I+1)/DZ(I+1) - 0.5*VVEL(I+1)                             TTSQ239
      A(I) = -Z1*Z2                                                     TTSQ240
      BR(I) = C5 + Z1*(Z3 + Z2)                                         TTSQ241
      C(I) = -Z1*Z3                                                     TTSQ242
      F(I,1) = C6*U2(I+1) - DTSF*CV(I+1) - GD2*U1(I+1)                  TTSQ243
     1 - DT * (U2(I+1)* PUX(I+1)+ V2(I+1)* PUY(I+1))                    TTSQ244
      F(I,2) = C6*V2(I+1) + DTSF*CU(I+1) - GD2*V1(I+1)                  TTSQ245
     1 - DT * (U2(I+1)* PVX(I+1)+ V2(I+1)* PVY(I+1))                    TTSQ246
   30 CONTINUE                                                          TTSQ247
      C(IT) = 0.                                                        TTSQ248
      F(IT,1) = F(IT,1) + Z1*Z3*U2(IT+2)                                TTSQ249
      F(IT,2) = F(IT,2) + Z1*Z3*V2(IT+2)                                TTSQ250
      Z1 = 1./(BR(I1)**2 + BG**2)                                       TTSQ251
      E(I1,1,1) = Z1*BR(I1)                                             TTSQ252
      E(I1,1,2) = -Z1*BG                                                TTSQ253
      E(I1,2,1) = -E(I1,1,2)                                            TTSQ254
      E(I1,2,2) = E(I1,1,1)                                             TTSQ255
      FST(I1,1) = E(I1,1,1)*F(I1,1) + E(I1,1,2)*F(I1,2)                 TTSQ256
      FST(I1,2) = E(I1,2,1)*F(I1,1) + E(I1,2,2)*F(I1,2)                 TTSQ257
      E(I1,1,1) = -C(I1)*E(I1,1,1)                                      TTSQ258
      E(I1,1,2) = -C(I1)*E(I1,1,2)                                      TTSQ259
      E(I1,2,1) = -E(I1,1,2)                                            TTSQ260
      E(I1,2,2) = E(I1,1,1)                                             TTSQ261
      DO 5 I=II,I2                                                      TTSQ262
      Z1 = A(I)*E(I-1,1,1) + BR(I)                                      TTSQ263
      Z2 = A(I)*E(I-1,1,2) + BG                                         TTSQ264
      Z3 = Z1**2 + Z2**2                                                TTSQ265
      R(I,1,1) = Z1/Z3                                                  TTSQ266
      R(I,1,2) = -Z2/Z3                                                 TTSQ267
      R(I,2,1) = -R(I,1,2)                                              TTSQ268
      R(I,2,2) = R(I,1,1)                                               TTSQ269
      E(I,1,1) = -R(I,1,1)*C(I)                                         TTSQ270
      E(I,1,2) = -R(I,1,2)*C(I)                                         TTSQ271
      E(I,2,1) = -E(I,1,2)                                              TTSQ272
      E(I,2,2) = E(I,1,1)                                               TTSQ273
    5 CONTINUE                                                          TTSQ274
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      Z1 = A(IT)*E(I2,1,1) + BR(IT)                                    TTSQ275
      Z2 = A(IT)*E(I2,1,2) + BG                                        TTSQ276
      Z3 = Z1**2 + Z2**2                                               TTSQ277
      R(IT,1,1) = Z1/Z3                                                TTSQ278
      R(IT,1,2) = -Z2/Z3                                               TTSQ279
      R(IT,2,1) = -R(IT,1,2)                                           TTSQ280
      R(IT,2,2) = R(IT,1,1)                                            TTSQ281
      DO 10 I=II,IT                                                    TTSQ282
      F(I,1) = F(I,1) - A(I)*FST(I-1,1)                                TTSQ283
      F(I,2) = F(I,2) - A(I)*FST(I-1,2)                                TTSQ284
      FST(I,1) = R(I,1,1)*F(I,1) + R(I,1,2)*F(I,2)                     TTSQ285
      FST(I,2) = R(I,2,1)*F(I,1) + R(I,2,2)*F(I,2)                     TTSQ286
   10 CONTINUE                                                         TTSQ287
      U3(I3) = FST(IT,1)                                               TTSQ288
      V3(I3) = FST(IT,2)                                               TTSQ289
      DO 20 I=I4,I5                                                    TTSQ290
      NR=IT-I                                                          TTSQ291
      EU3 = E(NR,1,1) *U3(NR+2)                                        TTSQ292
       EV3 = E(NR,1,2) *V3(NR+2)                                       TTSQ293
      U3(NR+1)=EU3+EV3+FST(NR,1)                                       TTSQ294
      EU3 = E(NR,2,1) *U3(NR+2)                                        TTSQ295
      EV3 = E(NR,2,2) * V3(NR+2)                                       TTSQ296
      V3(NR+1)=EU3+EV3+FST(NR,2)                                       TTSQ297
   20 CONTINUE                                                         TTSQ298
   99 CONTINUE                                                         TTSQ299
      RETURN                                                           TTSQ300
      END                                                              TTSQ301
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      SUBROUTINE SDATA                                                  SDATA000
      INTEGER RDRUM,SDRUM,TDRUM                                         SDATA001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     SDATA002
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    SDATA003
     2   ,WO,WSC,XKT,XYY,YY,GTO                                         SDATA004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        SDATA005
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      SDATA006
     2   ,TT3(30),W3(30),SST                                            SDATA007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,SDATA008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CESDATA009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             SDATA010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               SDATA011
     1   ,XLAM,RSUM(15),B1,B2                                           SDATA012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    SDATA013
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  SDATA014
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   SDATA015
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  SDATA016
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        SDATA017
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              SDATA018
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         SDATA019
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)SDATA020
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      SDATA021
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    SDATA022
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) SDATA023
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      SDATA024
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   SDATA025
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     SDATA026
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  SDATA027
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    SDATA028
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           SDATA029
     5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                   SDATA030
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     SDATA031
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                     SDATA032
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    SDATA033
     2     , T13,T14,T15,T16,XD1,YD1                                    SDATA034
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                        SDATA035
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II SDATA036
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     SDATA037
     1 , I1IHT,I2IHT,I3IHT,I4IHT                                        SDATA038
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          SDATA039
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     SDATA040
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             SDATA041
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      SDATA042
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      SDATA043
      COMMON /GRDNTS / GXY(30,12),PGXY(30,12),CGXY(30,12)               SDATA044
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     SDATA045
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               SDATA046
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               SDATA047
     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              SDATA048
     4  ,CP2X(30),CP2Y(30)                                             SDATA049
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))             SDATA050
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))               SDATA051
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))               SDATA052
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))               SDATA053
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))              SDATA054
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      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))                SDATA055
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))                SDATA056
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))                SDATA057
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))                SDATA058
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))                SDATA059
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))                SDATA060
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))                SDATA061
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))                SDATA062
      DIMENSION YIN2(1),YIN3(1),YIN4(1),YIN5(1)                            SDATA063
      EQUIVALENCE (XYY(1,1,2),YIN2(1)),(XYY(1,1,3),YIN3(1))                SDATA064
     1       ,(XYY(1,1,4),YIN4(1)),(XYY(1,1,5),YIN5(1))                    SDATA065
      DIMENSION VAR3(50)                                                   SDATA066
      DIMENSION ALL(12,5) ,IALL(12,5)                                      SDATA067
      EQUIVALENCE (VAR3(1),C(1)) ,(IALL(1,1),ALL(1,1))                     SDATA068
      DOUBLE PRECISION XTIME,XT1                                           SDATA069
C  SUBROUTINE TO SET DATA AT EACH STATION INITIALLY AND AT EACH RESTART     SDATA070
      IF (ITM) 11,11,301                                                   SDATA071
   11 IF (IS-1) 12,12,1313                                                 SDATA072
C  READ IN INITIAL TIME ONLY        FOLLOWING FOR ALL STATIONS             SDATA073
   12 CONTINUE                                                             SDATA074
      READ 2,NLAP,NPU                                                      SDATA075
      NTOP = NLAP+NP1                                                      SDATA076
      NATAL = NTOP-IX                                                      SDATA077
      DO 13I=NP2,NTOP                                                      SDATA078
      READ 1, PA(I),TA(I),QA(I),COB(I)                                     SDATA079
      PRINT 1,PA(I),TA(I),QA(I),COB(I)                                     SDATA080
   13 CONTINUE                                                             SDATA081
      ST4(NP2)=SIG*TA(NP2)**4                                              SDATA082
      NTOP1=NTOP-1                                                         SDATA083
      TW = 0.                                                              SDATA084
      IF (XIIN.EQ.1..AND.XJIN.EQ.1.) GO TO 19                              SDATA085
C     XYY(LEVEV,        VARIABLE IN YY  ,STATION)                          SDATA086
      XD1 = XD*(XIIN-1.)                                                   SDATA087
      YD1 =-XD*(XJIN-1.)                                                   SDATA088
      DO 191J=1,6                                                          SDATA089
  184 I = J                                                                SDATA090
  190 DO 18 K=1,NP1                                                        SDATA091
   18 XYY(K,J,2) = YY(K,J  ) -ZE2(K,I)*YD1-ZE1(K,I)*XD1                    SDATA092
      IF (J-4) 192,191,191                                                 SDATA093
  192 XYY(IP1,J,2) = XYY(IX,J,2)                                           SDATA094
  191 CONTINUE                                                             SDATA095
      GO TO 25                                                             SDATA096
   19 DO 20 J=1,6                                                          SDATA097
      DO 20 I=1,NP1                                                        SDATA098
   20 XYY(I,J  ,2)  =    YY(I,J)                                           SDATA099
C  ALL CARDS READ IN AFTER ALL STATIONS STARTED                            SDATA100
C  FOLLOWING AT EACH STATION AT TIME STEP ZERO                             SDATA101
   25 IF (NTIME.LT.0) GO TO 1313                                           SDATA102
  301 IF (ITM.NE.NTIME.OR.IS.GT.1) GO TO 389                               SDATA103
      IGET = ITM                                                           SDATA104
      READ 2, NTIME,K                                                      SDATA105
      DO 302 I=1,NP1                                                       SDATA106
  302 READ 1,(VARIN(I,J),J=1,4)                                            SDATA107
      DO 303 I=1,K                                                         SDATA108
      IF (NVCHS(1).EQ.1) READ 1,BR(I),(R(I,J,1),J=1,4)                     SDATA109
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      IF (NVCHS(2).EQ.1) READ 1,V3(I),(E(I,J,1),J=1,4)                  SDATA110
  303 CONTINUE                                                          SDATA111
      DO 304 I=1,NP1                                                    SDATA112
      T1 = Z(I)                                                         SDATA113
      IF (I.EQ.IX) T1=T1-.00001                                         SDATA114
      IF (I.EQ.IP1)T1=T1+.00001                                         SDATA115
      IF (NVCHS(1).NE.1) GO TO 305                                      SDATA116
      CALL XINEAR (T1,BR,4,K,L,R(1,1,1),GNV(I,1),                       SDATA117
     1  R(1,2,1),GNV(I,2),R(1,3,1),GNV(I,3),R(1,4,1),GNV(I,4))          SDATA118
      GXY(I,1) = GNV(I,1)                                               SDATA119
      GXY(I,7) = GNV(I,2)                                               SDATA120
      GXY(I,2) = GNV(I,3)                                               SDATA121
      GXY(I,8) = GNV(I,4)                                               SDATA122
  305 IF (NVCHS(2).NE.1) GO TO 304                                      SDATA123
      CALL XINEAR (T1,V3,4,K,L,E(1,1,1),GNV(I,5),                       SDATA124
     1  E(1,2,1),GNV(I,6),E(1,3,1),GNV(I,7),E(1,4,1),GNV(I,8))          SDATA125
      GXY(I,3 ) = GNV(I,5)                                              SDATA126
      GXY(I,9 ) = GNV(I,6)                                              SDATA127
      GXY(I,4 ) = GNV(I,7)                                              SDATA128
      GXY(I,10) = GNV(I,8)                                              SDATA129
  304 CONTINUE                                                          SDATA130
  389 IF (ITM) 1313,1313,500                                            SDATA131
 1313 CONTINUE                                                          SDATA132
      IRAT = IMARA                                                      SDATA133
      INEW = 10 *IMARA                                                  SDATA134
      INEWC = INEW                                                      SDATA135
C  READ FOR EACH STATION   CLOUDS FROM RAD                             SDATA136
C                          THERMAL CONDUCTIVI  IF LAND                 SDATA137
C             ANY OTHER VARIABLE REQUIRE FOR A PARTICULAR RUN          SDATA138
C  READ STATION VALUES                FOLLOWING AT STATION START      SDATA139
      READ 2, NTFOR,NCL,NTCUV,IPOI,IGONY,ISSI1,ISSI2                    SDATA140
      READ 67,PSFA,XLAM,DEL                                             SDATA141
      READ 68,          SLOPX,SLOPY,HEIGHT,ETAINX,ETAINY,IANV           SDATA142
   68 FORMAT(5E12.5,I12)                                                SDATA143
   67 FORMAT(8F10.2)                                                    SDATA144
    1 FORMAT(7F10.2)                                                    SDATA145
      PRINT 1111,PSFA,XLAM,DEL,SLOPX,SLOPY,HEIGHT,ETAINX,ETAINY,IANV    SDATA146
      IGOGO = IGONY + 3                                                 SDATA147
      IGOG  = IGOGO                                                     SDATA148
      HEIGHT = HEIGHT*100.                                              SDATA149
      IF(HEIGHT.EQ.0.0) GO TO 313                                       SDATA150
      DO 34 I=1,IX                                                      SDATA151
      K = IX-I+1                                                        SDATA152
      IF(HEIGHT.LT.Z(K)) GO TO 34                                       SDATA153
      IHT = K +1                                                        SDATA154
      GO TO 36                                                          SDATA155
   34 CONTINUE                                                          SDATA156
      IHT = 1                                                           SDATA157
      GO TO 36                                                          SDATA158
  313 IHT = IP1                                                         SDATA159
   36 CONTINUE                                                          SDATA160
      DO 30 I=1,NTCUV                                                   SDATA161
      READ  5, ICUV(I),XOCU(I),XOCV(I),XACU(I),XACV(I),T1,T2            SDATA162
   30 PRINT 5,ICUV(I),XOCU(I),XOCV(I),XACU(I),XACV(I),T1,T2             SDATA163
      IF (NTFOR.LE.0) NTFOR = 1                                         SDATA164
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      ISTEP(1) = 601                                                    SDATA165
      IF(NCL)114,114,115                                                SDATA166
C     NUMBER OF CLOUD LAYERS,AMOUNTS AND RAINFALL RATE INPUT            SDATA167
  115 DO 933 I=1,NTFOR                                                  SDATA168
      READ  3,ISTEP(I),NXN(I),RAINI(I),(LLCI(I,L),ECLI(I,L),TCLI(I,L),  SDATA169
     1  L=1,NCL)                                                        SDATA170
      PRINT 3,ISTEP(I),NXN(I),RAINI(I),(LLCI(I,L),ECLI(I,L),TCLI(I,L),  SDATA171
     1  L=1,NCL)                                                        SDATA172
      DO 933 LL=1,NCL                                                   SDATA173
  933 LLCI(I,LL) = LLCI(I,LL)    -IX                                    SDATA174
  114 NCLI = NCL                                                        SDATA175
      LLCI(1,NCL+1) = 61                                                SDATA176
      GO TO (1520,1520,1520,1510),IGOGO                                 SDATA177
 1510 READ 1   , SRS,ROW,CW,XMQ,RADMX                                   SDATA178
      PRINT 1   ,SRS,ROW,CW,XMQ,RADMX                                   SDATA179
      READ  1   , (XKT(I),I=1,IM1)                                      SDATA180
      PRINT 1   , (XKT(I),I=1,IM1)                                      SDATA181
 1520 CONTINUE                                                          SDATA182
      DO 699I=1,20                                                      SDATA183
      SOU1(I) = 0.                                                      SDATA184
      SOU2(I) = 0.                                                      SDATA185
      IF(I.GT.6) GO TO 699                                              SDATA186
      SH1(I) = 0.                                                       SDATA187
      SH2(I) = 0.                                                       SDATA188
  699 CONTINUE                                                          SDATA189
      IF(IPOI)700,700,701                                               SDATA190
  701 READ 2, (ITS1(I),I=1,ISSI1)                                       SDATA191
      PRINT 2,(ITS1(I),I=1,ISSI1)                                       SDATA192
      READ 1   , (SOU1(I),I=1,ISSI1)                                    SDATA193
      PRINT 1   ,(SOU1(I),I=1,ISSI1)                                    SDATA194
      READ 1   ,(SH1(I),I=1,6)                                          SDATA195
      PRINT 1   ,(SH1(I),I=1,6)                                         SDATA196
      IF(IPOI.EQ.1) GO TO 700                                           SDATA197
      READ 2,  (ITS2(I),I=1,ISSI2)                                      SDATA198
      PRINT 2, (ITS2(I),I=1,ISSI2)                                      SDATA199
      READ 1   ,  (SOU2(I),I=1,ISSI2)                                   SDATA200
      PRINT 1   , (SOU2(I),I=1,ISSI2)                                   SDATA201
      READ 1   ,(SH2(I),I=1,6)                                          SDATA202
      PRINT 1   ,(SH2(I),I=1,6)                                         SDATA203
  700 DO 117  L=NP2,NTOP1                                               SDATA204
      IF(QA(L+1).LE.0.0) QA(L+1) = 0.001                                SDATA205
      T1 = (QA(L)+QA(L+1))/2.*(PA(L)-PA(L+1))/G                         SDATA206
      TW = TW + T1                                                      SDATA207
      K=L-IX                                                            SDATA208
      DUW(K) = T1                                                       SDATA209
      COA(K) = .4148239*(PA(L)-PA(L+1))                                 SDATA210
C     T8 = (COB(K)+COB(K+1))/2.*DZ(L)*1.E-5                             SDATA211
C  DZ(L) NOT SET ABOVE THE TOP PREDICTION LEVEL                         SDATA212
      T8 = (COB(L)+COB(L+1))/2.*1.E-5  *AR/G*TA(L)/PA(L)*               SDATA213
     1    (PA(L)-PA(L+1))                                               SDATA214
C   XNO IS THE INFRARED ABSORPTION COEFFICIENT FOR AEROSOLS             SDATA215
      CGA(K) = T8*1.66*XNO                                              SDATA216
      PAAB(K) = T8*SOAB                                                 SDATA217
      PASA(K) = T8*SOSC                                                 SDATA218
      ST4(L+1)=SIG*(TA(L+1)**4)                                         SDATA219
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      DST4(L) = (ST4(L)+ST4(L+1))*.5                                    SDATA220
  117 CONTINUE                                                          SDATA221
      DO 23 N=1,JMAX                                                    SDATA222
      DO 23 M=1,IMAX                                                    SDATA223
      XD1 = XD*(M-1)                                                    SDATA224
      YD1 =-XD*(N-1)                                                    SDATA225
      DO 23 I=1,NP1                                                     SDATA226
      T1 = XD1*ZE1(I,1)+YD1*ZE2(I,1)+XYY(I,1,2)                         SDATA227
      T2 = XD1*ZE1(I,2)+YD1*ZE2(I,2)+XYY(I,2,2)                         SDATA228
      T3 =  T1**2+T2**2                                                 SDATA229
      IF (T3) 23,23,223                                                 SDATA230
  223 T3 = SQRT(T3)                                                     SDATA231
      IF (T3.GT.SAVE)  SAVE = T3                                        SDATA232
   23 CONTINUE                                                          SDATA233
      TDEL = XD/SAVE                                                    SDATA234
      SAVE = 0.01                                                       SDATA235
      DO 108  I=IY,NX                                                   SDATA236
      T1  =-2.*G*(Z(I+1)-Z(I))                                          SDATA237
      T2  =AR*(TT2(I)+TT2(I+1))                                         SDATA238
  108 VAR3(I) = EXP(T1/T2)                                              SDATA239
      IF (NPU) 101,101,102                                              SDATA240
  101 PA(IP1)= PSFA                                                     SDATA241
  109 DO 111  I=IY,NX                                                   SDATA242
      PA(I+1)=PA(I)*VAR3(I)                                             SDATA243
  111 CONTINUE                                                          SDATA244
      GO TO 103                                                         SDATA245
  102 PA(NP1) = PSFA                                                    SDATA246
  110 DO 113 I=IY,NX                                                    SDATA247
      K = NX - I + IY                                                   SDATA248
      PA(K)=VAR3(K)/PA(K+1)                                             SDATA249
  113 CONTINUE                                                          SDATA250
  103 CONTINUE                                                          SDATA251
      IF (IGONY) 51,51,150                                              SDATA252
  150 DEL = 0.                                                          SDATA253
      GO TO 52                                                          SDATA254
   51 ROW = 1.                                                          SDATA255
      CW  = .935                                                        SDATA256
      XMQ =1.                                                           SDATA257
      IF (XLAM) 52,4,52                                                 SDATA258
    4 DEL=.055                                                          SDATA259
   52 CONTINUE                                                          SDATA260
   33 XM = MS-1                                                         SDATA261
      YM = NS-1                                                         SDATA262
      XD1 = XD*XM                                                       SDATA263
      YD1 =-XD*YM                                                       SDATA264
      DO 29 J=1,6                                                       SDATA265
  284 I = J                                                             SDATA266
  290 DO 28 K=1,NP1                                                     SDATA267
   28 YY(K,J  ) = XYY(K,J,2) +ZE2(K,I)*YD1+ZE1(K,I)*XD1                 SDATA268
      IF (J-4) 291,29,29                                                SDATA269
  291 YY(IP1,J) = YY(IX,J)                                              SDATA270
   29 CONTINUE                                                          SDATA271
C     ALL INITIAL DATA SET                                              SDATA272
      GO TO (797,796,796,795),IGOGO                                     SDATA273
  795 DO 14 J=1,4                                                       SDATA274
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      DO 141I=1,IX                                                    SDATA275
   14 YY(I,J) = 0.                                                    SDATA276
      GO TO 1114                                                      SDATA277
  797 DO 798 J=1,2                                                    SDATA278
      DO 798 I=1,IX                                                   SDATA279
  798 YY(I,J) = 0.                                                    SDATA280
      GO TO 1114                                                      SDATA281
  796 IQI = 5                                                         SDATA282
      IF(W2(IX).EQ.0.0) IQI =4                                        SDATA283
      DO 141J=IQI,6                                                   SDATA284
      DO 141I=1,IX                                                    SDATA285
  141 YY(I,J) = 0.                                                    SDATA286
      IF(IHT.EQ.1) GO TO 122                                          SDATA287
      IIHT = IHT - 1                                                  SDATA288
      DO 121 I=1,IIHT                                                 SDATA289
      U2(I) = 0.0                                                     SDATA290
  121 V2(I) =0.0                                                      SDATA291
  122 IF(IGONY.EQ.0) GO TO 1114                                       SDATA292
      IF(IANV.GT.1) GO TO 118                                         SDATA293
      DO 119 I=1,IX                                                   SDATA294
  119 V2(I) = 0.0                                                     SDATA295
      GO TO 1114                                                      SDATA296
  118 DO 120 I=1,IX                                                   SDATA297
  120 U2(I) = 0.0                                                     SDATA298
 1114 READ 16, (YY(I,3),I=1,IP1)                                      SDATA299
   16 FORMAT(6E12.4)                                                  SDATA300
      IF(IPOL.EQ.0) GO TO 350                                         SDATA301
      READ 16, (YY(I,5),I=IX,NP1)                                     SDATA302
      DO 351 I=IX,NP1                                                 SDATA303
      YY(I,5) = YY(I,5)/ROA/100.                                      SDATA304
  351 CONTINUE                                                        SDATA305
      IF(IPOL.EQ.1) GO TO 350                                         SDATA306
      READ 16, (YY(I,6),I=IX,NP1)                                     SDATA307
      DO 352 I=IX,NP1                                                 SDATA308
      YY(I,6) = YY(I,6)/ROA/100.                                      SDATA309
  352 CONTINUE                                                        SDATA310
  350 IF(IGONY.EQ.0) GO TO 10                                         SDATA311
      U2(IP1) = 0.                                                    SDATA312
      V2(IP1) = 0.                                                    SDATA313
   10 DO 9I=1,NP1                                                     SDATA314
      TTO(I)=TT2(I)                                                   SDATA315
      TT2(I)=0.                                                       SDATA316
      TT1(I) = TT2(I)                                                 SDATA317
      U1(I) = U2(I)                                                   SDATA318
      V1(I) = V2(I)                                                   SDATA319
      WO(I)=W2(I)                                                     SDATA320
      W2(I)=0.                                                        SDATA321
      W1(I) = W2(I)                                                   SDATA322
      TT3(I) = TT2(I)                                                 SDATA323
      U3(I) = U2(I)                                                   SDATA324
      V3(I) = V2(I)                                                   SDATA325
      W3(I) = W2(I)                                                   SDATA326
      PP21(I) = PP22(I)                                               SDATA327
      PP11(I) = PP12(I)                                               SDATA328
      PP13(I) = PP12(I)                                               SDATA329
```

```
      PP23(I) = PP22(I)                                                 SDATA330
    9 CONTINUE                                                          SDATA331
      ICK = ITESTP                                                      SDATA332
      ISTR=0                                                            SDATA333
      LY=1                                                              SDATA334
      C5 = 1.                                                           SDATA335
      C6 = 1.                                                           SDATA336
      GD2 = 0.                                                          SDATA337
      PHI = PHIBOT + XDT1*(JMAX-NS)                                     SDATA338
      T1= PHI * .017453293                                              SDATA339
      H= HWEST + (MS-1) * XDT1/COS(T1)                                  SDATA340
      PHIR = T1                                                         SDATA341
      CPH = COS(PHIR)                                                   SDATA342
      SPH = SIN(PHIR)                                                   SDATA343
      SF = 14.584E-5*SIN(T1)                                            SDATA344
      DTSF = DT*SF                                                      SDATA345
      C1 = 3.7943/PA(IP1)                                               SDATA346
      GSF = G/SF                                                        SDATA347
      GFR =GSF/ROW                                                      SDATA348
      DTA = DT                                                          SDATA349
      DTA2 = 2.*DT                                                      SDATA350
      T10 = XLAM*DEL/2.                                                 SDATA351
      DO 720 I=1,NX                                                     SDATA352
      ZDL2(I) = (ZA(I) + T10) **2                                       SDATA353
  720 CONTINUE                                                          SDATA354
      TK = XK2**2                                                       SDATA355
      DO 725 I=1,IM1                                                    SDATA356
      CK0(I) = TK*ZDL2(I)                                               SDATA357
  725 CONTINUE                                                          SDATA358
      TK = XK12                                                         SDATA359
      DO 735 I=IP1,NX                                                   SDATA360
      CK0(I) = TK*ZDL2(I)                                               SDATA361
  735 CONTINUE                                                          SDATA362
      DO 2000I=1,15                                                     SDATA363
 2000 RSUM(I) = 0.                                                      SDATA364
      RANS = 0.                                                         SDATA365
      RABNS = 0.                                                        SDATA366
      RABS = 0.                                                         SDATA367
      CRNS = 0.                                                         SDATA368
      CRS = 0.                                                          SDATA369
      RAA = 0.                                                          SDATA370
      TOUPRA = 0.                                                       SDATA371
      IF(XLAM) 45,99,45                                                 SDATA372
   45 IF(DEL)60,50,60                                                   SDATA373
   50 T6 = Z(IP2)/XLAM                                                  SDATA374
      T6 = ABS(T6)                                                      SDATA375
      B1 = 1./XK1*ALOG(T6)                                              SDATA376
      T7 = Z(IM1)/XLAM                                                  SDATA377
      T7 = ABS(T7)                                                      SDATA378
   54 B2 = 1./XK1*ALOG(T7)                                              SDATA379
      GO TO 70                                                          SDATA380
   60 T8 = XLAM/2./PI                                                   SDATA381
      T16=T8**EX2                                                       SDATA382
      T9=SQRT(G)*DEL*T16                                                SDATA383
      DO 65 I=1,NX                                                      SDATA384
```

```
      T10 = -ZA(I)/T8                                                   SDATA385
      CSW(I) = T9*EXP(T10)                                              SDATA386
   65 CONTINUE                                                          SDATA387
      XKU(IP1) = CK0(IP1)*CSW(IP1)                                      SDATA388
      XKT(IP1) = XKU(IP1)                                               SDATA389
      XKU(IM1) = CK0(IM1)*CSW(IM1)                                      SDATA390
      XKT(IM1) = XKU(IM1)                                               SDATA391
   70 CONTINUE                                                          SDATA392
      GO TO 99                                                          SDATA393
  500 CONTINUE                                                          SDATA394
      NVAR1 = 1                                                         SDATA395
      NVAR6 = 6                                                         SDATA396
      DO 585 I = 1,NP1                                                  SDATA397
      U3(I) = 0.                                                        SDATA398
      V3(I) = 0.                                                        SDATA399
      TT3(I) = 0.                                                       SDATA400
      W3(I) = 0.                                                        SDATA401
      PP13(I) = 0.                                                      SDATA402
      PP23(I) = 0.                                                      SDATA403
  585 CONTINUE                                                          SDATA404
C*************************************************************************SDATA405
C**** FLOATING GRID STATIONS ARE ASSIGNED THE FOLLOWING NUMBERS ********SDATA406
C                                                                       SDATA407
C                                  6  4  7                              SDATA408
C                                                                       SDATA409
C                                  1  2  3                              SDATA410
C                                                                       SDATA411
C                                  8  5  9                              SDATA412
C                                                                       SDATA413
C**** WHERE THE COMPUTED GRADIENTS ARE APPLIED AT STATION 2 ************SDATA414
C*************************************************************************SDATA415
      DO 666 I=1,5                                                      SDATA416
      IF(I.EQ.2.OR.I.EQ.3) GO TO 666                                    SDATA417
      DO 666 J=1,12                                                     SDATA418
      ALL(J,I) = 0.                                                     SDATA419
  666 CONTINUE                                                          SDATA420
C  SET DATA FROM RESTART                                                SDATA421
C   COMPUTES THE CENTERED AND UPWIND GRADIENTS                          SDATA422
      IU3 = 3                                                           SDATA423
      IF (MS-2) 511,501,501                                             SDATA424
C  SETS STATION 2   MS=1                                                SDATA425
  511 READ (RDRUM'IS)     (YIN2(I),I=1,NWSYY)                           SDATA426
      DO 600 I=1,12                                                     SDATA427
      ALL(I,2) = YIN3(I)                                                SDATA428
  600 CONTINUE                                                          SDATA429
      SLOPX = ALL(1,2)                                                  SDATA430
      SLOPY = ALL(2,2)                                                  SDATA431
      HEIGHT = ALL(3,2)                                                 SDATA432
      ETA1   = ALL(4,2)                                                 SDATA433
      ETA2   = ALL(5,2)                                                 SDATA434
      XETA2  = ALL(6,2)                                                 SDATA435
      YETA2  = ALL(7,2)                                                 SDATA436
      IHT    =IALL(8,2)                                                 SDATA437
      IANV   =IALL(9,2)                                                 SDATA438
      IGOGO  =IALL(10,2)                                                SDATA439
```

```
      IGONY=IGOGO-3                                                    SDATA440
      ETAINX = ALL(11,2)                                               SDATA441
      ETAINY = ALL(12,2)                                               SDATA442
      LOCXYY(2) = -1                                                   SDATA443
      IU3 = 2                                                          SDATA444
      ALL(11,1) = ALL(11,2)                                            SDATA445
      ALL(12,1) = ALL(12,2)                                            SDATA446
C  SETS STATION 3   MS GT 1                                            SDATA447
  501 DO 503 J=NVAR1,NVAR6                                             SDATA448
      DO 503 K=1,NP1                                                   SDATA449
      IF (MS.EQ.1) GO TO 1603                                          SDATA450
      XYY(K,J,1) = XYY(K,J,2)                                          SDATA451
      XYY(K,J,2) = XYY(K,J,3)                                          SDATA452
 1603 YY(K,J)    = XYY(K,J,IU3)                                        SDATA453
  503 CONTINUE                                                         SDATA454
      PP23(NP1) = PP22(NP1)                                            SDATA455
      PP13(NP1) = PP12(NP1)                                            SDATA456
      IF(MS.EQ.1) GO TO 610                                            SDATA457
      DO 604 I=1,12                                                    SDATA458
      IF(I.EQ.8.OR.I.EQ.10) GO TO 1610                                 SDATA459
      ALL(I,1) = ALL(I,2)                                              SDATA460
      ALL(I,2) = ALL(I,3)                                              SDATA461
      GO TO 604                                                        SDATA462
 1610 IALL(I,1) = IALL(I,2)                                            SDATA463
      IALL(I,2) = IALL(I,3)                                            SDATA464
  604 CONTINUE                                                         SDATA465
      SLOPX = ALL(1,2)                                                 SDATA466
      SLOPY = ALL(2,2)                                                 SDATA467
      HEIGHT = ALL(3,2)                                                SDATA468
      ETA1   = ALL(4,2)                                                SDATA469
      ETA2   = ALL(5,2)                                                SDATA470
      XETA2  = ALL(6,2)                                                SDATA471
      YETA2  = ALL(7,2)                                                SDATA472
      IHT    =IALL(8,2)                                                SDATA473
      IANV   =IALL(9,2)                                                SDATA474
      IGOGO  =IALL(10,2)                                               SDATA475
      IGONY=IGOGO-3                                                    SDATA476
      ETAINX = ALL(11,2)                                               SDATA477
      ETAINY = ALL(12,2)                                               SDATA478
  610 LOCXYY(1) = LOCXYY(2)                                            SDATA479
      LOCXYY(2) = IS                                                   SDATA480
  515 IF (MS-IMAX) 560,561,561                                         SDATA481
  560 LOCXYY(3) = IS+1                                                 SDATA482
      READ (RDRUM'IS+1)   (YIN3(I),I=1,NWSYY)                          SDATA483
      DO 601 I=1,12                                                    SDATA484
      ALL(I,3) = YIN4(I)                                               SDATA485
  601 CONTINUE                                                         SDATA486
      GO TO 562                                                        SDATA487
  561 LOCXYY(3) = -1                                                   SDATA488
C   STATIONS 1-3 SET   NOW SET 4-5                                     SDATA489
  562 IF (NS-1) 563,563,564                                            SDATA490
  563 LOCXYY(4) = -1                                                   SDATA491
      ALL(11,4) = ALL(11,2)                                            SDATA492
      ALL(12,4) = ALL(12,2)                                            SDATA493
      GO TO 565                                                        SDATA494
```

```
  564 LOCXYY(4) = IS-IMAX                                              SDATA495
      READ (RDRUM'LOCXYY(4)) (YIN4(I),I=1,NWSYY)                       SDATA496
      DO 602 I=1,12                                                    SDATA497
      ALL(I,4) = YIN5(I)                                               SDATA498
  602 CONTINUE                                                         SDATA499
  565 IF (NS-JMAX) 566,567,567                                         SDATA500
  566 LOCXYY(5) = IS+IMAX                                              SDATA501
      READ (RDRUM'LOCXYY(5)) (YIN5(I),I=1,NWSYY)                       SDATA502
      DO 603 L=1,12                                                    SDATA503
      K = NWSYY - 12 + L                                               SDATA504
      ALL(L,5) = YIN5(K)                                               SDATA505
  603 CONTINUE                                                         SDATA506
      GO TO 568                                                        SDATA507
  567 LOCXYY(5) = -1                                                   SDATA508
      ALL(11,5) = ALL(11,2)                                            SDATA509
      ALL(12,5) = ALL(12,2)                                            SDATA510
C  ENTIRE XYY NOW SET FOR UPWIND                                       SDATA511
  568 CONTINUE                                                         SDATA512
  619 SQ2 = SQRT(2.)                                                   SDATA513
C    UPWIND/CENTERED DIFFERENCE ROUTINE FOR UP TO 6 VARIABLES          SDATA514
      XMD = 1. /XD                                                     SDATA515
      DO 649 I=1,12                                                    SDATA516
      DO 649 J=1,30                                                    SDATA517
      PGXY(J,I) = 0.                                                   SDATA518
      CGXY(J,I) = 0.                                                   SDATA519
  649 CONTINUE                                                         SDATA520
      GO TO (620,642,642,620),IGOGO                                    SDATA521
  642 II = 6                                                           SDATA522
      IJ = 1                                                           SDATA523
      IK = 3                                                           SDATA524
      IL = 11                                                          SDATA525
      DO 644 KK = 1,2                                                  SDATA526
      IF(LOCXYY(IJ).LT.0.OR.LOCXYY(IK).LT.0) GO TO 645                 SDATA527
      ALL(II,2) = (ALL(5,IK) - ALL(5,IJ))*XMD/2.                       SDATA528
      GO TO 615                                                        SDATA529
  645 IF(LOCXYY(IJ).LT.0.AND.LOCXYY(IK).LT.0) GO TO 646                SDATA530
      IF(LOCXYY(IJ).LT.0) GO TO 647                                    SDATA531
      IF(LOCXYY(IK).LT.0) GO TO 648                                    SDATA532
  646 ALL(II,2) =(ALL(IL,IK) - ALL(IL,IJ))*XMD/2.                      SDATA533
      GO TO 615                                                        SDATA534
  647 ALL(II,2) = (ALL(5,IK) - ALL(IL,IJ))*XMD/2.                      SDATA535
      GO TO 615                                                        SDATA536
  648 ALL(II,2) = (ALL(IL,IK) - ALL(5,IJ))*XMD/2.                      SDATA537
  615 II = 7                                                           SDATA538
      IJ = 5                                                           SDATA539
      IK = 4                                                           SDATA540
      IL = 12                                                          SDATA541
  644 CONTINUE                                                         SDATA542
      XETA2 = ALL(6,2)                                                 SDATA543
      YETA2 = ALL(7,2)                                                 SDATA544
      IF(IGONY.EQ.-1) GO TO 620                                        SDATA545
  641 I2IHT = IHT                                                      SDATA546
      I3IHT = IHT                                                      SDATA547
      DO 607 J=1,3                                                     SDATA548
      IIHT = IALL(8,J)                                                 SDATA549
```

```
      IF(IIHT.GT.I2IHT) I2IHT= IALL(8,J)                                SDATA550
  607 CONTINUE                                                          SDATA551
      DO 608 J=4,5                                                      SDATA552
      IIHT = IALL(8,J)                                                  SDATA553
      IF(IIHT.GT.I3IHT) I3IHT = IALL(8,J)                               SDATA554
  608 CONTINUE                                                          SDATA555
  620 DO 599 IJXY=1,2                                                   SDATA556
      IXY =(IJXY-1)*6                                                   SDATA557
      IF (IJXY-1) 1501,1501,1502                                        SDATA558
 1501 IF (LOCXYY(3)) 521,521,522                                        SDATA559
  521 IU3 = 2                                                           SDATA560
      GO TO 523                                                         SDATA561
  522 IU3 = 3                                                           SDATA562
  523 IF (LOCXYY(1)) 524,524,525                                        SDATA563
  524 IU1 = 2                                                           SDATA564
      GO TO 1505                                                        SDATA565
  525 IU1 = 1                                                           SDATA566
      GO TO 1505                                                        SDATA567
 1502 IF (LOCXYY(4)) 1521,1521,1522                                     SDATA568
 1521 IU3 = 2                                                           SDATA569
      GO TO 2521                                                        SDATA570
 1522 IU3 = 4                                                           SDATA571
 2521 IF (LOCXYY(5)) 1524,1524,1525                                     SDATA572
 1524 IU1 = 2                                                           SDATA573
      GO TO 1505                                                        SDATA574
 1525 IU1 = 5                                                           SDATA575
C  UPWIND DIFFERENCE IN X(IJXY=1)/Y(IJXY=2) DIRECTION                   SDATA576
 1505 IKI = 1                                                           SDATA577
      IF(IGONY.EQ.1) IKI=IP2                                            SDATA578
      DO 550  LR=IKI,NP1                                                SDATA579
      IF(XYY(LR,IJXY,2)) 531,532,536                                    SDATA580
C ABOVE CHECKS U/V  NOW INFLOW CONDITION CHECK                          SDATA581
  531 IF (IU3-2) 435,532,435                                            SDATA582
  435 IU3U = IU3                                                        SDATA583
      IU2 = 2                                                           SDATA584
      GO TO 534                                                         SDATA585
C  UPWIND IS INFLOW--SET TO INPUT                                       SDATA586
  532 DO 533 J=NVAR1,NVAR6                                              SDATA587
      K = IXY+J                                                         SDATA588
  533 PGXY(LR,K) = GXY(LR,K)                                            SDATA589
      GO TO 540                                                         SDATA590
  536 IF (IU1-2) 537,532,538                                            SDATA591
  537 IU3U = 2                                                          SDATA592
      IU2 = 1                                                           SDATA593
      GO TO 534                                                         SDATA594
  538 IU3U = 2                                                          SDATA595
      IU2  = 5                                                          SDATA596
C  UPWIND DIFFERENCE                                                    SDATA597
  534 DO 535 J=NVAR1,NVAR6                                              SDATA598
      K = IXY+J                                                         SDATA599
      PGXY(LR,K) = XMD*(XYY(LR,J,IU3U)-XYY(LR,J,IU2))                   SDATA600
  535 CONTINUE                                                          SDATA601
C    C COMPUTE CENTERED DIFFERENCE.                                     SDATA602
  540 DO 547 J=NVAR1,NVAR6                                              SDATA603
      K = IXY+J                                                         SDATA604
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      CGXY(LR,K) =((XYY(LR,J,IU3) - XYY(LR,J,2))                        SDATA605
     1  +(XYY(LR,J,2)- XYY(LR,J,IU1)))*XMD/2.                          SDATA606
      IF(IGONY.LT.0) GO TO 547                                          SDATA607
      IF (IU3.EQ.2.OR .IU1.EQ.2) CGXY(LR,K) =PGXY(LR,K)                 SDATA608
  547 CONTINUE                                                          SDATA609
  550 CONTINUE                                                          SDATA610
  599 CONTINUE                                                          SDATA611
   99 RETURN                                                            SDATA612
    2 FORMAT ( 14I5)                                                    SDATA613
    3 FORMAT(I4,I2,F6.2,5(I3,F5.1,F4.0))                               SDATA614
    5 FORMAT(I5,4F10.2,2A4)                                             SDATA615
 1111 FORMAT(' SFC P =',F10.4/' LAMBDA =',F10.4/' DELTA =',F10.4/' SLOPXSDATA616
     1=',F10.4/' SLOPY =',F10.4/' HEIGHT(+)/DEPTH(-) =',F10.4/' THE INPUSDATA617
     2T SURFACE HEIGHT FOR OPEN WATER BOUNDARIES'/' INPUT X-ETA =',F10.4SDATA618
     3/' INPUT Y-ETA =',F10.4/' IANV =',I10//)                          SDATA619
      END                                                               SDATA620
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```
      SUBROUTINE INFRAI(WA ,COA,CGA,KA,NTOP)                            INFRA000
C    CALL INFRAI PRIOR TO CALLING INFRA  WHEN USING A GIVEN DELTA EMISSIVINFRA001
C    PATH LENGTHS ARE   WA  FOR WATER VAPOR                            INFRA002
C                       COA  FOR CARBORN DIOXIDE                       INFRA003
C                       CGA FOR AEROSOLS                               INFRA004
      DIMENSION WA(1),COA(1),CGA(1),DTAUF(25,16),TOTAU(16)              INFRA005
      DIMENSION STB(1),ST4(1),LLC(1),EC(1),DTT(1),RA(1),RB(1)           INFRA006
      DIMENSION DT(20),PA(1)                                            INFRA007
C  TO STORE VALUES OF EMISSIVITY FOR KA LEVELS                          INFRA008
C  WITH NTOP ATMOSPHERIC LAYERS                                         INFRA009
      AW = 980./240.                                                    INFRA010
      MM1 = NTOP-1                                                      INFRA011
      KSAV = MIN0(KA,16)                                                INFRA012
      DO 70 LR=1,KSAV                                                   INFRA013
      KUHN = 1                                                          INFRA014
      UW = 0.                                                           INFRA015
      UC = 0.                                                           INFRA016
      TP = 1.                                                           INFRA017
      UAA= 0.                                                           INFRA018
      DEP= 0.                                                           INFRA019
      DO135 I=LR,MM1                                                    INFRA020
      UW = UW+WA(I)                                                     INFRA021
      UC = UC+COA(I)                                                    INFRA022
      UAA= UAA+CGA(I)                                                   INFRA023
      T1 = -.32*UC**.4                                                  INFRA024
      TC =(1.-EXP(T1))*.185                                             INFRA025
      IF (UAA) 136,136,137                                              INFRA026
  137 TP = EXP(-UAA)                                                    INFRA027
  136 CALL XUHN(UW,EW,KUHN)                                             INFRA028
      T1 = EW+TC                                                        INFRA029
      TT = (1.-T1)*TP                                                   INFRA030
      DEW = 1.-TT                                                       INFRA031
      DTAUF(I,LR) = DEW-DEP                                             INFRA032
      DEP = DEW                                                         INFRA033
  135 CONTINUE                                                          INFRA034
      IF (LR-1) 70,70,245                                               INFRA035
  245 KUHN = 1                                                          INFRA036
      UC = 0.                                                           INFRA037
      UW = 0.                                                           INFRA038
      UAA= 0.                                                           INFRA039
      I1 = LR-1                                                         INFRA040
      TP = 1.                                                           INFRA041
      DEP = 0.                                                          INFRA042
      DO155 I=1,I1                                                      INFRA043
      K = LR-I                                                          INFRA044
      UW = WA(K)+UW                                                     INFRA045
      UC = COA(K)+UC                                                    INFRA046
      UAA= CGA(K)+UAA                                                   INFRA047
      TC = 1.-EXP(-.32*UC**.4)                                          INFRA048
      CALL XUHN (UW,EW,KUHN)                                            INFRA049
      IF (UAA) 154,154,153                                              INFRA050
  153 TP = EXP(-UAA)                                                    INFRA051
  154 T1 = EW+TC   *.185                                                INFRA052
      TT = (1.-T1)*TP                                                   INFRA053
      DEW = 1.-TT                                                       INFRA054
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      SUBROUTINE SOLARI( P ,TW,CSZI,TE)                                 SOLAR000
      DIMENSION DUW(1),PA(1),PASA(1),PAAB(1),DTDU(1),STHE(25)           SOLAR001
      ATWA(AP,AC) = SQRT((.000949*AP+.051)/AC)                          SOLAR002
      CO3 = 980./ 239.                                                  SOLAR003
      XIO = 1.95/60.                                                    SOLAR004
      COSZ = CSZI                                                       SOLAR005
      IF (COSZ-.17365) 11,12,12                                         SOLAR006
   11 VALUE = COSZ/.17365                                               SOLAR007
      COSZ = .17365                                                     SOLAR008
      GO TO 13                                                          SOLAR009
   12 VALUE = 1.                                                        SOLAR010
   13 TAU1 = 1.041-0.16*ATWA(P,COSZ)                                    SOLAR011
      TAU1 = .5+.5*TAU1                                                 SOLAR012
      TAU2 =  .077*(TW/COSZ)**.3                                        SOLAR013
      TE = XIO*COSZ*VALUE*(TAU1-TAU2)                                   SOLAR014
      TE = AMAX1(TE,0.)                                                 SOLAR015
      UT = TW                                                           SOLAR016
      RETURN                                                            SOLAR017
      ENTRY SOLHEA(NLAY,XIN5,PA,DUW,PASA,PAAB,DTDT,TOPRA)               SOLAR018
      CO1 = XIO*2.4674E-5*VALUE                                         SOLAR019
      CO2 = 7.55E-4*VALUE                                               SOLAR020
      TAU1 = DTDT(2)                                                    SOLAR021
      TOPRA = 0.                                                        SOLAR022
      DO 30 K=1,NLAY                                                    SOLAR023
      I = NLAY+1-K                                                      SOLAR024
      P3 =(PA(I+1)+PA(I))/2.                                            SOLAR025
      DIZ = CO1*(PA(I)-PA(I+1))/ATWA(P3,COSZ)                           SOLAR026
      DIW  = CO2/(UT/COSZ)**.7*DUW(I)*TAU1                              SOLAR027
      UT = UT+DUW(I)                                                    SOLAR028
      DIPA = 0.                                                         SOLAR029
      DIPS = 0.                                                         SOLAR030
      IF (PAAB(I).GT.0.) DIPA=XIN5*(1.-1./EXP(PAAB(I)/COSZ))            SOLAR031
      XIN6 = XIN5-DIPA                                                  SOLAR032
      XIN6 = AMAX1(XIN6,0.)                                             SOLAR033
      IF (PASA(I).GT.0.) DIPS=XIN6*(1.-1./EXP(PASA(I)/COSZ     ))       SOLAR034
      STHE(I) = CO3*(DIW+DIPA)/(PA(I)-PA(I+1)  )                        SOLAR035
      XIN5 = XIN5-(DIZ+DIW+DIPA+DIPS)                                   SOLAR036
      TOPRA = TOPRA+DIPS+DIZ                                            SOLAR037
      XIN5 = AMAX1(XIN5,0.)                                             SOLAR038
   30 CONTINUE                                                          SOLAR039
      DO 80 I=2,NLAY                                                    SOLAR040
      T1 = (PA(I)-PA(I-1))/(PA(I+1)-PA(I-1))                            SOLAR041
      DTDT(I) = STHE(I-1)+T1*(STHE(I)-STHE(I-1))                        SOLAR042
   80 CONTINUE                                                          SOLAR043
      RETURN                                                            SOLAR044
      END                                                               SOLAR045
```

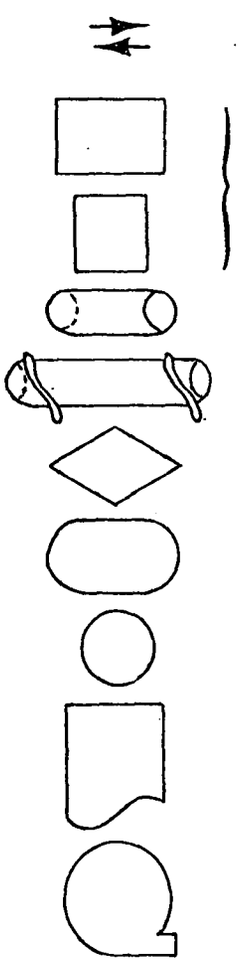
The following named subprograms used in the RIGID LID model can be found in the FREE SURFACE model listing of this report.

Program Name	Page Number
SOLAR2	111, 112
LINEAR	115
XUHN	116
TRANS	117
FILES	118

3.0 MAIN PROGRAM: FREE SURFACE Version

This section contains a flow diagram (Figure 4) which shows the operation in the numerical model MAIN Program, FREE SURFACE version, for the atmosphere-water planetary boundary layer with land option and pollutants. Following the flow diagram is its accompanying program listing.

The symbols used in the diagram are, for the most part, those which have become standard flow chart symbols. The explanation of the symbols is as follows:



Flow direction.

Program steps.

Subroutine call.

Disk (temporary storage).

Switch disk (temporary storage).

Decision on symbol contents.

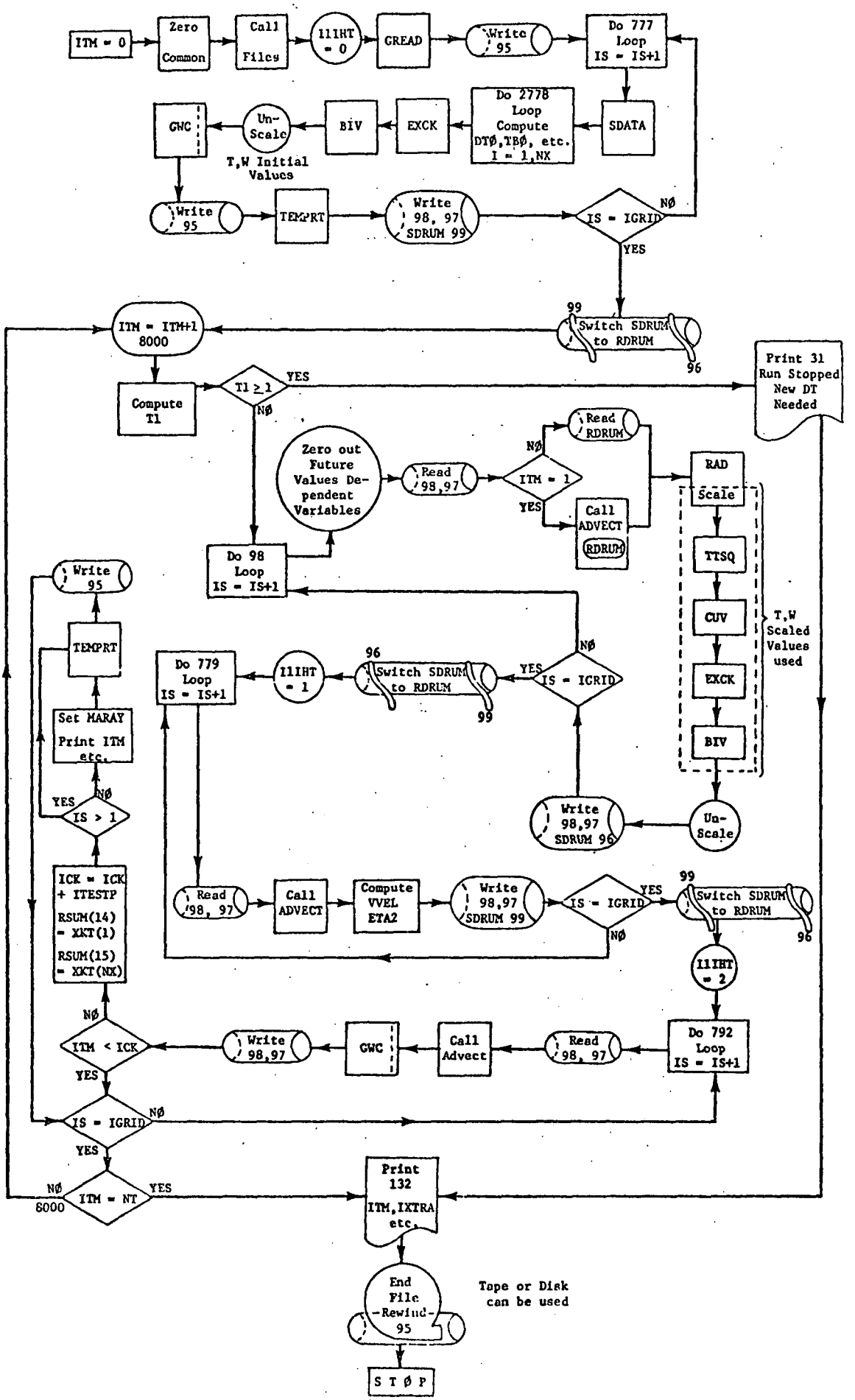
Multiple entrance branch.

Contents self-explained.

Printed (output).

Magnetic tape (output).

Figure 3. Flow Diagram MAIN Program, FREE SURFACE Version: Air-sea-land interaction model.→


ITM = 0
Zero Common
Call Files
111HT = 0
GREAD
Write 95
Do 777 Loop IS = IS+1
SDATA
Do 2778 Loop Compute DTØ,TBØ, etc. I = 1,NX
EXCK
BIV
Un-Scale
T,W Initial Values
GWC
Write 95
TEMPRT
Write 98, 97 SDRUM 99
IS = IGRID
NØ
YES
99
Switch SDRUM to RDRUM
96
ITM = ITM+1 8000
Compute T1
T1 ≥ 1
YES
NØ
Print 31 Run Stopped New DT Needed
Zero out Future Values Dependent Variables
Read 98,97
ITM = 1
Read RDRUM
Call ADVECT RDRUM
RAD
Scale
TTSQ
CUV
EXCK
BIV
T,W Scaled Values used
Un-Scale
Write 98,97 SDRUM 96
Do 98 Loop IS = IS+1
Do 779 Loop IS = IS+1
111HT = 1
Switch SDRUM to RDRUM
Write 95
TEMPRT
Set MARAY Print ITM etc.
IS > 1
ICK = ICK + ITESTP
RSUM(14) = XKT(1)
RSUM(15) = XKT(NX)
Read 98, 97
Call ADVECT
Compute VVEL ETA2
Write 98,97 SDRUM 99
111HT = 2
Do 792 Loop IS = IS+1
Read 98, 97
Call Advect
GWC
Write 98,97
ITM < ICK
IS = IGRID
ITM = NT
8000
Print 132 ITM,IXTRA etc.
End File -Rewind- 95
Tape or Disk can be used
S T Ø P

FREE SERVICE Program Listing

```
C       MAIN PROGRAM AIR-SEA INTERACTION  WITH  LAND OPTION                MAIN 000
C  1972 VERSION      TAPE OUTPUT  AT YOU GO                                 MAIN 001
       INTEGER RDRUM,SDRUM,TDRUM                                           MAIN 002
       DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12       MAIN 003
      1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3      MAIN 004
      2   ,WO,WSC,XKT,XYY,YY,GTO                                           MAIN 005
COMMON-DOUBLE PRECISION NOT ON DISK OR RESTART                             MAIN 006
       COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)          MAIN 007
      1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)        MAIN 008
      2   ,TT3(30),W3(30),SST                                              MAIN 009
COMMON-FOR PRINT ONLY                                                      MAIN 010
       COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,MAIN 011
      1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CEMAIN 012
      2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             MAIN 013
COMMON-FOR RESTART AND PRINTOUT                                            MAIN 014
       COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL                 MAIN 015
      1   ,XLAM,RSUM(15),B1,B2                                             MAIN 016
COMMON-NEEDED FOR RESTART ONLY                                             MAIN 017
       COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)      MAIN 018
      1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)    MAIN 019
      2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2     MAIN 020
      3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)   MAIN 021
      4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)          MAIN 022
      5   ,NXN(10),TTW,DECL,COCOB,DELZ,NTFOR,GSF,GFR,DTSF,SF               MAIN 023
      6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV           MAIN 024
      7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                              MAIN 025
COMMON-OTHER THAN DOUBLE PRECISION-PRINT OR RESTART                        MAIN 026
      7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)MAIN 027
       COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)       MAIN 028
      1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)     MAIN 029
      2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)  MAIN 030
       COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                        MAIN 031
       COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6     MAIN 032
      1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3       MAIN 033
      2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME    MAIN 034
      3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2      MAIN 035
      4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2             MAIN 036
      5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                    MAIN 037
       COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL       MAIN 038
      1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                       MAIN 039
       COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20      MAIN 040
      2     ,  T13,T14,T15,T16,XD1,YD1                                     MAIN 041
      3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                          MAIN 042
       COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II  MAIN 043
       COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)       MAIN 044
      1 , I1IHT,I4IHT                                                      MAIN 045
       DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)            MAIN 046
       EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))       MAIN 047
      1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))               MAIN 048
       COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                        MAIN 049
       COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                        MAIN 050
       COMMON /GRDNTS / GXY(30,12)                                         MAIN 051
       DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)       MAIN 052
      1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)                 MAIN 053
      2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)                 MAIN 054
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     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)                    MAIN 055
     4  ,CP2X(30),CP2Y(30)                                                    MAIN 056
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))                  MAIN 057
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))                   MAIN 058
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))                   MAIN 059
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))                   MAIN 060
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))                  MAIN 061
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))                 MAIN 062
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))                 MAIN 063
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))                 MAIN 064
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))                 MAIN 065
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))                 MAIN 066
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))                 MAIN 067
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))                 MAIN 068
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))                 MAIN 069
C    UNITS 99,96 FOR YY TO STORE FOR COMPUTATION OF GRADIENTS--DIRECT ACCMAIN 070
C    UNIT  98  FOR RESTART VARIABLES -- DIRECT ACCESS                      MAIN 071
C    UNIT  95  STORAGE FILE FOR PRINT -- TAPE OR DISK SEQUENTIAL           MAIN 072
      DOUBLE PRECISION XT1,XTIME                                            MAIN 073
      DIMENSION ZEROCM(2)    ,YIN(1)                                        MAIN 074
      EQUIVALENCE (ZEROCM(1),XYY(1,1,1))  , (U2(1),YIN(1))                  MAIN 075
      DO 555 I=1,6989                                                       MAIN 076
  555 ZEROCM(I) = 0.                                                        MAIN 077
      CALL FILES                                                            MAIN 078
      SDRUM = 99                                                            MAIN 079
      RDRUM = 96                                                            MAIN 080
      NWSYY = 180*2 + 12                                                    MAIN 081
      DELZ = 0.0                                                            MAIN 082
C     TIMES 2 FOR DOUBLE PRECISION ONLY                                     MAIN 083
      IXTRA = 1                                                             MAIN 084
      NCR = 1717                                                            MAIN 085
      NCR1 = 753                                                            MAIN 086
      NCS =  594                                                            MAIN 087
      TDEL = 0.                                                             MAIN 088
      IK = 0                                                                MAIN 089
C     COMPUTE GRADIENTS   AND READ IN DATA FOR THE GRID                     MAIN 090
      CALL GREAD                                                            MAIN 091
      I = 0                                                                 MAIN 092
      DO 702 J=1,20                                                         MAIN 093
      ITIMES(J) = I                                                         MAIN 094
  702 I = I+ITESTP                                                          MAIN 095
      ITM = 0                                                               MAIN 096
      IF (ITIMES(20).LT.NT) GO TO 80                                        MAIN 097
      NSTART = 0                                                            MAIN 098
C     INDIVIDUAL STATION PREDICTION FILE 1                                  MAIN 099
      XDT1 = XD/110.8 * 1.E-5                                               MAIN 100
      SAVE = 0.01                                                           MAIN 101
      U3(1) = NCS                                                           MAIN 102
      U3(2) = JMAX                                                          MAIN 103
      U3(3)= IMAX                                                           MAIN 104
      U3(4) = IPOL+11                                                       MAIN 105
      U3(5) = NP1                                                           MAIN 106
      U3(6) = IX                                                            MAIN 107
      U3(7) = DT                                                            MAIN 108
      DO 703 I=1,20                                                         MAIN 109
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  703 U3(I+7) = ITIMES(I)                                                MAIN 110
      U3(28) = XD * 1.E-5                                                MAIN 111
      WRITE (95     ) (Z(I),I=1,NCS)                                     MAIN 112
      DO 777 NS=1,JMAX                                                   MAIN 113
      DO 777 MS=1,IMAX                                                   MAIN 114
      IS = (NS-1)*IMAX + MS                                              MAIN 115
      CALL SDATA                                                         MAIN 116
      DO 2778 I=1,NX                                                     MAIN 117
      DTO(I)=TTO(I+1)-TTO(I)                                             MAIN 118
      TBO(I)=(TTO(I+1)+TTO(I))/2.                                        MAIN 119
      WBO(I)=(WO(I+1)+WO(I))/2.                                          MAIN 120
      IF(I-IX) 888,2778,888                                              MAIN 121
  888 DWO(I) = WO(I+1)-WO(I)                                             MAIN 122
      GTO(I)=DTO(I)/DZ(I)                                                MAIN 123
      GWO(I)=DWO(I)/DZ(I)                                                MAIN 124
 2778 CONTINUE                                                           MAIN 125
      H3 = 0.                                                            MAIN 126
C     INEWC = INEW                                                       MAIN 127
      IRAT = IMARA                                                       MAIN 128
   35 CALL EXCK                                                          MAIN 129
      H = H * .017453293                                                 MAIN 130
      RSUM(15) = XKT(NX)                                                 MAIN 131
      RSUM(14) = XKT(1)                                                  MAIN 132
   40 CALL BIV                                                           MAIN 133
      DO3101  I=1,NP1                                                    MAIN 134
      TSC(I)=TT2(I)                                                      MAIN 135
      WSC(I)=W2(I)                                                       MAIN 136
C     COMPUTE UNSCALED T AND W FOR GWC,RAD                               MAIN 137
      TT2(I)=TT2(I)+TTO(I)                                               MAIN 138
 3101 W2(I)=W2(I)+WO(I)                                                  MAIN 139
   45 CALL GWC                                                           MAIN 140
C     STORE INITIAL TIME STEP DATA FOR ALL STATIONS FOR PRINT FILE 3     MAIN 141
      IF (IS.GT.1) GO TO 46                                              MAIN 142
      MARAY(IXTRA) = MARAY(IXTRA)+1                                      MAIN 143
      PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)                          MAIN 144
   46 WRITE (95) (RI(I),I=1,NCS)                                         MAIN 145
      CALL TEMPRT                                                        MAIN 146
      PRINT 101,ETA2,DELZ,XETA2,YETA2,CU(IX),CV(IX),IHT,IGOGO            MAIN 147
      WRITE (98'IS) ( RI(I),I=1,NCR)                                     MAIN 148
      WRITE(97'IS) (NXN(I),I=1,NCR1)                                     MAIN 149
      WRITE (SDRUM'IS) (YIN(I),I=1,NWSYY)                                MAIN 150
  777 CONTINUE                                                           MAIN 151
      ICK = ITESTP                                                       MAIN 152
C     SWITCH FILE UNITS  FOR ADVECT READ                                 MAIN 153
      I = RDRUM                                                          MAIN 154
      RDRUM = SDRUM                                                      MAIN 155
      SDRUM = I                                                          MAIN 156
 8000 ITM = ITM + 1                                                      MAIN 157
      IIIHT = 0                                                          MAIN 158
      T1 = TDEL /(1.424214*DT)                                           MAIN 159
      PRINT 335,ITM,DT,T1                                                MAIN 160
      IF (T1-1.)1112,1112,336                                            MAIN 161
 1112 PRINT 31                                                           MAIN 162
      GO TO 80                                                           MAIN 163
  336 NU1X =  1                                                          MAIN 164
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      IF(ITM+NU1X.GT.NT)NU1X = NT-ITM                                    MAIN 165
      IF(NTIME.GT.0.AND.ITM+NU1X.GT.NTIME)NU1X = NTIME-ITM               MAIN 166
      NUX = NSTART + NU1X                                                MAIN 167
       IF(ITM.NE.2) GO TO 49                                             MAIN 168
   51 DTA = 2.*DTA                                                       MAIN 169
      DTA2 = 2.*DTA2                                                     MAIN 170
      C5 = 1.5                                                           MAIN 171
      C6 = 2.                                                            MAIN 172
      GD2 = .5                                                           MAIN 173
      LY=2                                                               MAIN 174
   49 NU = NUX                                                           MAIN 175
   41 DO 98 NS=1,JMAX                                                    MAIN 176
      DO 98 MS=1,IMAX                                                    MAIN 177
      IS = (NS-1) * IMAX + MS                                            MAIN 178
      DO 585 I = 1,NP1                                                   MAIN 179
      U3(I) = 0.                                                         MAIN 180
      V3(I) = 0.                                                         MAIN 181
      TT3(I) = 0.                                                        MAIN 182
      W3(I) = 0.                                                         MAIN 183
      PP13(I) = 0.                                                       MAIN 184
      PP23(I) = 0.                                                       MAIN 185
  585 CONTINUE                                                           MAIN 186
C     READ FILE 1 FOR RESTART                                            MAIN 187
       READ (98'IS) ( RI(I),I=1,NCR)                                     MAIN 188
       READ(97'IS) (NXN(I),I=1,NCR1)                                     MAIN 189
      IF(ITM.EQ.2) GD2 = .5                                              MAIN 190
      IF(ITM.EQ.1) CALL ADVECT                                           MAIN 191
      IF(ITM.EQ.1) GO TO 47                                              MAIN 192
      READ(RDRUM'IS) (YIN(I),I=1,NWSYY)                                  MAIN 193
   47 IF (NTIME.LT.0.OR.IGET.NE.ITM) GO TO 319                           MAIN 194
      XM = MS                                                            MAIN 195
      YM = NS                                                            MAIN 196
      XD1 = XD*(XIIN-XM)                                                 MAIN 197
      YD1 =-XD*(XJIN-YM)                                                 MAIN 198
      XT1= NTIME-IGET                                                    MAIN 199
      XTIME = 1./XT1                                                     MAIN 200
      DO 315 I=1,NP1                                                     MAIN 201
      IF (NVCHS(1).NE.1)  GO TO 312                                      MAIN 202
C  COMPUTE NEW INPUT U3,V3                                               MAIN 203
      U3(I)  = VARIN(I,1)-GNV(I,2)*YD1-GNV(I,1)*XD1                      MAIN 204
      V3(I)  = VARIN(I,2)-GNV(I,4)*YD1-GNV(I,3)*XD1                      MAIN 205
      U1(I) = U2(I)-XTIME*(U3(I)-U2(I))                                  MAIN 206
      V1(I) = V2(I)-XTIME*(V3(I)-V2(I))                                  MAIN 207
  312 IF (NVCHS(2).NE.1) GO TO 315                                       MAIN 208
      TT3(I) = VARIN(I,3)-GNV(I,6)*YD1-GNV(I,5)*XD1-TTO(I)               MAIN 209
      W3 (I) = VARIN(I,4)-GNV(I,8)*YD1-GNV(I,7)*XD1-WO(I)                MAIN 210
      TT1(I)= TT2(I)-XTIME*(TT3(I)-TT2(I))                               MAIN 211
      W1 (I)= W2 (I)-XTIME*(W3 (I)-W2(I))                                MAIN 212
  315 CONTINUE                                                           MAIN 213
  319 DO 2000 I=1,NX                                                     MAIN 214
      DTO(I)=TTO(I+1)-TTO(I)                                             MAIN 215
      TBO(I)=(TTO(I+1)+TTO(I))/2.                                        MAIN 216
      WBO(I)=(WO(I+1)+WO(I))/2.                                          MAIN 217
      IF(I-IX)88,2000,88                                                 MAIN 218
   88 DWO(I) = WO(I+1)-WO(I)                                             MAIN 219
```

```
      GTO(I)=DTO(I)/DZ(I)                                          MAIN 220
      GWO(I)=DWO(I)/DZ(I)                                          MAIN 221
 2000 CONTINUE                                                     MAIN 222
      H3 = 0.                                                      MAIN 223
C     INEWC = INEW                                                 MAIN 224
      IRAT = IMARA                                                 MAIN 225
      IF(IGONY.EQ.1) DELZ=0.0                                      MAIN 226
      IF(NVCHS(4).NE.1) CALL RAD                                   MAIN 227
      CALL TTSQ                                                    MAIN 228
      IF (NTIME.LT.0) GO TO 117                                    MAIN 229
      DO 116I=1,NP1                                                MAIN 230
      IF (NVCHS(1).NE.1) GO TO 114                                 MAIN 231
      U3(I) = 2.*U2(I) - U1(I)                                     MAIN 232
      V3(I) = 2.*V2(I) - V1(I)                                     MAIN 233
  114 IF(NVCHS(2).NE.1)GO TO 116                                   MAIN 234
      W3(I) =  2.*W2(I)-W1(I)                                      MAIN 235
      TT3(I) = 2.*TT2(I)-TT1(I)                                    MAIN 236
  116 CONTINUE                                                     MAIN 237
      IF (NVCHS(1).EQ.1)  GO TO 52                                 MAIN 238
  117 GO TO (112,111,111,112),IGOGO                                MAIN 239
  111 I1 = 1                                                       MAIN 240
      II=2                                                         MAIN 241
      IT=IM2                                                       MAIN 242
      I2=IM3                                                       MAIN 243
      I3=IM1                                                       MAIN 244
  129 I5 = IT -   IHT + 1                                          MAIN 245
      IF(  IHT.GT.2) GO TO 131                                     MAIN 246
      I5 = IM3                                                     MAIN 247
      I1 = 1                                                       MAIN 248
      II = 2                                                       MAIN 249
  131 CALL CUV                                                     MAIN 250
      IF(IGONY.EQ.0) GO TO 121                                     MAIN 251
  113 IF(IANV.GT.1) GO TO 118                                      MAIN 252
      DO 119 I=IHT,IX                                              MAIN 253
      V3(I) = 0.0                                                  MAIN 254
  119 CONTINUE                                                     MAIN 255
      GO TO 112                                                    MAIN 256
  118 DO 120 I=IHT,IX                                              MAIN 257
      U3(I) = 0.0                                                  MAIN 258
  120 CONTINUE                                                     MAIN 259
      GO TO 112                                                    MAIN 260
  121 IF(IHT.EQ.1) GO TO 112                                       MAIN 261
      IF(I2IHT.LE.IHT) GO TO 123                                   MAIN 262
      IIHT = I2IHT-1                                               MAIN 263
      DO 124 I= IHT, IIHT                                          MAIN 264
  124 U3(I) = 0.0                                                  MAIN 265
  123 IF(I3IHT.LE.IHT)GO TO 112                                    MAIN 266
      IIHT = I3IHT-1                                               MAIN 267
      DO 125 I= IHT, IIHT                                          MAIN 268
  125 V3(I)= 0.0                                                   MAIN 269
  112 I1 = IP1                                                     MAIN 270
      II=IP2                                                       MAIN 271
      IT=NM1                                                       MAIN 272
      I2=NM2                                                       MAIN 273
      I3=NX                                                        MAIN 274
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      I5=IA                                                              MAIN 275
      CALL CUV                                                           MAIN 276
   52 CONTINUE                                                           MAIN 277
      DO 54 I=1,NP1                                                      MAIN 278
      TT1(I) = TT2(I)                                                    MAIN 279
      U1(I) = U2(I)                                                      MAIN 280
      V1(I) = V2(I)                                                      MAIN 281
      W1(I) = W2(I)                                                      MAIN 282
      TT2(I) = TT3(I)                                                    MAIN 283
      U2(I) = U3(I)                                                      MAIN 284
      V2(I) = V3(I)                                                      MAIN 285
      W2(I) = W3(I)                                                      MAIN 286
      PP11(I) = PP12(I)                                                  MAIN 287
      PP21(I) = PP22(I)                                                  MAIN 288
      PP12(I) = PP13(I)                                                  MAIN 289
      PP22(I) = PP23(I)                                                  MAIN 290
   54 CONTINUE                                                           MAIN 291
      IF(NVCHS(4).EQ.1) XT2 = TT3(IX)                                    MAIN 292
      TT2(IX) = XT2                                                      MAIN 293
      TT2(IP1) = XT2                                                     MAIN 294
      CALL EXCK                                                          MAIN 295
      CALL BIV                                                           MAIN 296
  371 DO3100  I=1,NP1                                                    MAIN 297
      TSC(I)=TT2(I)                                                      MAIN 298
      WSC(I)=W2(I)                                                       MAIN 299
C     COMPUTE UNSCALED T AND W FOR GWC,RAD                               MAIN 300
      TT2(I)=TT2(I)+TTO(I)                                               MAIN 301
 3100 W2(I)=W2(I)+WO(I)                                                  MAIN 302
C     STORING COMPUTED VALUES ON DRUM FOR RESTART OF EACH GRID STATION AMAIN 303
      WRITE (98'IS) ( RI(I),I=1,NCR)                                     MAIN 304
      WRITE(97'IS) (NXN(I),I=1,NCR1)                                     MAIN 305
      DO 59 I=1,NP1                                                      MAIN 306
      T1 = U2(I)**2+V2(I)**2                                             MAIN 307
      IF (T1) 59,59,159                                                  MAIN 308
  159 T1 = SQRT(T1)                                                      MAIN 309
      IF (T1.GT.SAVE)  SAVE = T1                                         MAIN 310
   59 CONTINUE                                                           MAIN 311
      TDEL = XD/SAVE                                                     MAIN 312
C   WRITE YY ON DISK USING DIRECT ACCESS                                 MAIN 313
      WRITE (SDRUM'IS) (YIN(I),I=1,NWSYY)                                MAIN 314
   98 CONTINUE                                                           MAIN 315
C   SWITCH FILE UNITS FOR RESTART                                        MAIN 316
      I = RDRUM                                                          MAIN 317
      RDRUM = SDRUM                                                      MAIN 318
      SDRUM = I                                                          MAIN 319
      I1IHT = 1                                                          MAIN 320
      DO 779 NS=1,JMAX                                                   MAIN 321
      DO 779 MS=1,IMAX                                                   MAIN 322
      IS = (NS-1)*IMAX + MS                                              MAIN 323
       READ (98'IS) ( RI(I),I=1,NCR)                                     MAIN 324
       READ(97'IS) (NXN(I),I=1,NCR1)                                     MAIN 325
      CALL ADVECT                                                        MAIN 326
  857 IF(IGONY.GT.0) GO TO 202                                           MAIN 327
      IF(IHT.GT.1) GO TO 201                                             MAIN 328
      SUM2 = (CUX(IX)+CVY(IX))*(DZ(IM1)/2.)                              MAIN 329
```

```
      DO 209 I=2,IX                                                    MAIN 330
      K=IX-I+1                                                         MAIN 331
      SUM2 = SUM2 + (CUX(K)+CVY(K))*(DZ(K-1)+DZ(K))/2.                 MAIN 332
  209 VVEL(K) = SUM2                                                   MAIN 333
      VVEL(IX)=0.                                                      MAIN 334
      IF(ITM.GT.1) GO TO 202                                           MAIN 335
      ETA2 = 0.                                                        MAIN 336
      DELZ = 0.                                                        MAIN 337
      SLOPX= 0.                                                        MAIN 338
      SLOPY= 0.                                                        MAIN 339
      GO TO 202                                                        MAIN 340
  201 DO 267 I=1,IX                                                    MAIN 341
  267 VVEL(I) = 0.0                                                    MAIN 342
      SUM1 = 0.                                                        MAIN 343
      IIHT = IHT                                                       MAIN 344
      IF(IGONY.EQ.-2) IIHT = 2                                         MAIN 345
      DO 200 K=IIHT,IM1                                                MAIN 346
      SUM1 = SUM1 - (CUX(K) + CVY(K))*(DZ(K-1) + DZ(K))/2.             MAIN 347
      VVEL(K) = SUM1                                                   MAIN 348
  200 CONTINUE                                                         MAIN 349
      VVEL(IX) = SUM1 - (CUX(IX) + CVY(IX))*(DZ(IM1)/2.)               MAIN 350
      VVEL(IP1) = VVEL(IX)                                             MAIN 351
      ETA2 = ETA1 + VVEL(IX)*DT                                        MAIN 352
      DELZ = ETA2 - ETA1                                               MAIN 353
      ETA1 = ETA2                                                      MAIN 354
      IF(ABS(ETA2).GT.500..AND .IGOGO.NE.1) GO TO 206                  MAIN 355
      GO TO 205                                                        MAIN 356
  206 PRINT 207,ETA2                        ,DELZ,VVEL(IX),ITM,IS,IGOGO  MAIN 357
  207 FORMAT(1X,'THE WATER SURFACE ELEVATION ETA2 IS',F12.3,/           MAIN 358
     1' DELZ = ',F12.3                                                 MAIN 359
     2/' VVEL(IX) = ',F12.3/' ITM = ',I10/' IS = ',I10/' IGOGO = ',I10) MAIN 360
      GO TO 99                                                         MAIN 361
  205 SUM1 = VVEL(IP1)                                                 MAIN 362
      DO 208 I=IP2,NP1                                                 MAIN 363
      SUM1 = SUM1 - (CUX(I) + CVY(I))*(DZ(I-1) + DZ(I))/2.             MAIN 364
      VVEL(I) = SUM1                                                   MAIN 365
  208 CONTINUE                                                         MAIN 366
      VVEL(NX) = SUM1 - (CUX(NX) + CVY(NX))*(DZ(NP1)/2.)               MAIN 367
      GO TO 50                                                         MAIN 368
  202 VVEL(IP1) = 0.0                                                  MAIN 369
      VVEL(IP2) =                          - (CUX(IP2)+ CVY(IP2))*     MAIN 370
     1((DZ(IP1) + DZ(IP2))/2.)                                         MAIN 371
      SUM1 = VVEL(IP2)                                                 MAIN 372
      DO 203 K=IP3,NP1                                                 MAIN 373
      SUM1 = SUM1 - (CUX(K) + CVY(K))*((DZ(K-1) + DZ(K))/2.)           MAIN 374
      VVEL(K) = SUM1                                                   MAIN 375
  203 CONTINUE                                                         MAIN 376
      VVEL(NX) = SUM1 - (CUX(NX)+ CVY(NX))*(DZ(NP1)/2.)                MAIN 377
   50 WRITE (98'IS) ( RI(I),I=1,NCR)                                   MAIN 378
      WRITE(97'IS) (NXN(I),I=1,NCR1)                                   MAIN 379
      WRITE (SDRUM'IS) (YIN(I),I=1,NWSYY)                              MAIN 380
  779 CONTINUE                                                         MAIN 381
C     SWITCH FILE UNITS  FOR ADVECT READ                               MAIN 382
      I = RDRUM                                                        MAIN 383
      RDRUM = SDRUM                                                    MAIN 384
```

```
      SDRUM = I                                                          MAIN 385
      I1IHT = 2                                                          MAIN 386
      DO 792 NS=1,JMAX                                                   MAIN 387
      DO 792 MS=1,IMAX                                                   MAIN 388
      IS = (NS-1)*IMAX + MS                                              MAIN 389
       READ (98'IS) ( RI(I),I=1,NCR)                                     MAIN 390
       READ(97'IS) (NXN(I),I=1,NCR1)                                     MAIN 391
      CALL ADVECT                                                        MAIN 392
      CALL GWC                                                           MAIN 393
      WRITE (98'IS) ( RI(I),I=1,NCR)                                     MAIN 394
      WRITE(97'IS) (NXN(I),I=1,NCR1)                                     MAIN 395
   65 IF(ITM-ICK)792,70,70                                               MAIN 396
   70 RSUM(14) = XKT(1)                                                  MAIN 397
      RSUM(15) = XKT(NX)                                                 MAIN 398
      IF (IS.GT.1) GO TO 701                                             MAIN 399
      MARAY(IXTRA) = MARAY(IXTRA)+1                                      MAIN 400
      PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)                          MAIN 401
  701 CALL TEMPRT                                                        MAIN 402
      PRINT 101,ETA2,DELZ,XETA2,YETA2,CU(IX),CV(IX),IHT,IGOGO            MAIN 403
  101 FORMAT(//'  ETA2 =',E18.8,/'  DELZ =',E18.8,/'  XETA2 =',E18.8,/' MAIN 404
     1 YETA2 =',E18.8,/'  CU(IX) =',E18.8,/'  CV(IX) =',E18.8,/'  IHT ='MAIN 405
     2,I10,/'  IGOGO =',I10)                                             MAIN 406
      WRITE (95) (RI(I),I=1,NCS)                                         MAIN 407
  792 CONTINUE                                                           MAIN 408
      IF(ITM-ICK) 793,7000,7000                                          MAIN 409
 7000 ICK = ICK + ITESTP                                                 MAIN 410
  793 IF(MARAY(IXTRA).NE.0) IXTRA = IXTRA + 1                            MAIN 411
      NSTART = NU                                                        MAIN 412
   94 IF(ITM.EQ.NT) GO TO 80                                             MAIN 413
      GO TO 8000                                                         MAIN 414
   80 PRINT 132, ITM,IXTRA,(MARAY(I),I=1,IXTRA)                          MAIN 415
      END FILE 95                                                        MAIN 416
      REWIND 95                                                          MAIN 417
   99 STOP                                                               MAIN 418
   31 FORMAT ('1RUN STOPPED--NEW DT NEEDED')                             MAIN 419
  132 FORMAT ('1TIME STEP STARTING = ',I5,' VALUES IN MARAY =',I5/' MARAMAIN 420
     1Y IS',2014)                                                        MAIN 421
  335 FORMAT (' ITM',I6,',DT',E12.4,',T1',E12.4)                         MAIN 422
      END                                                                MAIN 423
```

```
      SUBROUTINE GREAD                                                  GREAD000
      INTEGER RDRUM,SDRUM,TDRUM                                         GREAD001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     GREAD002
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    GREAD003
     2.  ,WO,WSC,XKT,XYY,YY,GTO                                         GREAD004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        GREAD005
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      GREAD006
     2   ,TT3(30),W3(30),SST                                           GREAD007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,GREAD008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CEGREAD009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             GREAD010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               GREAD011
     1   ,XLAM,RSUM(15),B1,B2                                          GREAD012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    GREAD013
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  GREAD014
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   GREAD015
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  GREAD016
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        GREAD017
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              GREAD018
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         GREAD019
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                           GREAD020
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)GREAD021
      COMMON U3(30),V3(30),TBO(30),WBO(30),CK0(30),CSW(30),PSS(30)      GREAD022
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    GREAD023
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) GREAD024
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      GREAD025
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   GREAD026
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     GREAD027
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  GREAD028
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    GREAD029
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           GREAD030
     5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                  GREAD031
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     GREAD032
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                    GREAD033
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    GREAD034
     2    ,  T13,T14,T15,T16,XD1,YD1                                    GREAD035
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                       GREAD036
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II GREAD037
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     GREAD038
     1 , I1IHT,I4IHT                                                   GREAD039
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          GREAD040
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     GREAD041
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             GREAD042
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      GREAD043
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      GREAD044
      COMMON /GRDNTS / GXY(30,12)                                       GREAD045
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     GREAD046
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               GREAD047
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               GREAD048
     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              GREAD049
     4  ,CP2X(30),CP2Y(30)                                             GREAD050
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))             GREAD051
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))               GREAD052
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))               GREAD053
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))               GREAD054
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      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))                  GREAD055
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))                 GREAD056
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))                 GREAD057
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))                 GREAD058
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))                 GREAD059
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))                 GREAD060
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))                 GREAD061
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))                 GREAD062
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))                 GREAD063
      DIMENSION ZI(30),ZDIX(30),ZDIY(30),ARPRT(18)                          GREAD064
      EQUIVALENCE (A(1),ZI(1)),(B(1),ZDIX(1)),(C(1),ZDIY(1))                GREAD065
      DATA ARPRT /4HU CO,4HMPON,4HENT ,4HV CO,4HMPOM,4HENT ,4HTEMP,4HERAGREAD066
     1T ,4HURE ,   4HSALI,4HN./H,4HUMID,4HPOLL,4HUTAN,4HT 1 ,4HPOLL,4HUTGREAD067
     2AN,4HT 2 /                                                          GREAD068
      READ 100, (COM(I),I=1,18)                                           GREAD069
      PRINT 101,(COM(I),I=1,18)                                           GREAD070
      ROA = .001                                                          GREAD071
      READ 110, NX,IX,NT,IMAX,JMAX,NTIME,NVAR6,ITESTP,IPOL                GREAD072
      DO 2I=1,5                                                           GREAD073
    2 NVCHS(I) = 0                                                        GREAD074
      IF(NTIME.GE.0)READ110,(NVCHS(I),I=1,5)                              GREAD075
      IGRID = JMAX * IMAX                                                 GREAD076
      PRINT 111, NX,IX,NT,IGRID                                           GREAD077
C     IGRID IS THE NUMBER OF STATIONS IN THIS MODEL GRID NETWORK          GREAD078
      READ 119,DT,XD,DECLX,DCHG,XIIN,XJIN                                 GREAD079
      DECL = DECLX* .017453293                                            GREAD080
      DCHG = DCHG * .017453293                                            GREAD081
      READ 119,PHIBOT,HWEST,EM,ZW,RTIME                                   GREAD082
      H = HWEST * .017453293                                              GREAD083
    3 PRINT 112, XIIN,XJIN,PHIBOT,DT,XD                                   GREAD084
      DT = DT*60.                                                         GREAD085
      PRINT 1212, RTIME                                                   GREAD086
      IF(RTIME.LE.0.) RTIME = DT/60.                                      GREAD087
  700 IMARA = RTIME/DT*60.  +.5                                           GREAD088
      XD = XD * 1.E5                                                      GREAD089
      NP1=NX+1                                                            GREAD090
      IS = 0                                                              GREAD091
      IP1 = IX+1                                                          GREAD092
C     INITIAL STATION DATA INPUT   Z,  T,  U,  V,  W                      GREAD093
      READ 119,(Z(I),I=1,NP1)                                             GREAD094
      DO 6 J=1,6                                                          GREAD095
      READ 119, (YY(I,J),I=1,NP1)                                         GREAD096
    6 CONTINUE                                                            GREAD097
      DO 230 I=5,6                                                        GREAD098
      DO 230 N=1,NP1                                                      GREAD099
  230 YY(N,I) = YY(N,I) / ROA / 100.                                      GREAD100
C     COMPUTE PERIPHERAL GRADIENTS                                        GREAD101
      DO 420  K=1,6                                                       GREAD102
      READ 110,IZ1                                                        GREAD103
      READ 120, (ZI(I),I=1,IZ1)                                           GREAD104
      READ 120, (ZDIX(I),I=1,IZ1)                                         GREAD105
      READ 120, (ZDIY(I),I=1,IZ1)                                         GREAD106
      K2 = 3*K                                                            GREAD107
      K1 = K2-2                                                           GREAD108
      PRINT 123, (ARPRT(I),I=K1,K2),(ZI(I),I=1,IZ1)                       GREAD109
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      PRINT 121, (ZDIX(I),I=1,IZ1)                                      GREAD110
      PRINT 122, (ZDIY(I),I=1,IZ1)                                      GREAD111
      DO 418 I=1,NP1                                                    GREAD112
      T1 = Z(I)                                                         GREAD113
      IF (I-IX) 417,416,417                                             GREAD114
  416 T1 = T1-.00001                                                    GREAD115
      GO TO 1418                                                        GREAD116
  417 IF (I-IP1) 1418,2418,1418                                         GREAD117
 2418 T1 = T1+.00001                                                    GREAD118
 1418 CALL XINEAR (T1,ZI,2,IZ1,L,ZDIX,GXY(I,K),ZDIY,GXY(I,K+6)          GREAD119
     1  ,T4,T4,T4,T4)                                                  GREAD120
      IF(K.LE.4) GO TO 231                                              GREAD121
      GXY(I,K) = GXY(I,K) / ROA / 100.                                  GREAD122
      GXY(I,K+6) = GXY(I,K+6) / ROA / 100.                              GREAD123
  231 PGXY(I,K) = GXY(I,K)                                              GREAD124
      CGXY(I,K) = GXY(I,K)                                              GREAD125
      PGXY(I,K+6) = GXY(I,K+6)                                          GREAD126
      CGXY(I,K+6) = GXY(I,K+6)                                          GREAD127
  418 CONTINUE                                                          GREAD128
  420 CONTINUE                                                          GREAD129
      READ 119,SOAB,SOSC,XNO,COCOB                                      GREAD130
      PRINT 119,SOAB,SOSC,XNO,COCOB                                     GREAD131
      IY = IP1                                                          GREAD132
      NP2=NX+2                                                          GREAD133
      NM1=NX-1                                                          GREAD134
      NM2=NX-2                                                          GREAD135
      IP2=IX+2                                                          GREAD136
      IP3=IX+3                                                          GREAD137
      IM1=IX-1                                                          GREAD138
      IM2=IX-2                                                          GREAD139
      IM3 = IX-3                                                        GREAD140
      I4=1                                                              GREAD141
      IA=NM1-IP1                                                        GREAD142
      EX2=-1./2.                                                        GREAD143
      EX3 = 1./3.                                                       GREAD144
      EX6 = -1./6.                                                      GREAD145
      XNV = .5                                                          GREAD146
      XNT = 1.5                                                         GREAD147
      BETV = 10.                                                        GREAD148
      BETT = 10./3.                                                     GREAD149
      DT2 = 2.*DT                                                       GREAD150
      G = 980.                                                          GREAD151
      CP = .239                                                         GREAD152
      PI = 3.1415927                                                    GREAD153
      GAM = .98E-4                                                      GREAD154
      GAM2 = 2.*GAM                                                     GREAD155
      ALF = -3.                                                         GREAD156
      XK1 = .4                                                          GREAD157
      XK2=.14                                                           GREAD158
      RALF = -1./ALF                                                    GREAD159
      RC = RALF/7.                                                      GREAD160
      T2 = (1. + ALF*RC)**2                                             GREAD161
      T3 = RC**EX3                                                      GREAD162
      CC = 3.*T3*T2                                                     GREAD163
      T4 = 3./CC                                                        GREAD164
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      C32 = T4**(-.5)                                                    GREAD165
      T4 = T4**1.5                                                       GREAD166
      XK12 = XK1**2                                                      GREAD167
      SH = XK12*T4                                                       GREAD168
      HKK = SH*XK2**2/XK12                                               GREAD169
      HK2 = SH/XK12                                                      GREAD170
      HKK=HKK*10.                                                        GREAD171
      CPP=-CP*1.0E06                                                     GREAD172
      SIG=1.354E-12                                                      GREAD173
      AW=1000.*G                                                         GREAD174
      AR=2.87E+06                                                        GREAD175
      NTOP=NLAP+NP1                                                      GREAD176
      ATC = .001                                                         GREAD177
      SK = 0.86933E-06                                                   GREAD178
      PI2 = PI * 2.                                                      GREAD179
      DELH = (DT/86400.) * PI2                                           GREAD180
    1 PDECL  = DECL / .017453293                                         GREAD181
      PDCHG = DCHG  / .017453293                                         GREAD182
      PRINH = H     / .017453293                                         GREAD183
      PRINT 126,PDECL,PDCHG,EM,PRINH                                     GREAD184
      DO 117 I=1,NX                                                      GREAD185
      T1 = (Z(I) + Z(I+1))/2.                                            GREAD186
      ZA(I) = ABS(T1)                                                    GREAD187
      DZ(I) = Z(I+1) - Z(I)                                              GREAD188
  117 CONTINUE                                                           GREAD189
      DO 23K=1,IM1                                                       GREAD190
      I=IM1-K+1                                                          GREAD191
   23 DS(K)   = ZA(I)-ZA(I+1)                                            GREAD192
      DS(IX)  = ABS(Z(1)) - ZA(1)                                        GREAD193
      DO 715 I=IP1,NP1                                                   GREAD194
      TE=Z(I)-ZW                                                         GREAD195
      IF (TE)715,10,715                                                  GREAD196
   10 IZW=I                                                              GREAD197
      GO TO 132                                                          GREAD198
  715 CONTINUE                                                           GREAD199
      PRINT 1000,  (Z(I),I=1,NP1),ZW                                     GREAD200
      CALL EXIT                                                          GREAD201
  132 IZW1=IZW-1                                                         GREAD202
      T20=ALOG(Z(IZW)/Z(IZW1))                                           GREAD203
      A1 = ALOG(1950.  /Z(IZW1))/T20                                     GREAD204
      A2 = ALOG(Z(IZW)/1950.  )/T20                                      GREAD205
   99 RETURN                                                             GREAD206
  100 FORMAT(18A4)                                                       GREAD207
  101 FORMAT(1X18A4///)                                                  GREAD208
  110 FORMAT(14I5)                                                       GREAD209
  111 FORMAT (4H NX=,I3/4H IX=,I3/4H NT=,I3/7H GRID =,I3)                GREAD210
  112 FORMAT (11H  XIIN   = F10.4/11H   XJIN  = F10.4/11H PHI     = F8.2GREAD211
     1/11H DELTA T = F6.1/10H DISTANCE=,F7.2)                            GREAD212
  119 FORMAT(6F12.4)                                                     GREAD213
  120 FORMAT (6E12.5)                                                    GREAD214
  121 FORMAT ('0X-GRAD    ',6E12.5)                                      GREAD215
  122 FORMAT ('0Y-GRAD    ',6E12.5)                                      GREAD216
  123 FORMAT ('0',3A4,' GRADIENTS--INPUT VALUES'/' HEIGHTS(M)',11F10.2)  GREAD217
  126 FORMAT(13H DECLINATION ,E12.4/8H CHANGE ,E12.4/ 36H INFRARED EMISSGREAD218
     1IVITY OF THE SURFACE ,E12.4/12H HOUR ANGLE ,E12.4)                 GREAD219
 1000 FORMAT(1H1,'   ZW VALUE IS INCORRECT--- HEIGHT ARRAY FOLLOWS'//   GREAD220
     1  (6F12.4))                                                       GREAD221
 1212 FORMAT ('0TIME STEP FOR RADIATION IS',F10.2,' MINUTES')            GREAD222
      END                                                                GREAD223
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  SUBROUTINE ADVECT                                                      ADVCT000
 INTEGER RDRUM,SDRUM,TDRUM                                               ADVCT001
 DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12           ADVCT002
1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3         ADVCT003
2   ,WO,WSC,XKT,XYY,YY,GTO                                              ADVCT004
 COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)              ADVCT005
1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)           ADVCT006
2   ,TT3(30),W3(30),SST                                                 ADVCT007
 COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,ADVCT008
1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CEADVCT009
2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2                  ADVCT010
 COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL                    ADVCT011
1   ,XLAM,RSUM(15),B1,B2                                                ADVCT012
 COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)         ADVCT013
1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)       ADVCT014
2   ,ZDLZ(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2        ADVCT015
3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)       ADVCT016
4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)             ADVCT017
5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF                   ADVCT018
6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV              ADVCT019
7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                                 ADVCT020
7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)ADVCT021
 COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)           ADVCT022
1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)         ADVCT023
2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)      ADVCT024
 COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                            ADVCT025
 COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6         ADVCT026
1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3          ADVCT027
2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME       ADVCT028
3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2         ADVCT029
4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2                ADVCT030
5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                       ADVCT031
 COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL          ADVCT032
1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                          ADVCT033
 COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20         ADVCT034
2     ,  T13,T14,T15,T16,XD1,YD1                                        ADVCT035
3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                            ADVCT036
 COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II     ADVCT037
 COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)          ADVCT038
1 , I1IHT,I4IHT                                                         ADVCT039
 DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)               ADVCT040
 EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))          ADVCT041
1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))                  ADVCT042
 COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                           ADVCT043
 COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                           ADVCT044
 COMMON /GRDNTS / GXY(30,12)                                            ADVCT045
 DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)          ADVCT046
1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)                    ADVCT047
2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)                    ADVCT048
3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)                   ADVCT049
4  ,CP2X(30),CP2Y(30)                                                   ADVCT050
 EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))                   ADVCT051
 EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))                    ADVCT052
 EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))                    ADVCT053
 EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))                    ADVCT054
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      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))                ADVCT055
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))               ADVCT056
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))               ADVCT057
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))               ADVCT058
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))               ADVCT059
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))               ADVCT060
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))               ADVCT061
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))               ADVCT062
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))               ADVCT063
      DIMENSION YIN2(1),YIN3(1),YIN4(1),YIN5(1)                           ADVCT064
      EQUIVALENCE (XYY(1,1,2),YIN2(1)),(XYY(1,1,3),YIN3(1))               ADVCT065
     1       ,(XYY(1,1,4),YIN4(1)),(XYY(1,1,5),YIN5(1))                   ADVCT066
      DIMENSION VAR3(50)                                                  ADVCT067
      DIMENSION ALL(12,5) ,IALL(12,5)                                     ADVCT068
      EQUIVALENCE (VAR3(1),C(1)) ,(IALL(1,1),ALL(1,1))                    ADVCT069
      DOUBLE PRECISION XTIME,XT1                                          ADVCT070
      NVAR1 = 1                                                           ADVCT071
      NVAR6 = 6                                                           ADVCT072
      DO 585 I = 1,NP1                                                    ADVCT073
      U3(I) = 0.                                                          ADVCT074
      V3(I) = 0.                                                          ADVCT075
      TT3(I) = 0.                                                         ADVCT076
      W3(I) = 0.                                                          ADVCT077
      PP13(I) = 0.                                                        ADVCT078
      PP23(I) = 0.                                                        ADVCT079
  585 CONTINUE                                                            ADVCT080
C*************************************************************************ADVCT081
C**** FLOATING GRID STATIONS ARE ASSIGNED THE FOLLOWING NUMBERS ********ADVCT082
C                                                                         ADVCT083
C                                 6  4  7                                 ADVCT084
C                                                                         ADVCT085
C                                 1  2  3                                 ADVCT086
C                                                                         ADVCT087
C                                 8  5  9                                 ADVCT088
C                                                                         ADVCT089
C**** WHERE THE COMPUTED GRADIENTS ARE APPLIED AT STATION 2 ************ADVCT090
C*************************************************************************ADVCT091
      DO 666 I=1,5                                                        ADVCT092
      IF(I.EQ.2.OR.I.EQ.3) GO TO 666                                      ADVCT093
      DO 666 J=1,12                                                       ADVCT094
      ALL(J,I) = 0.                                                       ADVCT095
  666 CONTINUE                                                            ADVCT096
C  SET DATA FROM RESTART                                                  ADVCT097
C   COMPUTES THE CENTERED AND UPWIND GRADIENTS                            ADVCT098
      IU3 = 3                                                             ADVCT099
      IF (MS-2) 511,501,501                                               ADVCT100
C  SETS STATION 2   MS=1                                                  ADVCT101
  511 READ (RDRUM'IS)     (YIN2(I),I=1,NWSYY)                             ADVCT102
      DO 600 I=1,12                                                       ADVCT103
      ALL(I,2) = YIN3(I)                                                  ADVCT104
  600 CONTINUE                                                            ADVCT105
      SLOPX = ALL(1,2)                                                    ADVCT106
      SLOPY = ALL(2,2)                                                    ADVCT107
      HEIGHT = ALL(3,2)                                                   ADVCT108
      ETA1   = ALL(4,2)                                                   ADVCT109
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      ETA2    = ALL(5,2)                                                ADVCT110
      XETA2   = ALL(6,2)                                                ADVCT111
      YETA2   = ALL(7,2)                                                ADVCT112
      IHT     =IALL(8,2)                                                ADVCT113
      IANV    =IALL(9,2)                                                ADVCT114
      ETAINX = ALL(11,2)                                                ADVCT115
      ETAINY = ALL(12,2)                                                ADVCT116
      IGOG = IGOGO                                                      ADVCT117
      LOCXYY(2) = -1                                                    ADVCT118
      IU3 = 2                                                           ADVCT119
      ALL(11,1) = ALL(11,2)                                             ADVCT120
      ALL(12,1) = ALL(12,2)                                             ADVCT121
C  SETS STATION 3   MS GT 1                                             ADVCT122
  501 DO 503 J=NVAR1,NVAR6                                              ADVCT123
      DO 503 K=1,NP1                                                    ADVCT124
      IF (MS.EQ.1) GO TO 1603                                           ADVCT125
      XYY(K,J,1) = XYY(K,J,2)                                           ADVCT126
      XYY(K,J,2) = XYY(K,J,3)                                           ADVCT127
 1603 YY(K,J)    = XYY(K,J,IU3)                                         ADVCT128
  503 CONTINUE                                                          ADVCT129
      PP23(NP1) = PP22(NP1)                                             ADVCT130
      PP13(NP1) = PP12(NP1)                                             ADVCT131
      IF(MS.EQ.1) GO TO 610                                             ADVCT132
      DO 604 I=1,12                                                     ADVCT133
      IF(I.EQ.8.OR.I.EQ.10) GO TO 1610                                  ADVCT134
      ALL(I,1) = ALL(I,2)                                               ADVCT135
      ALL(I,2) = ALL(I,3)                                               ADVCT136
      GO TO 604                                                         ADVCT137
 1610 IALL(I,1) = IALL(I,2)                                             ADVCT138
      IALL(I,2) = IALL(I,3)                                             ADVCT139
  604 CONTINUE                                                          ADVCT140
      SLOPX = ALL(1,2)                                                  ADVCT141
      SLOPY = ALL(2,2)                                                  ADVCT142
      HEIGHT = ALL(3,2)                                                 ADVCT143
      ETA1    = ALL(4,2)                                                ADVCT144
      ETA2    = ALL(5,2)                                                ADVCT145
      XETA2   = ALL(6,2)                                                ADVCT146
      YETA2   = ALL(7,2)                                                ADVCT147
      IHT     =IALL(8,2)                                                ADVCT148
      IANV    =IALL(9,2)                                                ADVCT149
      ETAINX = ALL(11,2)                                                ADVCT150
      ETAINY = ALL(12,2)                                                ADVCT151
      IGOG = IGOGO                                                      ADVCT152
  610 LOCXYY(1) = LOCXYY(2)                                             ADVCT153
      LOCXYY(2) = IS                                                    ADVCT154
  515 IF (MS-IMAX) 560,561,561                                          ADVCT155
  560 LOCXYY(3) = IS+1                                                  ADVCT156
      READ (RDRUM'IS+1)    (YIN3(I),I=1,NWSYY)                          ADVCT157
      DO 601 I=1,12                                                     ADVCT158
      ALL(I,3) = YIN4(I)                                                ADVCT159
  601 CONTINUE                                                          ADVCT160
      GO TO 562                                                         ADVCT161
  561 LOCXYY(3) = -1                                                    ADVCT162
C   STATIONS 1-3 SET   NOW SET 4-5                                      ADVCT163
  562 IF (NS-1) 563,563,564                                             ADVCT164
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  563 LOCXYY(4) = -1                                                    ADVCT165
      ALL(11,4) = ALL(11,2)                                             ADVCT166
      ALL(12,4) = ALL(12,2)                                             ADVCT167
      GO TO 565                                                         ADVCT168
  564 LOCXYY(4) = IS-IMAX                                               ADVCT169
      READ (RDRUM'LOCXYY(4)) (YIN4(I),I=1,NWSYY)                        ADVCT170
      DO 602 I=1,12                                                     ADVCT171
      ALL(I,4) = YIN5(I)                                                ADVCT172
  602 CONTINUE                                                          ADVCT173
  565 IF (NS-JMAX) 566,567,567                                          ADVCT174
  566 LOCXYY(5) = IS+IMAX                                               ADVCT175
      READ (RDRUM'LOCXYY(5)) (YIN5(I),I=1,NWSYY)                        ADVCT176
      DO 603 L=1,12                                                     ADVCT177
      K = NWSYY - 12 + L                                                ADVCT178
      ALL(L,5) = YIN5(K)                                                ADVCT179
  603 CONTINUE                                                          ADVCT180
      GO TO 568                                                         ADVCT181
  567 LOCXYY(5) = -1                                                    ADVCT182
      ALL(11,5) = ALL(11,2)                                             ADVCT183
      ALL(12,5) = ALL(12,2)                                             ADVCT184
C  ENTIRE XYY NOW SET FOR UPWIND                                        ADVCT185
  568 CONTINUE                                                          ADVCT186
  619 SQ2 = SQRT(2.)                                                    ADVCT187
C   UPWIND/CENTERED DIFFERENCE ROUTINE FOR UP TO 6 VARIABLES            ADVCT188
      XMD = 1. /XD                                                      ADVCT189
      DO 649 I=1,12                                                     ADVCT190
      DO 649 J=1,30                                                     ADVCT191
      PGXY(J,I) = 0.                                                    ADVCT192
      CGXY(J,I) = 0.                                                    ADVCT193
  649 CONTINUE                                                          ADVCT194
      GO TO (620,642,642,620),IGOGO                                     ADVCT195
  642 IF(111HT.LT.2) GO TO 41                                           ADVCT196
      II = 6                                                            ADVCT197
      IJ = 1                                                            ADVCT198
      IK = 3                                                            ADVCT199
      IL = 11                                                           ADVCT200
      DO 644 KK = 1,2                                                   ADVCT201
      IF(LOCXYY(IJ).LT.0.OR.LOCXYY(IK).LT.0) GO TO 645                  ADVCT202
      ALL(II,2) = (ALL(5,IK) - ALL(5,IJ))*XMD/2.                        ADVCT203
      GO TO 615                                                         ADVCT204
  645 IF(LOCXYY(IJ).LT.0.AND.LOCXYY(IK).LT.0) GO TO 646                 ADVCT205
      IF(LOCXYY(IJ).LT.0) GO TO 647                                     ADVCT206
      IF(LOCXYY(IK).LT.0) GO TO 648                                     ADVCT207
  646 ALL(II,2) =(ALL(IL,IK) - ALL(IL,IJ))*XMD/2.                       ADVCT208
      GO TO 615                                                         ADVCT209
  647 ALL(II,2) = (ALL(5,IK) - ALL(IL,IJ))*XMD/2.                       ADVCT210
      GO TO 615                                                         ADVCT211
  648 ALL(II,2) = (ALL(IL,IK) - ALL(5,IJ))*XMD/2.                       ADVCT212
  615 II = 7                                                            ADVCT213
      IJ = 5                                                            ADVCT214
      IK = 4                                                            ADVCT215
      IL = 12                                                           ADVCT216
  644 CONTINUE                                                          ADVCT217
      XETA2 = ALL(6,2)                                                  ADVCT218
      YETA2 = ALL(7,2)                                                  ADVCT219
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      IF(I1IHT.EQ.2) RETURN                                          ADVCT220
   41 IF(IGONY.EQ.-1) GO TO 620                                      ADVCT221
      IF(ITM.GT.1) GO TO 620                                         ADVCT222
      IF(I1IHT.EQ.1) GO TO 620                                       ADVCT223
  641 I2IHT = IHT                                                    ADVCT224
      I3IHT = IHT                                                    ADVCT225
      DO 607 J=1,3                                                   ADVCT226
      IIHT = IALL(8,J)                                               ADVCT227
      IF(IIHT.GT.I2IHT) I2IHT= IALL(8,J)                             ADVCT228
  607 CONTINUE                                                       ADVCT229
      DO 608 J=4,5                                                   ADVCT230
      IIHT = IALL(8,J)                                               ADVCT231
      IF(IIHT.GT.I3IHT) I3IHT = IALL(8,J)                            ADVCT232
  608 CONTINUE                                                       ADVCT233
  620 DO 599 IJXY=1,2                                                ADVCT234
      IXY =(IJXY-1)*6                                                ADVCT235
      IF (IJXY-1) 1501,1501,1502                                     ADVCT236
 1501 IF (LOCXYY(3)) 521,521,522                                     ADVCT237
  521 IU3 = 2                                                        ADVCT238
      GO TO 523                                                      ADVCT239
  522 IU3 = 3                                                        ADVCT240
  523 IF (LOCXYY(1)) 524,524,525                                     ADVCT241
  524 IU1 = 2                                                        ADVCT242
      GO TO 1505                                                     ADVCT243
  525 IU1 = 1                                                        ADVCT244
      GO TO 1505                                                     ADVCT245
 1502 IF (LOCXYY(4)) 1521,1521,1522                                  ADVCT246
 1521 IU3 = 2                                                        ADVCT247
      GO TO 2521                                                     ADVCT248
 1522 IU3 = 4                                                        ADVCT249
 2521 IF (LOCXYY(5)) 1524,1524,1525                                  ADVCT250
 1524 IU1 = 2                                                        ADVCT251
      GO TO 1505                                                     ADVCT252
 1525 IU1 = 5                                                        ADVCT253
C  UPWIND DIFFERENCE IN X(IJXY=1)/Y(IJXY=2) DIRECTION                ADVCT254
 1505 IKI = 1                                                        ADVCT255
      IF(IGONY.EQ.1) IKI=IP2                                         ADVCT256
      DO 550  LR=IKI,NP1                                             ADVCT257
      IF(XYY(LR,IJXY,2)) 531,532,536                                 ADVCT258
C ABOVE CHECKS U/V  NOW INFLOW CONDITION CHECK                       ADVCT259
  531 IF (IU3-2) 435,532,435                                         ADVCT260
  435 IU3U = IU3                                                     ADVCT261
      IU2 = 2                                                        ADVCT262
      GO TO 534                                                      ADVCT263
C  UPWIND IS INFLOW--SET TO INPUT                                    ADVCT264
  532 DO 533 J=NVAR1,NVAR6                                           ADVCT265
      K = IXY+J                                                      ADVCT266
  533 PGXY(LR,K) = GXY(LR,K)                                         ADVCT267
      GO TO 540                                                      ADVCT268
  536 IF (IU1-2) 537,532,538                                         ADVCT269
  537 IU3U = 2                                                       ADVCT270
      IU2 = 1                                                        ADVCT271
      GO TO 534                                                      ADVCT272
  538 IU3U = 2                                                       ADVCT273
      IU2  = 5                                                       ADVCT274
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C  UPWIND DIFFERENCE                                                    ADVCT275
  534 DO 535 J=NVAR1,NVAR6                                             ADVCT276
      K = IXY+J                                                        ADVCT277
      PGXY(LR,K) = XMD*(XYY(LR,J,IU3U)-XYY(LR,J,IU2))                  ADVCT278
  535 CONTINUE                                                         ADVCT279
C    C COMPUTE CENTERED DIFFERENCE                                     ADVCT280
  540 DO 547 J=NVAR1,NVAR6                                             ADVCT281
      K = IXY+J                                                        ADVCT282
      CGXY(LR,K) =((XYY(LR,J,IU3) - XYY(LR,J,2))                       ADVCT283
     1  +(XYY(LR,J,2)- XYY(LR,J,IU1)))*XMD/2.                         ADVCT284
      IF(IGONY.LT.0) GO TO 547                                         ADVCT285
      IF (IU3.EQ.2.OR .IU1.EQ.2) CGXY(LR,K) =PGXY(LR,K)                ADVCT286
  547 CONTINUE                                                         ADVCT287
  550 CONTINUE                                                         ADVCT288
  599 CONTINUE                                                         ADVCT289
      RETURN                                                           ADVCT290
      END                                                              ADVCT291
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      SUBROUTINE RAD                                                    RAD  000
C     SUBROUTINE TO COMPUTE TEMPERATURE CHANGES DUE TO RADIATION        RAD  001
      INTEGER RDRUM,SDRUM,TDRUM                                         RAD  002
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     RAD  003
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3   RAD  004
     2   ,WO,WSC,XKT,XYY,YY,GTO                                         RAD  005
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        RAD  006
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      RAD  007
     2   ,TT3(30),W3(30),SST                                           RAD  008
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,RAD  009
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CERAD  010
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2            RAD  011
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               RAD  012
     1   ,XLAM,RSUM(15),B1,B2                                          RAD  013
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    RAD  014
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  RAD  015
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   RAD  016
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  RAD  017
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        RAD  018
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              RAD  019
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         RAD  020
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                           RAD  021
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)RAD  022
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      RAD  023
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    RAD  024
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) RAD  025
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      RAD  026
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   RAD  027
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     RAD  028
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  RAD  029
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    RAD  030
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           RAD  031
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                  RAD  032
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     RAD  033
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                    RAD  034
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    RAD  035
     2     ,  T13,T14,T15,T16,XD1,YD1                                  RAD  036
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                       RAD  037
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II RAD  038
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     RAD  039
     1 , I1IHT,I4IHT                                                   RAD  040
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          RAD  041
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     RAD  042
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             RAD  043
      DIMENSION DTR(50)                                                 RAD  044
      EQUIVALENCE (DTR(1),C(1))                                         RAD  045
  213 FORMAT ('0INITIAL PRES AND QS'/(1X2F15.5))                        RAD  046
  106 NCL = NCLI                                                        RAD  047
      IF(ITM.LT.ISTEP(1)) NCL=0                                         RAD  048
      CX = 1.                                                           RAD  049
      RAINX = 0.                                                        RAD  050
      IF(NCL)1108,1108,116                                              RAD  051
  116 CALL LINEAR (ITM,ISTEP,1,NTFOR, L,RAINI,RAINX,T4,T4,T4,T4,T4,T4)  RAD  052
      NCL = NXN(L)                                                      RAD  053
      DO 934 I=1,NCL                                                    RAD  054
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      CALL LINEAR(ITM,ISTEP,1,NTFOR,L,ECLI(1,I),EC(I),T4,T4,T4,T4,T4,T4)RAD  055
      TCL(I) = TCLI(L,I)                                                RAD  056
  934 LLC(I) = LLCI(L,I)                                                RAD  057
      CX = 1. -EC(NCL)                                                  RAD  058
 1108 LLC(NCL+1) = 61                                                   RAD  059
      DO 107I=IM1,NP1                                                   RAD  060
      TA(I)=TT2(I)                                                      RAD  061
      QA(I)=W2(I)                                                       RAD  062
      COB(I) = PP12(I)*COCOB                                            RAD  063
  107 CONTINUE                                                          RAD  064
C  FOLLOWING RECOMUTES EMISSIUIY H20,CO2 ATEACH STATION WHEN XD.GT.50KM RAD  065
 1407 ICOM = -1                                                         RAD  066
      IF (XD.GT. 50.E5) GO TO 112                                       RAD  067
      IF(IS.NE.1) GO TO 1507                                            RAD  068
  112 INEWC = INEWC+1                                                   RAD  069
      IF (INEWC-INEW) 1507,1505,1505                                    RAD  070
 1505 INEWC = 0                                                         RAD  071
      ICOM = 1                                                          RAD  072
 1507 CONTINUE                                                          RAD  073
 1408 C1 = 3.7943/PA(IP1)                                               RAD  074
C  COMPUTE PATH LENGTHS,ST4,QS                                          RAD  075
      TTW = TW                                                          RAD  076
      DO 104 L=IP1,NP1                                                  RAD  077
      K=L-IX                                                            RAD  078
      IF (ICOM) 501,501,702                                             RAD  079
  702 DUW(K)=(PA(L)-PA(L+1))*(QA(L)+QA(L+1))/G/2.                       RAD  080
      TTW = TTW+DUW(K)                                                  RAD  081
C   CARBON DIOXIDE ASSUMED AT 320 PPM                                   RAD  082
      COA(K) = .4148239*(PA(L)-PA(L+1))                                 RAD  083
  501 IF (IPOL) 499,499,709                                             RAD  084
  499 CGA(K) = 0.                                                       RAD  085
      PAAB(K) = 0.                                                      RAD  086
      PASA(K) = 0.                                                      RAD  087
      GO TO 502                                                         RAD  088
  709 T8  = (COB(L)+COB(L+1))/2.*DZ(L)*1.E-5                            RAD  089
      CGA(K) = T8*1.66*XNO                                              RAD  090
      PAAB(K) = T8*SOAB                                                 RAD  091
      PASA(K) = T8*SOSC                                                 RAD  092
  502 ST4(L) = SIG*TA(L)**4                                             RAD  093
      DST4(L) = SIG*((TA(L)+TA(L+1))/2.)**4                             RAD  094
      CXPA = 3.7943/PA(L)                                               RAD  095
      TEX = 3.0 + 7.5 *(TA(L)-273.16)/(TA(L)-35.66)                     RAD  096
      QS(L) = CXPA * 10.0**TEX                                          RAD  097
  104 CONTINUE                                                          RAD  098
      KA = NP1-IX   +1                                                  RAD  099
      IF (ICOM.EQ.1) CALL INFRAI(DUW,COA,KA,NATAL)                      RAD  100
      IF (ITM-1) 212,212,297                                            RAD  101
  212 PRINT 213, (PA(I),QS(I),          I=IY,NP1)                       RAD  102
C  *** SOLAR RADIATION COMPUTATIONS                                     RAD  103
  297 T3 = COS(H)                                                       RAD  104
      T4 = COS(DECL)                                                    RAD  105
      T6 = SIN(DECL)                                                    RAD  106
      T5 = SPH*T6+CPH*T3*T4                                             RAD  107
      COSZ = T5                                                         RAD  108
      H = H + DELH                                                      RAD  109
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      IF(H.LE.PI) GO TO 2                                                RAD  110
      H = H-PI2                                                          RAD  111
      DECL= DECL+ DCHG                                                   RAD  112
      PDECL = DECL/.017453293                                            RAD  113
      PRINT 299,ITM,PDECL                                                RAD  114
  299 FORMAT(//' MIDNIGHT OCCURS AT TIME STEP',I5,' NEW DECLINATION IS'  RAD  115
     1,E12.4)                                                            RAD  116
    2 IF(T5)5,5,19                                                       RAD  117
    5 CRS = 0.                                                           RAD  118
      TE = 0.                                                            RAD  119
      RH = 0.                                                            RAD  120
      TOUPRA = 0.                                                        RAD  121
      DO 6I=1,NP1                                                        RAD  122
    6 DTDT(I) = 0.                                                       RAD  123
      GO TO 99                                                           RAD  124
   19 N1 = NP1 - IX                                                      RAD  125
      CALL SOLAR2 (N1 ,PA(IY),DUW,PASA,PAAB,EC,TCL,LLC,COSZ,DTDT(IY),    RAD  126
     1 CRS,TE,TOUPRA,NATAL)                                              RAD  127
      GO TO (86,86,86,1414), IGOGO                                       RAD  128
   86 SINZ = SQRT(1.-COSZ*COSZ)                                          RAD  129
      SRS = -.0139 + .0467 * (SINZ/COSZ)                                 RAD  130
      SRS = AMIN1(1.,SRS)                                                RAD  131
      SRS = AMAX1(.03,SRS)                                               RAD  132
 1414 CONTINUE                                                           RAD  133
      RAI(IX) = CRS * (1.-SRS)                                           RAD  134
      TOUPRA = TOUPRA + CRS*SRS                                          RAD  135
      RH = RAI(IX)                                                       RAD  136
      IF(IGONY.GT.0) GO TO 99                                            RAD  137
 6843 SECZ = 1./COSZ                                                     RAD  138
      IF(SECZ.GT.10.) SECZ = 10.                                         RAD  139
      IF(RAI(IX).LE.1.0E-30) RAI(IX) = 0.0                               RAD  140
      DO 25 M=2,IX                                                       RAD  141
      I = IX-M+2                                                         RAD  142
      T2 = ZA(I-1)/100.                                                  RAD  143
      CALL KAPPA(T2,AK)                                                  RAD  144
      IF(RAI(I).LT.1.0E-20) RAI(I)=0.0                                   RAD  145
      T100 = -AK*ZA(I-1)*SECZ/100.                                       RAD  146
      IF(T100.LE.-40.0) T100 = -40.0                                     RAD  147
      RAI(I-1) = RAI(IX)*EXP(T100)                                       RAD  148
   25 DTR(I) = RAI(I) - RAI(I-1)                                         RAD  149
      DTR(1) = RAI(1)                                                    RAD  150
      DO 27I=1,IM1                                                       RAD  151
      M=IX-I+1                                                           RAD  152
   27 DTDT(I) = DTR(I) / DS(M)                                           RAD  153
      RH = RAI(IX) - RAI(IM1)                                            RAD  154
C  INFRARED SURFACE FLUX                                                 RAD  155
   99 CALL INFRA (1,DST4(IP1),ST4(IP1),LLC,EC,DTT,PA(IP1),RA,RB,CGA)     RAD  156
      RAA = RA(1) + RADMX                                                RAD  157
      RSUM(6) = DT*RA(1) + RSUM(6)                                       RAD  158
C  *** HEAT BALANCE                                                      RAD  159
      LOOP = 0                                                           RAD  160
      TG1= TA(IP1)                                                       RAD  161
      IF(TG1- 273.16)855,855,860                                         RAD  162
  855 XLT = 677.                                                         RAD  163
      GO TO 861                                                          RAD  164
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  860 XLT = 597.3 - 0.57*(TG1-273.16)                                    RAD  165
  861 T5 = 1. / (EM * SIG)                                               RAD  166
      IF(RAINX.GT.0) GO TO 862                                           RAD  167
      TRW = TA(IP1)                                                      RAD  168
      GO TO 865                                                          RAD  169
  862 TWBAR = 0.                                                         RAD  170
      NC = 0                                                             RAD  171
C     RAINFALL THROUGH LAYER COMPUTATION                                 RAD  172
      DO 864 I=IP2,NP1                                                   RAD  173
      ZWS = Z(I)                                                         RAD  174
      IF(ZW.GT.ZWS.AND.ZWS.GT.0.) GO TO 863                              RAD  175
      SN = NC                                                            RAD  176
      TRW = TWBAR/SN                                                     RAD  177
      GO TO 865                                                          RAD  178
  863 NC = NC+1                                                          RAD  179
      TWBAR = TWBAR + (TA(I)-XLT*1.E-03/CP * (QS(I)-QA(I)))              RAD  180
  864 CONTINUE                                                           RAD  181
  865 ET1 = -.001 * ROA * XKT(IP1)                                       RAD  182
      N = 1                                                              RAD  183
      AT1 = -ROA * CP * XKT(IP1)                                         RAD  184
      ST1 = ROW * CW * XKT(IM1)                                          RAD  185
  532 CONTINUE                                                           RAD  186
      ET = ET1 * ((W2(IP2) - W2(IP1)) / Z(IP2))                          RAD  187
      AT = AT1 * ((TA(IP2) - TA(IP1)) / DZ(IP1)  + GAM )                 RAD  188
      ST = ST1 * ((TA(IP1) - TA(IM1)) / DZ(IM1))                         RAD  189
C     RAIN EFFECT TERM  -PT-                                             RAD  190
      PT = .935*RAINX*(TRW-TA(IP1))                                      RAD  191
      T4 = T5 *(RH + RAA - AT - ST -XLT*ET + PT)                         RAD  192
      IF(T4)74,74,870                                                    RAD  193
   74 IF(LOOP)75,75,203                                                  RAD  194
   75 PRINT 150,ITM,ET,AT,ST,XLT, RAA ,RH,SRS                            RAD  195
      TG3 = TG1/2.                                                       RAD  196
      GO TO 871                                                          RAD  197
  870 TG3 = T4**.25                                                      RAD  198
  871 GO TO (199,200,200),N                                              RAD  199
  199 N = 2                                                              RAD  200
      DET1 = TG3-TG1                                                     RAD  201
      TG = TG3                                                           RAD  202
      IF(ABS(DET1)-ATC)882,882,181                                       RAD  203
  200 DET2 = TG3-TG2                                                     RAD  204
      IF(ABS(DET2)-ATC)105,105,186                                       RAD  205
  105 TG = (TG2+TG3)/2.                                                  RAD  206
      GO TO 882                                                          RAD  207
  186 IF(ABS(DET1)-ATC)882,882,1106                                      RAD  208
 1106 IF(DET1)191,882,192                                                RAD  209
  191 IF(DET2)193,193,184                                                RAD  210
  192 IF(DET2)184,193,193                                                RAD  211
  184 N=3                                                                RAD  212
      GO TO 203                                                          RAD  213
  193 TG1 = TG2                                                          RAD  214
      GO TO (199,202,203),N                                              RAD  215
  202 TG = TG3                                                           RAD  216
      DET1 = DET2                                                        RAD  217
      GO TO 181                                                          RAD  218
  203 DET1 = DET1/2.                                                     RAD  219
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      TG = TG1 + DET1                                                    RAD  220
  181 LOOP = LOOP + 1                                                    RAD  221
      TG2 = TG                                                           RAD  222
      IF(LOOP-25)884,884,97                                              RAD  223
  884 TEX = 3.0 + 7.5 * (TG-273.16) / (TG-35.66)                         RAD  224
      QSG = C1*10.0**TEX                                                 RAD  225
      W2(IP1) = QSG*XMQ+(1.-XMQ)*W2(IP2)                                 RAD  226
      TA(IP1) = TG                                                       RAD  227
      GO TO 532                                                          RAD  228
  882 CONTINUE                                                           RAD  229
      IF (W2(IP1).GT.QSG) W2(IP1) = QSG                                  RAD  230
      GO TO 404                                                          RAD  231
   97 PRINT 151,ITM,ET,AT,ST,XLT, RAA ,RH,SRS ,TG                        RAD  232
  150 FORMAT(15H  IN TIME STEP ,I3,' T**4 INITIALLY COMPUTED LESS THAN ZRAD  233
     XERO'//'VALUES OF ET,AT,ST,XLT, RAA ,RH AND SRS FOLLOW'/7E12.4)     RAD  234
  151 FORMAT(15H  IN TIME STEP ,I3,' AFTER 25 ITERATIONS T(Z=0) DID NOT RAD  235
     XCONVERGE TO WITHIN THE SPECIFIED TOLERANCE'//'VALUES OF ET,AT,ST,XRAD  236
     XLT, RAA ,RH, SRS,TG FOLLOW',/8E12.4)                               RAD  237
  404 IX1 = IX+2                                                         RAD  238
  405 II = NP1-IX                                                        RAD  239
C   *** INFRARED ATMOSPHERIC COOLING                                     RAD  240
      CALL INFRA(NX,DST4(IP1),ST4(IP1),LLC,EC,DTT,PA(IP1),RA,RB,CGA)     RAD  241
 1607 DO 1621 I=IX1,NP1                                                  RAD  242
      L = I-IX                                                           RAD  243
 1621 DT1(I) = DTDT(I)+DTT(L)                                            RAD  244
      DO 4999K=1,IM1                                                     RAD  245
 4999 DT1(K) = DTDT(K)                                                   RAD  246
      TSC(IX) =   TG    - TTO(IP1)                                       RAD  247
      TSC(IP1) = TSC(IX)                                                 RAD  248
      TEX = 3.0 + 7.5 * (TG-273.16) / (TG-35.66)                         RAD  249
      QSG = C1*10.0**TEX                                                 RAD  250
      W2(IP1) = QSG                                                      RAD  251
      W2(IP1)=W2(IP1)*XMQ+(1.-XMQ)*W2(IP2)                               RAD  252
      WSC(IP1) = W2(IP1)-WO(IP1)                                         RAD  253
C  RADIATION AND HEAT BALANCE SUMS                                       RAD  254
      RSUM(1) = RSUM(1) + DT * ET * XLT                                  RAD  255
      RSUM(2) = RSUM(2) + DT * AT                                        RAD  256
      RSUM(3) = RSUM(3) + DT * ST                                        RAD  257
      RSUM(4) = RSUM(4) + DT * PT                                        RAD  258
      RSUM(5) = RSUM(5) + DT * RH                                        RAD  259
      RSUM(7) = RSUM(7) + DT * RADMX                                     RAD  260
      RSUM(8) = RSUM(8) + DT * TG**4 * SIG * EM                          RAD  261
      RSUM(9) = RSUM(9)+DT*(TE-TOUPRA)                                   RAD  262
      K = NP1-IX+1                                                       RAD  263
      RSUM(10)= RSUM(10)+DT*(RA(K)-RB(K))                                RAD  264
      XT2 = TSC(IX)                                                      RAD  265
      RANS = RA(K) * 1.E3                                                RAD  266
      RABNS= RB(K) * 1.E3                                                RAD  267
      RABS = RB(1) * 1.E3                                                RAD  268
      CRNS = TE * 1.E3                                                   RAD  269
      TRAUS= (RB(K)-RA(K) + CRS*SRS) * 1.E3                              RAD  270
      DO 5000  I=1,NP1                                                   RAD  271
      TT2(I)=TSC(I)                                                      RAD  272
 5000 W2(I)=WSC(I)                                                       RAD  273
      HAI = AT                                                           RAD  274
      HSI= ST                                                            RAD  275
      CE = ET - RAINX                                                    RAD  276
      RETURN                                                             RAD  277
      END                                                                RAD  278
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      SUBROUTINE SDATA                                                  SDATA000
      INTEGER RDRUM,SDRUM,TDRUM                                         SDATA001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     SDATA002
     1    ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3   SDATA003
     2    ,WO,WSC,XKT,XYY,YY,GTO                                        SDATA004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        SDATA005
     1    ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)     SDATA006
     2    ,TT3(30),W3(30),SST                                           SDATA007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,SDATA008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CESDATA009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             SDATA010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               SDATA011
     1    ,XLAM,RSUM(15),B1,B2                                          SDATA012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    SDATA013
     1    ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30) SDATA014
     2    ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2  SDATA015
     3    ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10) SDATA016
     4    ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)       SDATA017
     5    ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF             SDATA018
     6    ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV        SDATA019
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                           SDATA020
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)SDATA021
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      SDATA022
     1    ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)   SDATA023
     2    ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) SDATA024
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      SDATA025
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   SDATA026
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     SDATA027
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  SDATA028
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2     SDATA029
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2            SDATA030
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                   SDATA031
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     SDATA032
     1    ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                    SDATA033
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    SDATA034
     2     ,  T13,T14,T15,T16,XD1,YD1                                   SDATA035
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                       SDATA036
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II SDATA037
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     SDATA038
     1 , I1IHT,I4IHT                                                    SDATA039
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          SDATA040
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     SDATA041
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             SDATA042
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      SDATA043
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      SDATA044
      COMMON /GRDNTS / GXY(30,12)                                       SDATA045
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     SDATA046
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               SDATA047
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               SDATA048
     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              SDATA049
     4  ,CP2X(30),CP2Y(30)                                            SDATA050
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))             SDATA051
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))              SDATA052
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))              SDATA053
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))              SDATA054
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      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))                SDATA055
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))               SDATA056
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))               SDATA057
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))               SDATA058
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))               SDATA059
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))               SDATA060
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))               SDATA061
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))               SDATA062
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))               SDATA063
      DIMENSION YIN2(1),YIN3(1),YIN4(1),YIN5(1)                           SDATA064
      EQUIVALENCE (XYY(1,1,2),YIN2(1)),(XYY(1,1,3),YIN3(1))               SDATA065
     1       ,(XYY(1,1,4),YIN4(1)),(XYY(1,1,5),YIN5(1))                   SDATA066
      DIMENSION VAR3(50)                                                  SDATA067
      DIMENSION ALL(12,5) ,IALL(12,5)                                     SDATA068
      EQUIVALENCE (VAR3(1),C(1)) ,(IALL(1,1),ALL(1,1))                    SDATA069
      DOUBLE PRECISION XTIME,XT1                                          SDATA070
C  SUBROUTINE TO SET DATA AT EACH STATION INITIALLY AND AT EACH RESTART   SDATA071
      IF (ITM) 11,11,301                                                  SDATA072
   11 IF (IS-1) 12,12,1313                                                SDATA073
C  READ IN INITIAL TIME ONLY        FOLLOWING FOR ALL STATIONS            SDATA074
   12 CONTINUE                                                            SDATA075
      READ 2,NLAP,NPU                                                     SDATA076
      NTOP = NLAP+NP1                                                     SDATA077
      NATAL = NTOP-IX                                                     SDATA078
      DO 13I=NP2,NTOP                                                     SDATA079
      READ 1, PA(I),TA(I),QA(I),COB(I)                                    SDATA080
      PRINT 1,PA(I),TA(I),QA(I),COB(I)                                    SDATA081
   13 CONTINUE                                                            SDATA082
      ST4(NP2)=SIG*TA(NP2)**4                                             SDATA083
      NTOP1=NTOP-1                                                        SDATA084
      TW = 0.                                                             SDATA085
      IF (XIIN.EQ.1..AND.XJIN.EQ.1.) GO TO 19                             SDATA086
C     XYY(LEVEV,         VARIABLE IN YY  ,STATION)                        SDATA087
      XD1 = XD*(XIIN-1.)                                                  SDATA088
      YD1 =-XD*(XJIN-1.)                                                  SDATA089
      DO 191J=1,6                                                         SDATA090
  184 I = J                                                               SDATA091
  190 DO 18 K=1,NP1                                                       SDATA092
   18 XYY(K,J,2) = YY(K,J  ) -ZE2(K,I)*YD1-ZE1(K,I)*XD1                   SDATA093
      IF (J-4) 192,191,191                                                SDATA094
  192 XYY(IP1,J,2) = XYY(IX,J,2)                                          SDATA095
  191 CONTINUE                                                            SDATA096
      GO TO 25,                                                           SDATA097
   19 DO 20 J=1,6                                                         SDATA098
      DO 20 I=1,NP1                                                       SDATA099
   20 XYY(I,J  ,2)  =    YY(I,J)                                          SDATA100
C  ALL CARDS READ IN AFTER ALL STATIONS STARTED                           SDATA101
C  FOLLOWING AT EACH STATION AT TIME STEP ZERO                            SDATA102
   25 IF (NTIME.LT.0) GO TO 1313                                          SDATA103
  301 IF (ITM.NE.NTIME.OR.IS.GT.1) GO TO 389                             SDATA104
      IGET = ITM                                                          SDATA105
      READ 2, NTIME,K                                                     SDATA106
      DO 302 I=1,NP1                                                      SDATA107
  302 READ 1,(VARIN(I,J),J=1,4)                                           SDATA108
      DO 303 I=1,K                                                        SDATA109
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      IF (NVCHS(1).EQ.1) READ 1,BR(I),(R(I,J,1),J=1,4)                  SDATA110
      IF (NVCHS(2).EQ.1) READ 1,V3(I),(E(I,J,1),J=1,4)                  SDATA111
  303 CONTINUE                                                          SDATA112
      DO 304 I=1,NP1                                                    SDATA113
      T1 = Z(I)                                                         SDATA114
      IF (I.EQ.IX) T1=T1-.00001                                         SDATA115
      IF (I.EQ.IP1)T1=T1+.00001                                         SDATA116
      IF (NVCHS(1).NE.1) GO TO 305                                      SDATA117
      CALL XINEAR (T1,BR,4,K,L,R(1,1,1),GNV(I,1),                       SDATA118
     1  R(1,2,1),GNV(I,2),R(1,3,1),GNV(I,3),R(1,4,1),GNV(I,4))          SDATA119
      GXY(I,1) = GNV(I,1)                                               SDATA120
      GXY(I,7) = GNV(I,2)                                               SDATA121
      GXY(I,2) = GNV(I,3)                                               SDATA122
      GXY(I,8) = GNV(I,4)                                               SDATA123
  305 IF (NVCHS(2).NE.1) GO TO 304                                      SDATA124
      CALL XINEAR (T1,V3,4,K,L,E(1,1,1),GNV(I,5),                       SDATA125
     1  E(1,2,1),GNV(I,6),E(1,3,1),GNV(I,7),E(1,4,1),GNV(I,8))          SDATA126
      GXY(I,3 ) = GNV(I,5)                                              SDATA127
      GXY(I,9 ) = GNV(I,6)                                              SDATA128
      GXY(I,4 ) = GNV(I,7)                                              SDATA129
      GXY(I,10) = GNV(I,8)                                              SDATA130
  304 CONTINUE                                                          SDATA131
  389 IF (ITM) 1313,1313,500                                            SDATA132
 1313 CONTINUE                                                          SDATA133
      IRAT = IMARA                                                      SDATA134
      INEW = 10 *IMARA                                                  SDATA135
      INEWC = INEW                                                      SDATA136
C  READ FOR EACH STATION   CLOUDS FROM RAD                             SDATA137
C                          THERMAL CONDUCTIVI  IF LAND                 SDATA138
C            ANY OTHER VARIABLE REQUIRE FOR A PARTICULAR RUN           SDATA139
C  READ STATION VALUES              FOLLOWING AT STATION START         SDATA140
      READ 2, NTFOR,NCL,NTCUV,IPOI,IGONY,ISSI1,ISSI2                    SDATA141
      READ 67,PSFA,XLAM,DEL                                             SDATA142
      READ 68,              SLOPX,SLOPY,HEIGHT,ETAINX,ETAINY,IANV       SDATA143
   68 FORMAT(5E12.5,I12)                                                SDATA144
   67 FORMAT(8F10.2)                                                    SDATA145
    1 FORMAT(7F10.2)                                                    SDATA146
      PRINT 1111,PSFA,XLAM,DEL,SLOPX,SLOPY,HEIGHT,ETAINX,ETAINY,IANV    SDATA147
      IGOGO = IGONY + 3                                                 SDATA148
      IGOG  = IGOGO                                                     SDATA149
      HEIGHT = HEIGHT*100.                                              SDATA150
      IF(HEIGHT.EQ.0.0) GO TO 313                                       SDATA151
      DO 34 I=1,IX                                                      SDATA152
      K = IX-I+1                                                        SDATA153
      IF(HEIGHT.LT.Z(K)) GO TO 34                                       SDATA154
      IHT = K +1                                                        SDATA155
      GO TO 36                                                          SDATA156
   34 CONTINUE                                                          SDATA157
      IHT = 1                                                           SDATA158
      GO TO 36                                                          SDATA159
  313 IHT = IP1                                                         SDATA160
   36 CONTINUE                                                          SDATA161
      DO 30 I=1,NTCUV                                                   SDATA162
      READ  5, ICUV(I),XOCU(I),XOCV(I),XACU(I),XACV(I),T1,T2            SDATA163
   30 PRINT 5,ICUV(I),XOCU(I),XOCV(I),XACU(I),XACV(I),T1,T2             SDATA164
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      IF (NTFOR.LE.0) NTFOR = 1                                          SDATA165
      ISTEP(1) = 601                                                     SDATA166
      IF(NCL)114,114,115                                                 SDATA167
C     NUMBER OF CLOUD LAYERS,AMOUNTS AND RAINFALL RATE INPUT             SDATA168
  115 DO 933 I=1,NTFOR                                                   SDATA169
      READ  3,ISTEP(I),NXN(I),RAINI(I),(LLCI(I,L),ECLI(I,L),TCLI(I,L),   SDATA170
     1  L=1,NCL)                                                         SDATA171
      PRINT 3,ISTEP(I),NXN(I),RAINI(I),(LLCI(I,L),ECLI(I,L),TCLI(I,L),   SDATA172
     1  L=1,NCL)                                                         SDATA173
      DO 933 LL=1,NCL                                                    SDATA174
  933 LLCI(I,LL) = LLCI(I,LL)    -IX                                     SDATA175
  114 NCLI = NCL                                                         SDATA176
      LLCI(1,NCL+1) = 61                                                 SDATA177
      GO TO (1520,1520,1520,1510),IGOGO                                  SDATA178
 1510 READ 1  , SRS,ROW,CW,XMQ,RADMX                                     SDATA179
      PRINT 1  ,SRS,ROW,CW,XMQ,RADMX                                     SDATA180
      READ  1  , (XKT(I),I=1,IMI)                                        SDATA181
      PRINT 1  , (XKT(I),I=1,IMI)                                        SDATA182
 1520 CONTINUE                                                           SDATA183
      DO 699I=1,20                                                       SDATA184
      SOU1(I) = 0.                                                       SDATA185
      SOU2(I) = 0.                                                       SDATA186
      IF(I.GT.6) GO TO 699                                               SDATA187
      SH1(I) = 0.                                                        SDATA188
      SH2(I) = 0.                                                        SDATA189
  699 CONTINUE                                                           SDATA190
      IF(IPOI)700,700,701                                                SDATA191
  701 READ 2, (ITS1(I),I=1,ISSII)                                        SDATA192
      PRINT 2,(ITS1(I),I=1,ISSI1)                                        SDATA193
      READ 1  , (SOU1(I),I=1,ISSI1)                                      SDATA194
      PRINT 1  ,(SOU1(I),I=1,ISSI1)                                      SDATA195
      READ 1  ,(SH1(I),I=1,6)                                            SDATA196
      PRINT 1  ,(SH1(I),I=1,6)                                           SDATA197
      IF(IPOI.EQ.1) GO TO 700                                            SDATA198
      READ 2,  (ITS2(I),I=1,ISSI2)                                       SDATA199
      PRINT 2, (ITS2(I),I=1,ISSI2)                                       SDATA200
      READ 1  ,  (SOU2(I),I=1,ISSI2)                                     SDATA201
      PRINT 1  , (SOU2(I),I=1,ISSI2)                                     SDATA202
      READ 1  ,(SH2(I),I=1,6)                                            SDATA203
      PRINT 1  ,(SH2(I),I=1,6)                                           SDATA204
  700 DO 117  L=NP2,NTOP1                                                SDATA205
      IF(QA(L+1).LE.0.0) QA(L+1) = 0.001                                 SDATA206
      T1 = (QA(L)+QA(L+1))/2.*(PA(L)-PA(L+1))/G                          SDATA207
      TW = TW + T1                                                       SDATA208
      K=L-IX                                                             SDATA209
      DUW(K) = T1                                                        SDATA210
      COA(K) = .4148239*(PA(L)-PA(L+1))                                  SDATA211
C     T8 = (COB(K)+COB(K+1))/2.*DZ(L)*1.E-5                              SDATA212
C  DZ(L) NOT SET ABOVE THE TOP PREDICTION LEVEL                          SDATA213
      T8 = (COB(L)+COB(L+1))/2.*1.E-5  *AR/G*TA(L)/PA(L)*                SDATA214
     1    (PA(L)-PA(L+1))                                                SDATA215
C   XNO IS THE INFRARED ABSORPTION COEFFICIENT FOR AEROSOLS              SDATA216
      CGA(K) = T8*1.66*XNO                                               SDATA217
      PAAB(K) = T8*SOAB                                                  SDATA218
      PASA(K) = T8*SOSC                                                  SDATA219
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      ST4(L+1)=SIG*(TA(L+1)**4)                                          SDATA220
      DST4(L) = (ST4(L)+ST4(L+1))*.5                                     SDATA221
  117 CONTINUE                                                           SDATA222
      DO 23 N=1,JMAX                                                     SDATA223
      DO 23 M=1,IMAX                                                     SDATA224
      XD1 = XD*(M-1)                                                     SDATA225
      YD1 =-XD*(N-1)                                                     SDATA226
      DO 23 I=1,NP1                                                      SDATA227
      T1 = XD1*ZE1(I,1)+YD1*ZE2(I,1)+XYY(I,1,2)                          SDATA228
      T2 = XD1*ZE1(I,2)+YD1*ZE2(I,2)+XYY(I,2,2)                          SDATA229
      T3 =  T1**2+T2**2                                                  SDATA230
      IF (T3) 23,23,223                                                  SDATA231
  223 T3 = SQRT(T3)                                                      SDATA232
      IF (T3.GT.SAVE)  SAVE = T3                                         SDATA233
   23 CONTINUE                                                           SDATA234
      TDEL = XD/SAVE                                                     SDATA235
      SAVE = 0.01                                                        SDATA236
      DO 108  I=IY,NX                                                    SDATA237
      T1  =-2.*G*(Z(I+1)-Z(I))                                           SDATA238
      T2  =AR*(TT2(I)+TT2(I+1))                                          SDATA239
  108 VAR3(I) = EXP(T1/T2)                                               SDATA240
      IF (NPU) 101,101,102                                               SDATA241
  101 PA(IP1)= PSFA                                                      SDATA242
  109 DO 111  I=IY,NX                                                    SDATA243
      PA(I+1)=PA(I)*VAR3(I)                                              SDATA244
  111 CONTINUE                                                           SDATA245
      GO TO 103                                                          SDATA246
  102 PA(NP1) = PSFA                                                     SDATA247
  110 DO 113 I=IY,NX                                                     SDATA248
      K = NX - I + IY                                                    SDATA249
      PA(K)=VAR3(K)/PA(K+1)                                              SDATA250
  113 CONTINUE                                                           SDATA251
  103 CONTINUE                                                           SDATA252
      IF (IGONY) 51,51,150                                               SDATA253
  150 DEL = 0.                                                           SDATA254
      GO TO 52                                                           SDATA255
   51 ROW = 1.                                                           SDATA256
      CW  = .935                                                         SDATA257
      XMQ =1.                                                            SDATA258
      IF (XLAM) 52,4,52                                                  SDATA259
    4 DEL=.055                                                           SDATA260
   52 CONTINUE                                                           SDATA261
   33 XM = MS-1                                                          SDATA262
      YM = NS-1                                                          SDATA263
      XD1 = XD*XM                                                        SDATA264
      YD1 =-XD*YM                                                        SDATA265
      DO 29 J=1,6                                                        SDATA266
  284 I = J                                                              SDATA267
  290 DO 28 K=1,NP1                                                      SDATA268
   28 YY(K,J  ) = XYY(K,J,2) +ZE2(K,I)*YD1+ZE1(K,I)*XD1                  SDATA269
      IF (J-4) 291,29,29                                                 SDATA270
  291 YY(IP1,J) = YY(IX,J)                                               SDATA271
   29 CONTINUE                                                           SDATA272
C     ALL INITIAL DATA SET                                               SDATA273
      GO TO (797,796,796,795),IGOGO                                      SDATA274
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  795 DO 14 J=1,4                                                    SDATA275
      DO 14I=1,IX                                                    SDATA276
   14 YY(I,J) = 0.                                                   SDATA277
      GO TO 1114                                                     SDATA278
  797 DO 798 J=1,2                                                   SDATA279
      DO 798 I=1,IX                                                  SDATA280
  798 YY(I,J) = 0.                                                   SDATA281
      GO TO 1114                                                     SDATA282
  796 IQI = 5                                                        SDATA283
      IF(W2(IX).EQ.0.0) IQI =4                                       SDATA284
      DO 141J=IQI,6                                                  SDATA285
      DO 141I=1,IX                                                   SDATA286
  141 YY(I,J) = 0.                                                   SDATA287
      IF(IHT.EQ.1) GO TO 122                                         SDATA288
      IIHT = IHT - 1                                                 SDATA289
      DO 121 I=1,IIHT                                                SDATA290
      U2(I) = 0.0                                                    SDATA291
  121 V2(I) =0.0                                                     SDATA292
  122 IF(IGONY.EQ.0) GO TO 1114                                      SDATA293
      IF(IANV.GT.1) GO TO 118                                        SDATA294
      DO 119 I=1,IX                                                  SDATA295
  119 V2(I) = 0.0                                                    SDATA296
      GO TO 1114                                                     SDATA297
  118 DO 120 I=1,IX                                                  SDATA298
  120 U2(I) = 0.0                                                    SDATA299
 1114 READ 16, (YY(I,3),I=1,IP1)                                     SDATA300
   16 FORMAT(6E12.4)                                                 SDATA301
      IF(IGONY.EQ.0) GO TO 10                                        SDATA302
      U2(IP1) = 0.                                                   SDATA303
      V2(IP1) = 0.                                                   SDATA304
   10 DO 9I=1,NP1                                                    SDATA305
      TTO(I)=TT2(I)                                                  SDATA306
      TT2(I)=0.                                                      SDATA307
      TT1(I) = TT2(I)                                                SDATA308
      U1(I) = U2(I)                                                  SDATA309
      V1(I) = V2(I)                                                  SDATA310
      WO(I)=W2(I)                                                    SDATA311
      W2(I)=0.                                                       SDATA312
      W1(I) = W2(I)                                                  SDATA313
      TT3(I) = TT2(I)                                                SDATA314
      U3(I) = U2(I)                                                  SDATA315
      V3(I) = V2(I)                                                  SDATA316
      W3(I) = W2(I)                                                  SDATA317
      PP21(I) = PP22(I)                                              SDATA318
      PP11(I) = PP12(I)                                              SDATA319
      PP13(I) = PP12(I)                                              SDATA320
      PP23(I) = PP22(I)                                              SDATA321
    9 CONTINUE                                                       SDATA322
      ICK = ITESTP                                                   SDATA323
      ISTR=0                                                         SDATA324
      LY=1                                                           SDATA325
      C5 = 1.                                                        SDATA326
      C6 = 1.                                                        SDATA327
      GD2 = 0.                                                       SDATA328
      PHI = PHIBOT + XDT1*(JMAX-NS)                                  SDATA329
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      T1= PHI * .017453293                                                  SDATA330
      H= HWEST + (MS-1) * XDT1/COS(T1)                                      SDATA331
      PHIR = T1                                                             SDATA332
      CPH = COS(PHIR)                                                       SDATA333
      SPH = SIN(PHIR)                                                       SDATA334
      SF = 14.584E-5*SIN(T1)                                                SDATA335
      DTSF = DT*SF                                                          SDATA336
      C1 = 3.7943/PA(IP1)                                                   SDATA337
      GSF = G/SF                                                            SDATA338
      GFR =GSF/ROW                                                          SDATA339
      DTA = DT                                                              SDATA340
      DTA2 = 2.*DT                                                          SDATA341
      T10 = XLAM*DEL/2.                                                     SDATA342
      DO 720 I=1,NX                                                         SDATA343
      ZDL2(I) = (ZA(I) + T10) **2                                           SDATA344
  720 CONTINUE                                                              SDATA345
      TK = XK2**2                                                           SDATA346
      DO 725 I=1,IM1                                                        SDATA347
      CK0(I) = TK*ZDL2(I)                                                   SDATA348
  725 CONTINUE                                                              SDATA349
      TK = XK12                                                             SDATA350
      DO 735 I=IP1,NX                                                       SDATA351
      CK0(I) = TK*ZDL2(I)                                                   SDATA352
  735 CONTINUE                                                              SDATA353
      DO 2000I=1,15                                                         SDATA354
 2000 RSUM(I) = 0.                                                          SDATA355
      RANS = 0.                                                             SDATA356
      RABNS = 0.                                                            SDATA357
      RABS = 0.                                                             SDATA358
      CRNS = 0.                                                             SDATA359
      CRS = 0.                                                              SDATA360
      RAA = 0.                                                              SDATA361
      TOUPRA = 0.                                                           SDATA362
      IF(XLAM) 45,99,45                                                     SDATA363
   45 IF(DEL)60,50,60                                                       SDATA364
   50 T6 = Z(IP2)/XLAM                                                      SDATA365
      T6 = ABS(T6)                                                          SDATA366
      B1 = 1./XK1*ALOG(T6)                                                  SDATA367
      T7 = Z(IM1)/XLAM                                                      SDATA368
      T7 = ABS(T7)                                                          SDATA369
   54 B2 = 1./XK1*ALOG(T7)                                                  SDATA370
      GO TO 70                                                              SDATA371
   60 T8 = XLAM/2./PI                                                       SDATA372
      T16=T8**EX2                                                           SDATA373
      T9=SQRT(G)*DEL*T16                                                    SDATA374
      DO 65 I=1,NX                                                          SDATA375
      T10 = -ZA(I)/T8                                                       SDATA376
      CSW(I) = T9*EXP(T10)                                                  SDATA377
   65 CONTINUE                                                              SDATA378
      XKU(IP1) = CK0(IP1)*CSW(IP1)                                          SDATA379
      XKT(IP1) = XKU(IP1)                                                   SDATA380
      XKU(IM1) = CK0(IM1)*CSW(IM1)                                          SDATA381
      XKT(IM1) = XKU(IM1)                                                   SDATA382
   70 CONTINUE                                                              SDATA383
      GO TO 99                                                              SDATA384
  500 CONTINUE                                                              SDATA385
   99 RETURN                                                                SDATA386
    2 FORMAT ( 14I5)                                                        SDATA387
    3 FORMAT(I4,I2,F6.2,5(I3,F5.1,F4.0))                                    SDATA388
    5 FORMAT(I5,4F10.2,2A4)                                                 SDATA389
 1111 FORMAT(' SFC P =',F10.4/' LAMBDA =',F10.4/' DELTA =',F10.4/' SLOPXSDATA390
     1=',F10.4/' SLOPY =',F10.4/' HEIGHT(+)/DEPTH(-) =',F10.4/' THE INPUSDATA391
     2T SURFACE HEIGHT FOR OPEN WATER BOUNDARIES'/' INPUT X-ETA =',F10.4SDATA392
     3/' INPUT Y-ETA =',F10.4/' IANV =',I10//)                           SDATA393
      END                                                                   SDATA394
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      SUBROUTINE TTSQ                                                   TTSQ 000
C     COMPUTE FCN  A  AND SET INDICES                                   TTSQ 001
      INTEGER RDRUM,SDRUM,TDRUM                                         TTSQ 002
      DOUBLE PRECISION Z1,Z2                                            TTSQ 003
      DOUBLE PRECISION AZER(36)                                         TTSQ 004
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     TTSQ 005
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    TTSQ 006
     2   ,WO,WSC,XKT,XYY,YY,GTO                                         TTSQ 007
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        TTSQ 008
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      TTSQ 009
     2   ,TT3(30),W3(30),SST                                            TTSQ 010
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,TTSQ 011
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CETTSQ 012
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2             TTSQ 013
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               TTSQ 014
     1   ,XLAM,RSUM(15),B1,B2                                           TTSQ 015
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    TTSQ 016
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  TTSQ 017
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   TTSQ 018
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  TTSQ 019
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        TTSQ 020
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              TTSQ 021
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         TTSQ 022
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                           TTSQ 023
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)TTSQ 024
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      TTSQ 025
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    TTSQ 026
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) TTSQ 027
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      TTSQ 028
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   TTSQ 029
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     TTSQ 030
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  TTSQ 031
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    TTSQ 032
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           TTSQ 033
     5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                  TTSQ 034
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     TTSQ 035
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                     TTSQ 036
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    TTSQ 037
     2    ,  T13,T14,T15,T16,XD1,YD1                                    TTSQ 038
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                        TTSQ 039
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II TTSQ 040
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     TTSQ 041
     1 ,I1IHT,I4IHT                                                     TTSQ 042
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          TTSQ 043
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     TTSQ 044
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             TTSQ 045
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      TTSQ 046
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      TTSQ 047
      COMMON /GRDNTS / GXY(30,12)                                       TTSQ 048
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     TTSQ 049
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               TTSQ 050
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               TTSQ 051
     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              TTSQ 052
     4  ,CP2X(30),CP2Y(30)                                             TTSQ 053
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))             TTSQ 054
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      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))                TTSQ 055
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))                TTSQ 056
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))                TTSQ 057
      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))               TTSQ 058
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))              TTSQ 059
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))              TTSQ 060
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))              TTSQ 061
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))              TTSQ 062
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))              TTSQ 063
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))              TTSQ 064
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))              TTSQ 065
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))              TTSQ 066
C *******              ***** TTSQ   ******             *******            TTSQ 067
      IF (ITM.GT.1)GO TO 18                                              TTSQ 068
      DO117 I=1,36                                                       TTSQ 069
  117 AZER(I) =0.                                                        TTSQ 070
   18 IF(NVCHS(2).EQ.1)GO TO 41                                          TTSQ 071
C     T--OCEAN                                                           TTSQ 072
      DO110  J=2,IM1                                                     TTSQ 073
      Z1=U2(J)*PTX(J)+V2(J)*PTY(J)                                       TTSQ 074
      FA(J)=-Z1+DT1(J)                                                   TTSQ 075
  110 CONTINUE                                                           TTSQ 076
      I1=1                                                               TTSQ 077
      II=2                                                               TTSQ 078
      IT=IM2                                                             TTSQ 079
      I2=IM3                                                             TTSQ 080
      I3=IM1                                                             TTSQ 081
      I4=1                                                               TTSQ 082
      IF(IGONY.EQ.1) GO TO 146                                           TTSQ 083
      I5 = IT-  IHT+1                                                    TTSQ 084
      IF(IHT.GT.2) GO TO 131                                             TTSQ 085
  146 I5 = IM3                                                           TTSQ 086
      I1 = 1                                                             TTSQ 087
      II = 2                                                             TTSQ 088
  131 CALL CTW(TT1,TT2,TT3,TTO)                                          TTSQ 089
      IF(IGONY.EQ.1) GO TO 145                                           TTSQ 090
C     W=S  OCEAN                                                         TTSQ 091
      DO130 J=2,IM1                                                      TTSQ 092
      Z1=U2(J)*PWX(J)+V2(J)*PWY(J)                                       TTSQ 093
      FA(J)=-Z1                                                          TTSQ 094
  130 CONTINUE                                                           TTSQ 095
      CALL CTW(W1,W2,W3,WO)                                              TTSQ 096
C     W=Q  ATMOSPHERE                                                    TTSQ 097
  145 DO140 J=IP2,NX                                                     TTSQ 098
      Z1=U2(J)*PWX(J)+V2(J)*PWY(J)                                       TTSQ 099
      FA(J)=-Z1                                                          TTSQ 100
  140 CONTINUE                                                           TTSQ 101
   41 I1 = IP1                                                           TTSQ 102
      II=IP2                                                             TTSQ 103
      IT=NM1                                                             TTSQ 104
      I2=NM2                                                             TTSQ 105
      I3=NX                                                              TTSQ 106
      I5=IA                                                              TTSQ 107
      IF(NVCHS(2).EQ.1)GO TO 22                                          TTSQ 108
      CALL CTW(W1,W2,W3,WO)                                              TTSQ 109
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C       T--ATMOSPHERE                                                   TTSQ 110
        DO120 J=IP2,NX                                                  TTSQ 111
        Z1=U2(J)*PTX(J)+V2(J)*PTY(J)                                    TTSQ 112
        Z2=GAM2/(DZ(J)+DZ(J-1))*(XKT(J)-XKT(J-1))                       TTSQ 113
        Z3=U2(J)*SLOPX+V2(J)*SLOPY                                      TTSQ 114
        FA(J)=-Z1+Z2+DT1(J) - VVEL(J) * GAM-Z3*GAM                      TTSQ 115
  120   CONTINUE                                                        TTSQ 116
        CALL CTW(TT1,TT2,TT3,TTO)                                       TTSQ 117
   22   IF(IPOL-1)169,164,161                                           TTSQ 118
  161   DO162 J=IP2,NX                                                  TTSQ 119
        Z1 = U2(J)*XP2(J)+V2(J)*PP2Y(J)                                 TTSQ 120
        Z2 = 0.                                                         TTSQ 121
        IF ((J-IX).GT.6) GO TO 162                                      TTSQ 122
        Z2 = SH2(20)*SH2(J-IX) /(Z(J+1)-Z(J-1))*2./ROA                  TTSQ 123
  162   FA(J) = -Z1+Z2                                                  TTSQ 124
        CALL CTW (PP21,PP22,PP23,AZER)                                  TTSQ 125
  164   DO165 J=IP2,NX                                                  TTSQ 126
        Z1 = U2(J)*XP1(J)+V2(J)*PP1Y(J)                                 TTSQ 127
        Z2 = 0.                                                         TTSQ 128
        IF ((J-IX).GT.6) GO TO 165                                      TTSQ 129
        Z2 = SH1(20)*SH1(J-IX) /(Z(J+1)-Z(J-1))*2./ROA                  TTSQ 130
  165   FA(J) = -Z1+Z2                                                  TTSQ 131
        CALL CTW (PP11,PP12,PP13,AZER)                                  TTSQ 132
  169   CONTINUE                                                        TTSQ 133
        RETURN                                                          TTSQ 134
C *******               ***** GWC    ******             *******         TTSQ 135
        ENTRY GWC                                                       TTSQ 136
C       COMPUTE GEOSTROPHIC WINDS AND CURRENTS                          TTSQ 137
        DIMENSION SX(30),SY(30)                                         TTSQ 138
        EQUIVALENCE (A(1),SX(1)),(B(1),SY(1))                           TTSQ 139
C       STORE SCALED T AND W TEMPORARILY                                TTSQ 140
        DO310 I=IP3,NP1                                                 TTSQ 141
        T1 = DZ(I-1)/TT2(I)**2                                          TTSQ 142
        SX(I) = T1*GXY(I,3)                                             TTSQ 143
        SY(I) = T1*GXY(I,9)                                             TTSQ 144
  310   CONTINUE                                                        TTSQ 145
        CALL LINEAR (ITM,ICUV,4,NTCUV,J,XOCU,CU(IX),XOCV,CV(IX),XACU,   TTSQ 146
       1   CU(NP1),XACV,CV(NP1))                                        TTSQ 147
        CUT = CU(NP1)/TTO(NP1)                                          TTSQ 148
        CVT = CV(NP1)/TTO(NP1)                                          TTSQ 149
        DO330 J=IP2,NX                                                  TTSQ 150
        SUMX = 0.                                                       TTSQ 151
        SUMY = 0.                                                       TTSQ 152
  315   J1=J+1                                                          TTSQ 153
        DO320 I=J1,NP1                                                  TTSQ 154
        SUMX = SUMX + SX(I)                                             TTSQ 155
        SUMY = SUMY + SY(I)                                             TTSQ 156
  320   CONTINUE                                                        TTSQ 157
        T1 = GSF*TT2(J)                                                 TTSQ 158
        TX = T1*SUMX                                                    TTSQ 159
        TY = T1*SUMY                                                    TTSQ 160
        CU(J) = CUT*TT2(J) + TY                                         TTSQ 161
        CV(J) = CVT*TT2(J) - TX                                         TTSQ 162
  330   CONTINUE                                                        TTSQ 163
        GO TO (399,  1,1,399), IGOGO                                    TTSQ 164
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    1 IF(IHT.GT.1) GO TO 850                                              TTSQ 165
      XETA2 = CV(IX)/GSF                                                  TTSQ 166
      YETA2 =-CU(IX)/GSF                                                  TTSQ 167
      GO TO 851                                                           TTSQ 168
  850 CV(IX) = GSF * XETA2                                                TTSQ 169
      CU(IX) = -GSF * YETA2                                               TTSQ 170
  851 DO340 I=2,IX                                                        TTSQ 171
      T3 =(CTY(I) + CTY(I-1))/2.                                          TTSQ 172
      T4 =(CWY(I) + CWY(I-1))/2.                                          TTSQ 173
      T1 = PST(I-1)*T3 + PSS(I-1)*T4                                      TTSQ 174
      T5 = (CTX(I) + CTX(I-1))/2.                                         TTSQ 175
      T6 = (CWX(I) + CWX(I-1))/2.                                         TTSQ 176
      T2 = PST(I-1)*T5 + PSS(I-1)*T6                                      TTSQ 177
      SX(I) = .001*T2*DZ(I-1)                                             TTSQ 178
      SY(I) = .001*T1*DZ(I-1)                                             TTSQ 179
  340 CONTINUE                                                            TTSQ 180
      DO350 K=2,IX                                                        TTSQ 181
      I=IX-K+1                                                            TTSQ 182
      SUMX = 0.                                                           TTSQ 183
      SUMY = 0.                                                           TTSQ 184
      DO345 J=I,IM1                                                       TTSQ 185
      SUMX = SUMX + SX(J+1)                                               TTSQ 186
      SUMY = SUMY + SY(J+1)                                               TTSQ 187
  345 CONTINUE                                                            TTSQ 188
      CU(I) = CU(IX) + GFR*SUMY                                           TTSQ 189
      CV(I) = CV(IX) - GFR*SUMX                                           TTSQ 190
  350 CONTINUE                                                            TTSQ 191
  399 RETURN                                                              TTSQ 192
C *******              ***** CUV    ******             *******             TTSQ 193
      ENTRY CUV                                                           TTSQ 194
C     COMPUTE U AND V COEFFICIENTS FOR GAUSSIAN ELIMINATION SCHEME        TTSQ 195
      A(I1) = 0.                                                          TTSQ 196
      Z1 = DT2/(DZ(I1) + DZ(II))                                          TTSQ 197
      Z2 = XKU(I1)/DZ(I1)                                                 TTSQ 198
      Z3 = XKU(II)/DZ(II)                                                 TTSQ 199
      BR(I1) = C5 + Z1*(Z3 + Z2)                                          TTSQ 200
      BG     = -DTSF                                                      TTSQ 201
      C(I1) = -Z1*Z3                                                      TTSQ 202
      IF(I1-1) 111,111,12                                                 TTSQ 203
  111 IF(IHT.EQ.1) GO TO 11                                               TTSQ 204
   35 IIHT = IHT -1                                                       TTSQ 205
      DO 36 I=I,IIHT                                                      TTSQ 206
      U3(I) = 0.                                                          TTSQ 207
   36 V3(I) = 0.                                                          TTSQ 208
      GO TO 13                                                            TTSQ 209
   11 U3(I1) = U2(I1) + DTSF * (V2(I1)-CV(I1))                            TTSQ 210
      V3(I1) = V2(I1) + DTSF * (CU(I1)-U2(I1))                            TTSQ 211
      GO TO 13                                                            TTSQ 212
   12 U3(IT+2) = CU(IT+2)                                                 TTSQ 213
      V3(IT+2) = CV(IT+2)                                                 TTSQ 214
   13 Z4 = C6 * U2(II) - DTSF * CV(II) - GD2 * U1(II)                     TTSQ 215
     1 - DT * (U2(II) * PUX(II) + V2(II) * PUY(II))                       TTSQ 216
      Z5 = Z1*Z2*U2(I1)                                                   TTSQ 217
      Z6 = C6*V2(II) + DTSF*CU(II) - GD2*V1(II)                           TTSQ 218
     1 - DT * (U2(II) * PVX(II) + V2(II) * PVY(II))                       TTSQ 219
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      Z7 = Z1*Z2*V2(I1)                                                 TTSQ 220
      F(I1,1) = Z4 + Z5                                                 TTSQ 221
      F(I1,2) = Z6 + Z7                                                 TTSQ 222
      DO 30 I=II,IT                                                     TTSQ 223
      Z1 = DT2/(DZ(I) + DZ(I+1))                                        TTSQ 224
      Z2 = XKU(I)/DZ(I) + 0.5*VVEL(I+1)                                 TTSQ 225
      Z3 = XKU(I+1)/DZ(I+1) - 0.5*VVEL(I+1)                             TTSQ 226
      A(I) = -Z1*Z2                                                     TTSQ 227
      BR(I) = C5 + Z1*(Z3 + Z2)                                         TTSQ 228
      C(I) = -Z1*Z3                                                     TTSQ 229
      F(I,1) = C6*U2(I+1) - DTSF*CV(I+1) - GD2*U1(I+1)                  TTSQ 230
     1 - DT * (U2(I+1)* PUX(I+1)+ V2(I+1)* PUY(I+1))                    TTSQ 231
      F(I,2) = C6*V2(I+1) + DTSF*CU(I+1) - GD2*V1(I+1)                  TTSQ 232
     1 - DT * (U2(I+1)* PVX(I+1)+ V2(I+1)* PVY(I+1))                    TTSQ 233
   30 CONTINUE                                                          TTSQ 234
      C(IT) = 0.                                                        TTSQ 235
      F(IT,1) = F(IT,1) + Z1*Z3*U2(IT+2)                                TTSQ 236
      F(IT,2) = F(IT,2) + Z1*Z3*V2(IT+2)                                TTSQ 237
      Z1 = 1./(BR(I1)**2 + BG**2)                                       TTSQ 238
      E(I1,1,1) = Z1*BR(I1)                                             TTSQ 239
      E(I1,1,2) = -Z1*BG                                                TTSQ 240
      E(I1,2,1) = -E(I1,1,2)                                            TTSQ 241
      E(I1,2,2) = E(I1,1,1)                                             TTSQ 242
      FST(I1,1) = E(I1,1,1)*F(I1,1) + E(I1,1,2)*F(I1,2)                 TTSQ 243
      FST(I1,2) = E(I1,2,1)*F(I1,1) + E(I1,2,2)*F(I1,2)                 TTSQ 244
      E(I1,1,1) = -C(I1)*E(I1,1,1)                                      TTSQ 245
      E(I1,1,2) = -C(I1)*E(I1,1,2)                                      TTSQ 246
      E(I1,2,1) = -E(I1,1,2)                                            TTSQ 247
      E(I1,2,2) = E(I1,1,1)                                             TTSQ 248
      DO 5 I=II,I2                                                      TTSQ 249
      Z1 = A(I)*E(I-1,1,1) + BR(I)                                      TTSQ 250
      Z2 = A(I)*E(I-1,1,2) + BG                                         TTSQ 251
      Z3 = Z1**2 + Z2**2                                                TTSQ 252
      R(I,1,1) = Z1/Z3                                                  TTSQ 253
      R(I,1,2) = -Z2/Z3                                                 TTSQ 254
      R(I,2,1) = -R(I,1,2)                                              TTSQ 255
      R(I,2,2) = R(I,1,1)                                               TTSQ 256
      E(I,1,1) = -R(I,1,1)*C(I)                                         TTSQ 257
      E(I,1,2) = -R(I,1,2)*C(I)                                         TTSQ 258
      E(I,2,1) = -E(I,1,2)                                              TTSQ 259
      E(I,2,2) = E(I,1,1)                                               TTSQ 260
    5 CONTINUE                                                          TTSQ 261
      Z1 = A(IT)*E(I2,1,1) + BR(IT)                                     TTSQ 262
      Z2 = A(IT)*E(I2,1,2) + BG                                         TTSQ 263
      Z3 = Z1**2 + Z2**2                                                TTSQ 264
      R(IT,1,1) = Z1/Z3                                                 TTSQ 265
      R(IT,1,2) = -Z2/Z3                                                TTSQ 266
      R(IT,2,1) = -R(IT,1,2)                                            TTSQ 267
      R(IT,2,2) = R(IT,1,1)                                             TTSQ 268
      DO 10 I=II,IT                                                     TTSQ 269
      F(I,1) = F(I,1) - A(I)*FST(I-1,1)                                 TTSQ 270
      F(I,2) = F(I,2) - A(I)*FST(I-1,2)                                 TTSQ 271
      FST(I,1) = R(I,1,1)*F(I,1) + R(I,1,2)*F(I,2)                      TTSQ 272
      FST(I,2) = R(I,2,1)*F(I,1) + R(I,2,2)*F(I,2)                      TTSQ 273
   10 CONTINUE                                                          TTSQ 274
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      U3(I3) = FST(IT,1)                                              TTSQ 275
      V3(I3) = FST(IT,2)                                              TTSQ 276
      DO 20 I=I4,I5                                                   TTSQ 277
      NR=IT-I                                                         TTSQ 278
      EU3 = E(NR,1,1) *U3(NR+2)                                       TTSQ 279
       EV3 = E(NR,1,2) *V3(NR+2)                                      TTSQ 280
      U3(NR+1)=EU3+EV3+FST(NR,1)                                      TTSQ 281
      EU3 = E(NR,2,1) *U3(NR+2)                                       TTSQ 282
      EV3 = E(NR,2,2) * V3(NR+2)                                      TTSQ 283
      V3(NR+1)=EU3+EV3+FST(NR,2)                                      TTSQ 284
   20 CONTINUE                                                        TTSQ 285
   99 CONTINUE                                                        TTSQ 286
      RETURN                                                          TTSQ 287
      END                                                             TTSQ 288
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      SUBROUTINE EXCK                                                   EXCK 000
      INTEGER RDRUM,SDRUM,TDRUM                                         EXCK 001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     EXCK 002
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    EXCK 003
     2   ,WO,WSC,XKT,XYY,YY,GTO                                         EXCK 004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        EXCK 005
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      EXCK 006
     2   ,TT3(30),W3(30),SST                                           EXCK 007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,EXCK 008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CEEXCK 009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2            EXCK 010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL               EXCK 011
     1   ,XLAM,RSUM(15),B1,B2                                          EXCK 012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    EXCK 013
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  EXCK 014
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   EXCK 015
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  EXCK 016
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        EXCK 017
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              EXCK 018
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         EXCK 019
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                           EXCK 020
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)EXCK 021
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      EXCK 022
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    EXCK 023
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) EXCK 024
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      EXCK 025
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   EXCK 026
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     EXCK 027
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  EXCK 028
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    EXCK 029
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           EXCK 030
     5  ,NWSYY,NTOP1,DELH,    TW,INEW,ITAPE,IRAT,INEWC                  EXCK 031
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     EXCK 032
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                    EXCK 033
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    EXCK 034
     2     ,  T13,T14,T15,T16,XD1,YD1                                  EXCK 035
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                       EXCK 036
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II EXCK 037
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     EXCK 038
     1 ,I1IHT,I4IHT                                                     EXCK 039
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          EXCK 040
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     EXCK 041
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))             EXCK 042
      DOUBLE PRECISION AA(9)                                            EXCK 043
C     PST  AND  PSS  TABLES FOR TALOP  REPLACED BY -AA-                 EXCK 044
      DATA AA/0.79701864,0.131710842E-03,-0.611831499E-07,.588194023E-01EXCK 045
     X,-0.25310441E-02,0.287971530E-05,-0.811465413E-02,0.389187483E-04,EXCK 046
     X.47660041E-04/                                                    EXCK 047
 3000 DO 1  I=1,NP1                                                     EXCK 048
      IF (DABS(U2(I)).LT.( 1.E-35))  U2(I)=0.                           EXCK 049
      IF (DABS(V2(I)).LT.( 1.E-35))  V2(I)=0.                           EXCK 050
   86 T1=U2(I)**2 + V2(I)**2                                            EXCK 051
      WS(I) = SQRT(T1)                                                  EXCK 052
    1 CONTINUE                                                          EXCK 053
      IF(XLAM)106,105,106                                               EXCK 054
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  105 W9=WS(IZW)*A1+WS(IZW1)*A2                                          EXCK 055
  401 HBAR=1.54165E-04*(W9**2)                                          EXCK 056
      H3=1.39536*HBAR                                                   EXCK 057
  405 T23 = SQRT(G)                                                     EXCK 058
  403 DO 100  I=1,NP1                                                   EXCK 059
      T21=HBAR/(DEL*2.*PI)                                              EXCK 060
      IF(T21)1001,1001,1002                                             EXCK 061
 1001 CSW(I)=0.                                                         EXCK 062
      GO TO 100                                                         EXCK 063
 1002 T22=1./SQRT(T21)                                                  EXCK 064
      T24=-ZA(I)*2.*PI*DEL/HBAR                                         EXCK 065
      IF (T24+75.) 300,301,301                                          EXCK 066
  300 CSW(I)=0.                                                         EXCK 067
      GO TO 100                                                         EXCK 068
  301 CSW(I)=T23*T22*EXP(T24)*DEL                                       EXCK 069
  100 CONTINUE                                                          EXCK 070
      TK=XK2**2                                                         EXCK 071
  407 DO 101  I=1,IM1                                                   EXCK 072
      T25=ZA(I)+HBAR/2.                                                 EXCK 073
      CKO(I)=TK*(T25**2)                                                EXCK 074
  101 CONTINUE                                                          EXCK 075
  409 DO 102  I=IP1,NX                                                  EXCK 076
      T26 = ZA(I)+HBAR/2.                                               EXCK 077
      CKO(I)=XK12*(T26**2)                                              EXCK 078
  102 CONTINUE                                                          EXCK 079
  411 XKU(IP1)=CKO(IP1)*CSW(IP1)                                        EXCK 080
      XKT(IP1)=XKU(IP1)                                                 EXCK 081
      XKU(IM1)=CKO(IM1)*CSW(IM1)                                        EXCK 082
      XKT(IM1)=XKU(IM1)                                                 EXCK 083
  106 J2=IM2                                                            EXCK 084
      IMA =   IHT - 1                                                   EXCK 085
      IF(IMA.EQ.0) IMA=1                                                EXCK 086
      IIPP1 = IP1-IMA  + 1                                              EXCK 087
      GO TO(412,413,413,412),IGOGO                                      EXCK 088
  412 IMA = IP1                                                         EXCK 089
      IIPP1 = IP1                                                       EXCK 090
      J2 = NX                                                           EXCK 091
  413 DO 41 J=IMA,IP2,IIPP1                                             EXCK 092
      DO 40 I=J,J2                                                      EXCK 093
      T1 = (U2(I+1) - U2(I))/DZ(I)                                      EXCK 094
      IF (ABS(T1) .LT.(1.E-35))  T1 = 0.                                EXCK 095
  131 T1 = T1**2                                                        EXCK 096
  132 T2 = (V2(I+1) - V2(I))/DZ(I)                                      EXCK 097
      IF (ABS(T2) .LT.(1.E-35))  T2 = 0.                                EXCK 098
  141 T2 = T2**2                                                        EXCK 099
  142 T3 = T1 + T2                                                      EXCK 100
      XCS =  SQRT(T3)                                                   EXCK 101
      IF (I.EQ.1) CSOUT(1) = XCS                                        EXCK 102
      IF (I.EQ.NX)CSOUT(2) = XCS                                        EXCK 103
      TB =  (TT2(I+1)+TT2(I))/2.+TBO(I)                                 EXCK 104
      T6 = XCS   + CSW(I)                                               EXCK 105
      T7 = T6**2                                                        EXCK 106
      T6 = CKO(I)*T6                                                    EXCK 107
      CL =  (TT2(I+1)-TT2(I))/DZ(I)                                     EXCK 108
    3 IF(I-IX)6,40,4                                                    EXCK 109
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C  ATMOSPHERIC                                                          EXCK 110
    4 CL = CL+GAM+GTO(I)+.00061*TB*((W2(I+1)-W2(I))/DZ(I)+GWO(I))       EXCK 111
      T7 = TB*T7                                                       EXCK 112
      T11= G*CL/TB                                                     EXCK 113
      T12 = HK2*CK0(I)                                                 EXCK 114
      TEST = RALF                                                      EXCK 115
      GO TO 8                                                          EXCK 116
C  OCEANIC                                                             EXCK 117
    6 SB = (W2(I+1)+W2(I))/2.+WBO(I)                                   EXCK 118
      TTB= TB-273.16                                                   EXCK 119
      PST(I) = AA(4)+2.*AA(7)*TTB+AA(5)*SB    +3.*AA(9)*TTB**2 +       EXCK 120
     X 2.*AA(8)*SB    *TTB + AA(6)*SB    **2                          EXCK 121
      PSS(I) = AA(1)+AA(5)*TTB+2.*AA(2)*SB    +AA(8)*TTB**2+2.*AA(6)*  EXCK 122
     X SB    *TTB + 3.*AA(3)*SB    **2                                 EXCK 123
      IF (SB.LE.0)  PSS(I)=0.                                          EXCK 124
      T4 = PST(I)*CL+PST(I)*GTO(I)                                     EXCK 125
      T5 = PSS(I)*(W2(I+1) - W2(I))/DZ(I)+PSS(I)*GWO(I)                EXCK 126
      CL = -.001*(T4+T5)                                               EXCK 127
      T11 = G*CL                                                       EXCK 128
      TEST = 1.E16                                                     EXCK 129
      T12 = HK2 * ZDL2(I)                                              EXCK 130
    8 IF(T7)1003,1003,1004                                             EXCK 131
 1003 IF (CL) 35,19,10                                                 EXCK 132
 1004 IF (CL) 1030,19,1031                                             EXCK 133
   19 RI(I) = 0.                                                       EXCK 134
      GO TO 15                                                         EXCK 135
C     CHECK MAGNITUDE OF CL(I)/T7 TO RESTRICT OVERFLOW EXCEPTION       EXCK 136
 1030 CLL1 = ABS(CL)                                                   EXCK 137
      CLL=ALOG10(CLL1)                                                 EXCK 138
      GO TO 1032                                                       EXCK 139
 1031 CLL  = ALOG10(CL)                                                EXCK 140
 1032 T7L=ALOG10(T7)                                                   EXCK 141
      CHECK1 = CLL-T7L                                                 EXCK 142
      IF(CHECK1-13.)1024,10,10                                         EXCK 143
 1024 RI(I)= G*CL/T7                                                   EXCK 144
      IF(RI(I)-TEST)15,15,10                                           EXCK 145
   10 RI(I) = TEST                                                     EXCK 146
   15 IF(RI(I))25,20,20                                                EXCK 147
C  RI G.T. ZERO                                                        EXCK 148
   20 IF(I-IX)21,21,22                                                 EXCK 149
C  OCEANIC                                                             EXCK 150
   21 EV = BETV                                                        EXCK 151
      ET = BETT                                                        EXCK 152
      XV = -XNV                                                        EXCK 153
      XT = -XNT                                                        EXCK 154
      GO TO 23                                                         EXCK 155
C  ATMOSPHERIC                                                         EXCK 156
   22 EV = ALF                                                         EXCK 157
      ET = ALF                                                         EXCK 158
      XV = 2.                                                          EXCK 159
      XT = 2.                                                          EXCK 160
   23 T8 = (1. + EV*RI(I))**XV                                         EXCK 161
      T9 = (1. + ET*RI(I))**XT                                         EXCK 162
      XKU(I) = T6*T8                                                   EXCK 163
      XKT(I) = T6*T9                                                   EXCK 164
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      GO TO 40                                                          EXCK 165
   25 IF(RI(I) + RC)35,35,30                                            EXCK 166
C  RI G.T. -RC, AND L.T. ZERO                                          EXCK 167
   30 T10 = 1. - ALF*RI(I)                                              EXCK 168
      XKU(I) = T6/T10**2                                                EXCK 169
      XKT(I) = XKU(I)/T10                                               EXCK 170
      GO TO 40                                                          EXCK 171
C  RI L.E. -RC                                                          EXCK 172
   35 T11 = ABS(T11)                                                    EXCK 173
      XKT(I) = T12*SQRT(T11)                                            EXCK 174
      IF(T7)1006,1006,1007                                              EXCK 175
 1006 XKU(I)=0.                                                         EXCK 176
      GO TO 40                                                          EXCK 177
 1007 T13 = ABS(RI(I))                                                  EXCK 178
      T13 = T13**EX6                                                    EXCK 179
      XKU(I) = XKT(I)*C32*T13                                           EXCK 180
   40 CONTINUE                                                          EXCK 181
      J2=NX                                                             EXCK 182
   41 CONTINUE                                                          EXCK 183
C  SET LIMITS ON ATMOSPHIC . K                                          EXCK 184
      T13 = 1.E7                                                        EXCK 185
      TEST = 100.                                                       EXCK 186
  415 DO 60 I=IP1,NX                                                    EXCK 187
      IF (ZA(I).GE.(1.E4)) TEST=1.E4                                    EXCK 188
      IF (XKU(I).LT.TEST)  XKU(I) = TEST                                EXCK 189
      IF (XKT(I).LT.TEST)  XKT(I) = TEST                                EXCK 190
      IF (XKT(I).GT.T13)   XKT(I) = T13                                 EXCK 191
      IF (XKU(I).GT.T13)   XKU(I) = T13                                 EXCK 192
   60 CONTINUE                                                          EXCK 193
C     SET LIMITS ON OCEANIC K                                           EXCK 194
 1009 DO 1013  I=1,IM1                                                  EXCK 195
      IF(XKT(I)-.0014)1011,1011,1017                                    EXCK 196
 1017 IF(XKU(I)-.014) 1012,1012,1013                                    EXCK 197
 1011 XKT(I)=.0014                                                      EXCK 198
 1012 XKU(I)=.0140                                                      EXCK 199
 1013 CONTINUE                                                          EXCK 200
   99 RETURN                                                            EXCK 201
      END                                                               EXCK 202
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      SUBROUTINE BIV                                                          BIV  000
      INTEGER RDRUM,SDRUM,TDRUM                                               BIV  001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12           BIV  002
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3         BIV  003
     2   ,WO,WSC,XKT,XYY,YY,GTO                                              BIV  004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)              BIV  005
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)           BIV  006
     2   ,TT3(30),W3(30),SST                                                 BIV  007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,BIV  008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CEBIV  009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2               BIV  010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL                     BIV  011
     1   ,XLAM,RSUM(15),B1,B2                                                BIV  012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)          BIV  013
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)       BIV  014
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2        BIV  015
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)       BIV  016
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)             BIV  017
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF                   BIV  018
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV              BIV  019
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                                 BIV  020
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)BIV  021
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)            BIV  022
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)         BIV  023
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30)      BIV  024
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                            BIV  025
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6         BIV  026
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3          BIV  027
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME       BIV  028
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2         BIV  029
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2                BIV  030
     5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                        BIV  031
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL           BIV  032
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                          BIV  033
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20          BIV  034
     2     ,  T13,T14,T15,T16,XD1,YD1                                        BIV  035
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                             BIV  036
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II BIV  037
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)           BIV  038
     1 , I1IHT,I4IHT                                                         BIV  039
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)                BIV  040
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))           BIV  041
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))                   BIV  042
C *******              ***** BIV    ******              *******                BIV  043
      T41 = TT2(IP1) - 273.16 + TTO(IP1)                                      BIV  044
      T21 = TT2(IP1) -  35.66 + TTO(IP1)                                      BIV  045
      T31 = 3.0   + 7.5  *T41/T21                                             BIV  046
      QSG = C1*10.**T31                                                       BIV  047
C     COMPUTE  W  SCALE FACTORS AT INTERFACE IN INITIAL TIME STEP             BIV  048
      IF (ITM-1) 1,2,2                                                        BIV  049
    1 IF (IGONY) 111,111,112                                                  BIV  050
  111 WO(IP1) = QSG                                                           BIV  051
  112 W2(IP1) =0.0                                                            BIV  052
      DWO(IP1)=WO(IP2)-WO(IP1)                                                BIV  053
      GWO(IP1)=DWO(IP1)/Z(IP2)                                                BIV  054
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      GO TO 11                                                          BIV  055
    2 W2(IP1)=QSG*XMQ+(1.-XMQ)*(W2(IP2)+WO(IP2))-WO(IP1)                BIV  056
   11 IF(DEL)20,40,20                                                   BIV  057
C  SEC.  3.3.1                                                         BIV  058
   20 T1 = ROA*XKU(IP1) / DZ(IP1)                                       BIV  059
      T2 = ROW*XKU(IM1) / DZ(IM1)                                       BIV  060
      T3 = T1*U2(IP2) + T2*U2(IM1)                                      BIV  061
      T4 = T1*V2(IP2) + T2*V2(IM1)                                      BIV  062
      T5 = T1 + T2                                                      BIV  063
      U2(IX) = T3/T5                                                    BIV  064
      V2(IX) = T4/T5                                                    BIV  065
      GO TO (60,61,64,60),IGOGO                                         BIV  066
   61 IF(IANV.EQ.1) GO TO 62                                            BIV  067
      U2(IX)= 0.0                                                       BIV  068
      U2(IP1) = U2(IX)                                                  BIV  069
      V2(IP1) = V2(IX)                                                  BIV  070
      GO TO 70                                                          BIV  071
   62 V2(IX) = 0.0                                                      BIV  072
      V2(IP1) = V2(IX)                                                  BIV  073
      U2(IP1) = U2(IX)                                                  BIV  074
      GO TO 70                                                          BIV  075
   60 U2(IX) =0.0                                                       BIV  076
      U2(IP1) = 0.0                                                     BIV  077
      V2(IX) = 0.0                                                      BIV  078
      V2(IP1) = 0.0                                                     BIV  079
      GO TO 70                                                          BIV  080
   64 U2(IP1) = U2(IX)                                                  BIV  081
      V2(IP1) = V2(IX)                                                  BIV  082
   70 T10 = U2(IX)**2 + V2(IX)**2                                       BIV  083
      WS(IX) = SQRT(T10)                                                BIV  084
      WS(IP1) = WS(IX)                                                  BIV  085
 1001 T8 = 1. - (W2(IM1) + WO(IM1)) * 1.E-3                             BIV  086
      IF(ITM.EQ.0) CE = 0.                                              BIV  087
      CF=W2(IM1)*CE/T8+WO(IM1)*CE/T8                                    BIV  088
      T9 = +CF/ROW/XKT(IM1)                                             BIV  089
   30 W2(IX) = T9 * DZ(IM1) + W2(IM1) - DWO(IM1)                        BIV  090
      IF(ITM-1)32,99,99                                                 BIV  091
   32 WO(IX) = T9 * DZ(IM1) + WO(IM1)                                   BIV  092
      W2(IX) = 0.0                                                      BIV  093
      DWO(IM1) = WO(IX) - WO(IM1)                                       BIV  094
      GWO(IM1) = DWO(IM1) /(-Z(IM1))                                    BIV  095
   31 GO TO 99                                                          BIV  096
C  SEC.  3.3.2                                                         BIV  097
   40 CONTINUE                                                          BIV  098
      T3 = B1 + SQRT(ROA/ROW) * B2                                      BIV  099
      T4 = WS(IP2) - WS(IM1)                                            BIV  100
      IF(XLAM) 41,41,42                                                 BIV  101
   41 UST = WS(IP2)/ B1                                                 BIV  102
      GO TO ( 141,141,141,142),IGOGO                                    BIV  103
  142 WS(IX) = 0.                                                       BIV  104
      GO TO 43                                                          BIV  105
  141  WS(IX) = WS(IM1) + SQRT(ROA/ROW) * UST * B2                      BIV  106
      GO TO 43                                                          BIV  107
   42 UST = T4/T3                                                       BIV  108
      WS(IX) = WS(IP2)-UST*B1                                           BIV  109
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   43 WS(IP1) = WS(IX)                                                    BIV  110
      T5 = WS(IP2) - WS(IX)                                               BIV  111
      T6 = T5/T4                                                          BIV  112
      U2(IX) = U2(IP2) - (U2(IP2) - U2(IM1))*T6                           BIV  113
      V2(IX) = V2(IP2) - (V2(IP2) - V2(IM1))*T6                           BIV  114
      IF(IGONY.EQ.0) GO TO 44                                             BIV  115
      U2(IX) = 0.                                                         BIV  116
      V2(IX) = 0.                                                         BIV  117
   44 U2(IP1) = U2(IX)                                                    BIV  118
      V2(IP1) = V2(IX)                                                    BIV  119
      QST = (W2(IP2) - W2(IP1))/B1+DWO(IP1)/B1                            BIV  120
      T7 = ABS(UST)                                                       BIV  121
      IF(ITM.EQ.0) RAINX=0.                                               BIV  122
      CE =(-ROA*T7*QST/1000.)-RAINX                                       BIV  123
      T8 = 1. - (W2(IM1) + WO(IM1)) * 1.E-3                               BIV  124
      CF = W2(IM1)*CE/T8+WO(IM1)*CE/T8                                    BIV  125
      XKU(IP1) = UST**2 * DZ(IP1) / WS(IP2)                               BIV  126
      XKT(IP1) = XKU(IP1)                                                 BIV  127
      IF(IGONY.GT.0) GO TO 99                                             BIV  128
   49 XKU(IM1) = UST**2 * DZ(IM1) / ABS(WS(IX)-WS(IM1)) * (ROA/ROW)       BIV  129
      XKT(IM1) = XKU(IM1)                                                 BIV  130
      SST = CF/SQRT(ROW*ROA)/T7                                           BIV  131
   50 W2(IX) = W2(IM1) + SST*B2 - DWO(IM1)                                BIV  132
   51 IF(ITM-1)52,99,99                                                   BIV  133
   52 WO(IX) = CF/ROW/XKT(IM1)*DZ(IM1)+WO(IM1)                            BIV  134
      W2(IX) = 0.0                                                        BIV  135
      DWO(IM1) = WO(IX) - WO(IM1)                                         BIV  136
      GWO(IM1) = DWO(IM1) /(-Z(IM1))                                      BIV  137
   99 IF (IPOL-1) 999,992,990                                             BIV  138
  990 CALL LINEAR (ITM,ITS2,1,ISSI2,L,SOU2,T2,T4,T4,T4,T4,T4,T4)          BIV  139
      SH2(20) = T2                                                        BIV  140
      T2 = SH2(1) * T2                                                    BIV  141
      PP22(IP1) = T2*DZ(IP1)/XKT(IP1)/ROA+PP22(IP2)                       BIV  142
  992 CALL LINEAR (ITM,ITS1,1,ISSI1,L,SOU1,T1,T4,T4,T4,T4,T4,T4)          BIV  143
      SH1(20) = T1                                                        BIV  144
      T1 = SH1(1) * T1                                                    BIV  145
      PP12(IP1) = T1*DZ(IP1)/XKT(IP1)/ROA+PP12(IP2)                       BIV  146
  999 RETURN                                                              BIV  147
C *******              ***** CTW    ******              *******            BIV  148
      ENTRY CTW(X1,X2,X3,XO)                                              BIV  149
C     COMPUTE COEFFICIENTS FOR T,W IN ATMOSPHERE OR OCEAN                 BIV  150
      DOUBLE PRECISION Z1,Z2,Z3,AD,AAD,AAAD                               BIV  151
      DOUBLE PRECISION X1,X2,X3,XO,CX                                     BIV  152
      DIMENSION X1(1),X2(1),X3(1),XO(1)                                   BIV  153
      A(I1)=0.                                                            BIV  154
      Z1=DT2/(DZ(II)+DZ(I1))                                              BIV  155
      Z2=XKT(I1)/DZ(I1) + 0.5*VVEL(II)                                    BIV  156
      Z3=XKT(II)/DZ(II) - 0.5*VVEL(II)                                    BIV  157
      C(I1)=-Z1*Z3                                                        BIV  158
      B(I1)=C5+Z1*(Z3+Z2)                                                 BIV  159
      AD=C6*X2(II)+Z2*Z1*(X2(I1)+XO(I1))-GD2*(X1(II))                     BIV  160
      AAD=DT*FA(II)                                                       BIV  161
      AAAD=(B(I1)-C5)*XO(II)+C(I1)*XO(II+1)                               BIV  162
      D(I1)=AD+AAD-AAAD                                                   BIV  163
      DO210  J=II,IT                                                      BIV  164
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      Z1=DT2/(DZ(J+1)+DZ(J))                                          BIV  165
      Z2=XKT(J)/DZ(J)  + 0.5*VVEL(J+1)                                BIV  166
      Z3=XKT(J+1)/DZ(J+1) - 0.5*VVEL(J+1)                             BIV  167
      A(J)=-Z1*Z2                                                     BIV  168
      C(J)=-Z1*Z3                                                     BIV  169
      B(J)=C5+Z1*(Z3+Z2)                                              BIV  170
      D(J)=C6*X2(J+1)-GD2*X1(J+1)+DT*FA(J+1)                          BIV  171
      D(J)=D(J)-(A(J)*XO(J)+(B(J)-C5)*XO(J+1)+C(J)*XO(J+2))           BIV  172
  210 CONTINUE                                                        BIV  173
      D(IT)=D(IT)+Z1*Z3*(X2(IT+2)+XO(IT+2))+C(IT)*XO(IT+2)            BIV  174
      C(IT)=0.                                                        BIV  175
      CST(I1)=-C(I1)/B(I1)                                            BIV  176
      DST(I1)=D(I1)/B(I1)                                             BIV  177
      DO211 J=I1,I2                                                   BIV  178
      Z1=A(J)*CST(J-1)+B(J)                                           BIV  179
      CST(J)=-C(J)/Z1                                                 BIV  180
      Z2=D(J)-A(J)*DST(J-1)                                           BIV  181
  211 DST(J) = Z2/Z1                                                  BIV  182
      Z1=D(IT)-A(IT)*DST(I2)                                          BIV  183
      Z2=A(IT)*CST(I2)+B(IT)                                          BIV  184
      X3(I3)=Z1/Z2                                                    BIV  185
      IF(IGONY.GT.0) GO TO 212                                        BIV  186
      IF (IHT.EQ.1) GO TO 212                                         BIV  187
      IIHT = IHT -1                                                   BIV  188
      DO 256 I=1,IIHT                                                 BIV  189
  256 X3(I) = 0.                                                      BIV  190
  212 DO221 J=I4,I5                                                   BIV  191
      NR=IT-J                                                         BIV  192
      CX = CST(NR) * X3(NR+2)                                         BIV  193
  221 X3(NR+1) = CX + DST(NR)                                         BIV  194
      RETURN                                                          BIV  195
      END                                                             BIV  196
```

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      SUBROUTINE TEMPRT                                                 TMPRT000
      INTEGER RDRUM,SDRUM,TDRUM                                         TMPRT001
      DOUBLE PRECISION A,B,C,CST,D,DTO,DWO,DST,DT1,FA,GWO,PP11,PP12     TMPRT002
     1   ,PP13,PP21,PP22,PP23,SST,TT1,TT2,TT3,TTO,TSC,U2,V2,W1,W2,W3    TMPRT003
     2   ,WO,WSC,XKT,XYY,YY,GTO                                         TMPRT004
      COMMON XYY(30,6,5),A(30),B(30),C(30),CST(30),D(30),DTO(30)        TMPRT005
     1   ,DWO(30),DST(30),FA(30),GTO(30),GWO(30),PP13(30),PP23(30)      TMPRT006
     2   ,TT3(30),W3(30),SST                                           TMPRT007
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2,TMPRT008
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CETMPRT009
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2            TMPRT010
      COMMON XKU(30),VVEL(30),SRS,RADMX,IGOGO,ROW,XMQ,DEL              TMPRT011
     1   ,XLAM,RSUM(15),B1,B2                                          TMPRT012
      COMMON PP11(30),PP21(30),TT1(30),TTO(30),TSC(30),W1(30),WO(30)    TMPRT013
     1   ,WSC(30),XKT(30),CU(30),CV(30),DTDT(30),DTT(30),U1(30),V1(30)  TMPRT014
     2   ,ZDL2(30),SOU1(20),SOU2(20),SH1(20),SH2(20),NCLI,ISSI1,ISSI2   TMPRT015
     3   ,ITS2(20),ITS1(20),ECLI(10,4),LLCI(10,5),TCLI(10,4),ISTEP(10)  TMPRT016
     4   ,RAINI(10),ICUV(20),XOCU(20),XOCV(20),XACU(20),XACV(20)        TMPRT017
     5   ,NXN(10),TTW,DECL,COCOB,ICK,NTFOR,GSF,GFR,DTSF,SF              TMPRT018
     6   ,PHIR,GD2,ISTR,SOSC,SOAB,XNO,CPH,SPH,PHI,H,IGONY,NTCUV         TMPRT019
     7 , PGXY(30,12),CGXY(30,12),I2IHT,I3IHT                           TMPRT020
     7  ,Z(30),ZA(30),DZ(30),DS(30),PA(45),TA(45),QA(45),COB(45),COM(18)TMPRT021
      COMMON U3(30),V3(30),TBO(30),WBO(30),CKO(30),CSW(30),PSS(30)      TMPRT022
     1   ,E(30,2,2),F(30,2),FST(30,2),R(30,2,2),BR(30),TTI(30),EC(5)    TMPRT023
     2   ,TCL(5),LLC(6),ST4(50),DST4(50),DUW(50),QS(50),RAI(20),PST(30) TMPRT024
      COMMON ITIMES(20),IXTRA,MARAY(20),PSFAIN(20)                      TMPRT025
      COMMON SAVE,TDEL,XDT1,DT,XD,DECLX,DCHG,PHIBOT,HWEST,EM,ZW,C5,C6   TMPRT026
     1  ,NX,IX,NT,IMAX,JMAX,NP1,IP1,NP2,NM1,NM2,IP2,IP3,IM1,IM2,IM3     TMPRT027
     2  ,I4,IA,RDRUM,SDRUM,TDRUM,IGRID,IMARA,RTIME,IPOL,PI2,CFAR,NTIME  TMPRT028
     3  ,EX2,EX3,EX6,XNV,XNT,BETV,BETT,DT2,DTA,DTA2,G,CP,PI,GAM,GAM2    TMPRT029
     4  ,ROA,ALF,XK1,XK2,RALF,RC,CC,C32,XK12,SH,HKK,HK2,A1,A2           TMPRT030
     5  ,NWSYY,NTOP1,DELH,   TW,INEW,ITAPE,IRAT,INEWC                  TMPRT031
      COMMON BG,AR,AW,SIG,ATC,SK,IZW,IZW1,IY,IR,LY,NCS,NCR,NLAP,NCL     TMPRT032
     1   ,NTOP,MA,NATAL,LAND,NVAR1,NVAR6,CPP,ITESTP                    TMPRT033
      COMMON T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,XIIN,XJIN,TE,T20    TMPRT034
     2    ,  T13,T14,T15,T16,XD1,YD1                                   TMPRT035
     3  ,IS,RAINX,ET,AT,ST,PT,NUX,LOCXYY(5),NU1X                       TMPRT036
      COMMON  CUT,CVT,C1,QST,NE,IGET,NN1,NU,ITM,I1,I2,I3,I5,IT,MS,NS,II TMPRT037
      COMMON COA(50),CGA(50),PAAB(50),PASA(50),RA(30),RB(30),FN(30)     TMPRT038
     1 , I1IHT,I4IHT                                                   TMPRT039
      DIMENSION U2(30),V2(30),TT2(30),W2(30),PP12(30),PP22(30)          TMPRT040
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,6),PP22(1))     TMPRT041
     1  ,(YY(1,3),TT2(1)),(YY(1,4),W2(1)),(YY(1,5),PP12(1))            TMPRT042
      COMMON /TAPBLK / IUAR96,IUAR97,IUAR98,IUAR99                      TMPRT043
      COMMON/INPUT/ VARIN(30,4),NVCHS(5),GNV(30,8)                      TMPRT044
      COMMON /GRDNTS / GXY(30,12)                                       TMPRT045
      DIMENSION ZE1(30,6),ZE2(30,6),PUX(30),PUY(30),PVX(30),PVY(30)     TMPRT046
     1  ,PTX(30),PTY(30),PWX(30),PWY(30),XP1(30),PP1Y(30)               TMPRT047
     2  ,XP2(30),PP2Y(30),CUX(30),CUY(30),CVX(30),CVY(30)               TMPRT048
     3  ,CTX(30),CTY(30),CWX(30),CWY(30),CP1X(30),CP1Y(30)              TMPRT049
     4  ,CP2X(30),CP2Y(30)                                            TMPRT050
      EQUIVALENCE  (GXY(1,1),ZE1(1,1)),(GXY(1,7),ZE2(1,1))             TMPRT051
      EQUIVALENCE  (PGXY(1,1),PUX(1)), (PGXY(1,7),PUY(1))              TMPRT052
      EQUIVALENCE  (PGXY(1,2),PVX(1)), (PGXY(1,8),PVY(1))              TMPRT053
      EQUIVALENCE  (PGXY(1,3),PTX(1)), (PGXY(1,9),PTY(1))              TMPRT054
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      EQUIVALENCE  (PGXY(1,4),PWX(1)), (PGXY(1,10),PWY(1))                TMPRT055
      EQUIVALENCE  (PGXY(1,5),XP1(1)), (PGXY(1,11),PP1Y(1))               TMPRT056
      EQUIVALENCE  (PGXY(1,6),XP2(1)), (PGXY(1,12),PP2Y(1))               TMPRT057
      EQUIVALENCE  (CGXY(1,1),CUX (1)),(CGXY(1,7 ),CUY (1))               TMPRT058
      EQUIVALENCE  (CGXY(1,2),CVX (1)),(CGXY(1,8 ),CVY (1))               TMPRT059
      EQUIVALENCE  (CGXY(1,3),CTX (1)),(CGXY(1,9 ),CTY (1))               TMPRT060
      EQUIVALENCE  (CGXY(1,4),CWX (1)),(CGXY(1,10),CWY (1))               TMPRT061
      EQUIVALENCE  (CGXY(1,5),CP1X(1)),(CGXY(1,11),CP1Y(1))               TMPRT062
      EQUIVALENCE  (CGXY(1,6),CP2X(1)),(CGXY(1,12),CP2Y(1))               TMPRT063
      IF(ITM.LE.1)ICTR = 0                                                TMPRT064
      ICTR = ICTR + 1                                                     TMPRT065
      IF(ICTR.LT.1)GO TO 888                                              TMPRT066
      ICTR = 0                                                            TMPRT067
      PRINT 1, ITM,NS,MS                                                  TMPRT068
    1 FORMAT ('1TIME STEP',I5,' FOR STATION',2I5)                         TMPRT069
      GO TO (550,551,552,553),IGOGO                                       TMPRT070
  550 PRINT 554                                                           TMPRT071
      GO TO 501                                                           TMPRT072
  554 FORMAT(1H+,40X,'(COASTAL CORNER STATION)')                          TMPRT073
  551 PRINT 555                                                           TMPRT074
      GO TO 501                                                           TMPRT075
  555 FORMAT(1H+,40X,'(COASTAL STATION)')                                 TMPRT076
  552 PRINT 556                                                           TMPRT077
      GO TO 501                                                           TMPRT078
  556 FORMAT(1H+,40X,'(WATER STATION)')                                   TMPRT079
  553 PRINT 557                                                           TMPRT080
  557 FORMAT(1H+,40X,'(LAND STATION)')                                    TMPRT081
  501 PRINT 4                                                             TMPRT082
      DO 10 IP=1,NP1                                                      TMPRT083
      PRINT 2, Z(IP),U2(IP),V2(IP),TT2(IP),W2(IP),XKT(IP), XKU(IP),       TMPRT084
     1  VVEL(IP),DT1(IP)                                                  TMPRT085
   10 CONTINUE                                                            TMPRT086
      PRINT 13, RANS,RABNS,RABS,RAA,CRNS,CRS,TOUPRA                       TMPRT087
   13 FORMAT(/'       RANS              RABNS              RABS           TMPRT088
     1    RAA              CRNS              CRS            TOUPRA'/ TMPRT089
     2  7E18.8)                                                          TMPRT090
      PRINT 14, SRS,CE,CF,HAI,HSI,H3,TRAUS                                TMPRT091
   14 FORMAT(/'       SRS               CE                CF             TMPRT092
     1    HAI              HSI               H3             TRAUS '/ TMPRT093
     2  7E18.8)                                                          TMPRT094
      PRINT 15, (RSUM(I),I=1,8)                                           TMPRT095
   15 FORMAT(/'       LE                A                 S             P TMPRT096
     1           R(1-A)            RA                MAN           T2**4TMPRT097
     2 '/ 8E16.6)                                                       TMPRT098
    4 FORMAT(//'  HEIGHT        U2             V2             TEMP       TMPRT099
     1  W2             XKT            XKU            VVEL          DT1 '/)TMPRT100
    2 FORMAT(9E14.5)                                                    TMPRT101
  888 RETURN                                                            TMPRT102
      ENTRY TEMGRA                                                      TMPRT103
      PRINT 5                                                           TMPRT104
    5 FORMAT(' THE FOLLOWING ARE COMPUTED GRADIENTS FOR RESTART'/'     PTMPRT105
     1UX           PUY            PVX            PVY           PTX     TMPRT106
     2   PTY           PWX            PWY       HEIGHT'/)              TMPRT107
      DO 6 I=1,NP1                                                      TMPRT108
      PRINT 7, PUX(I),PUY(I),PVX(I),PVY(I),PTX(I),PTY(I),PWX(I),PWY(I), TMPRT109
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   1 Z(I)                                                                  TMPRT110
  6 CONTINUE                                                               TMPRT111
    PRINT 778                                                              TMPRT112
    DO 777 I=1,NP1                                                         TMPRT113
    PRINT 7,CUX(I),CUY(I),CVX(I),CVY(I),CTX(I),CTY(I),CWX(I),CWY(I)        TMPRT114
   1,Z(I)                                                                  TMPRT115
777 CONTINUE                                                               TMPRT116
778 FORMAT ('0CENTERED GRADIENTS')                                         TMPRT117
  7 FORMAT(8E14.5,F8.0)                                                    TMPRT118
    RETURN                                                                 TMPRT119
    END                                                                    TMPRT120
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      SUBROUTINE INFRAI (WA,COA,KA,NTOP)                                INFRA000
C  SET TRANSMISSION VALUES FOR CO2 AND H2O                              INFRA001
      DIMENSION WA(1),COA(1),CGA(1),STB(1),ST4(1),LLC(1),EC(1),DTT(1)   INFRA002
     1 ,RA(1),RB(1),PA(1)                                               INFRA003
      DIMENSION TAUF(50,20)                                             INFRA004
      DATA AW /4.0833333/                                               INFRA005
      MM1 = NTOP-1                                                      INFRA006
      IF (KA.GT.20) GO TO 999                                           INFRA007
      KSAV = KA                                                         INFRA008
      DO 70 LR=1,KSAV                                                   INFRA009
      KUHN = 1                                                          INFRA010
      UW = 0.                                                           INFRA011
      UC = 0.                                                           INFRA012
      DO135 I=LR,MM1                                                    INFRA013
      UW = UW+WA(I)                                                     INFRA014
      UC = UC+COA(I)                                                    INFRA015
      TC = .185*EXP(-.32*UC**.4)                                        INFRA016
  136 CALL XUHN(UW,EW,KUHN)                                             INFRA017
  135 TAUF(I,LR) = .815-EW+TC                                           INFRA018
      IF (LR-1) 70,70,245                                               INFRA019
  245 KUHN = 1                                                          INFRA020
      UC = 0.                                                           INFRA021
      UW = 0.                                                           INFRA022
      I1 = LR-1                                                         INFRA023
      DO155 I=1,I1                                                      INFRA024
      K = LR-I                                                          INFRA025
      UW = WA(K)+UW                                                     INFRA026
      UC = COA(K)+UC                                                    INFRA027
      TC = .185*EXP(-.32*UC**.4)                                        INFRA028
      CALL XUHN (UW,EW,KUHN)                                            INFRA029
  155 TAUF(K,LR) = .815-EW+TC                                           INFRA030
   70 CONTINUE                                                          INFRA031
      RETURN                                                            INFRA032
      ENTRY INFRA (NIP,STB,ST4,LLC,EC,DTT,PA,RA,RB,CGA)                 INFRA033
C   COMPUTES INFRARED RADIATION IN PRESENCE OF CLOUDS AND  POLLUTANTS    INFRA034
      N1P1 = MIN0(NIP,KSAV)                                             INFRA035
      NSTART = MIN0 (2,N1P1)                                            INFRA036
      DO 40 LR=NSTART,N1P1                                              INFRA037
      LSAV = 1                                                          INFRA038
      DO 31 I=1,6                                                       INFRA039
      IF (LLC(I).GT.NTOP) GO TO 32                                      INFRA040
      IF (LR.GT.LLC(I)) LSAV = I+1                                      INFRA041
   31 CONTINUE                                                          INFRA042
   32 LL = LSAV                                                         INFRA043
      TP = 1.                                                           INFRA044
      UAA = 0.                                                          INFRA045
      E2 = 1.                                                           INFRA046
      RCL = 0.                                                          INFRA047
      ECP = 1.                                                          INFRA048
      RA(LR) = 0.                                                       INFRA049
C  RCL=R(CLD),ECP=PRODUCT(1-EC),E2=AIR TRANSMISSION                     INFRA050
      DO 35 I=LR,MM1                                                    INFRA051
      IF (LLC(LL).NE.I) GO TO  33                                       INFRA052
C  COMPUTE CLD RADIATION  MANABE AND STRICKLER 1964 JAS                 INFRA053
      RCL = RCL+EC(LL)*ST4(I)*ECP*E2                                    INFRA054
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      ECP = ECP*(1.-EC(LL))                                              INFRA055
      LL = LL+1                                                          INFRA056
   33 IF (CGA(I).LE.0) GO TO 34                                          INFRA057
      UAA = UAA+CGA(I)                                                   INFRA058
      TP = EXP(-UAA)                                                     INFRA059
   34 TT = TP*TAUF(I,LR)                                                 INFRA060
      RA(LR) = RA(LR)+STB(I)*(E2-TT)*ECP                                 INFRA061
      E2 = TT                                                            INFRA062
   35 CONTINUE                                                           INFRA063
      RA(LR) = RA(LR)+RCL                                                INFRA064
      IF (N1P1.LE.1) GO TO 99                                            INFRA065
      IF (LR.EQ.1) GO TO 40                                              INFRA066
      I1 = LR-1                                                          INFRA067
      RB(LR) = 0.                                                        INFRA068
      RCL = 0.                                                           INFRA069
      ECP = 1.                                                           INFRA070
      E2 = 1.                                                            INFRA071
      UAA = 0.                                                           INFRA072
      LL = LSAV -1                                                       INFRA073
      TP = 1.                                                            INFRA074
      DO 60 K=1,I1                                                       INFRA075
      I = LR-K                                                           INFRA076
      IF (LL.LT.1) GO TO 55                                              INFRA077
C  ASSUMES CLD TOP IS AT LEVEL ABOVE CLD BASE                            INFRA078
      IF (LLC(LL).NE.I)  GO TO 55                                        INFRA079
      RCL = RCL+EC(LL)*ST4(I+1)*ECP*E2                                   INFRA080
      ECP = ECP*(1.-EC(LL))                                              INFRA081
      LL = LL-1                                                          INFRA082
   55 IF (CGA(I).LE.0) GO TO 56                                          INFRA083
      UAA = UAA+CGA(I)                                                   INFRA084
      TP = EXP(-UAA)                                                     INFRA085
   56 TT = TP*TAUF(I,LR)                                                 INFRA086
      RB(LR) = RB(LR)+STB(I)*(E2-TT)*ECP                                 INFRA087
      E2 = TT                                                            INFRA088
   60 CONTINUE                                                           INFRA089
      RB(LR) = RB(LR)+RCL+ ECP*TT*ST4(1)                                 INFRA090
   40 CONTINUE                                                           INFRA091
      T1 = RB(2)-RA(2)                                                   INFRA092
      RB(1) = ST4(1)                                                     INFRA093
      DO 80 LR=3,N1P1                                                    INFRA094
      TT = RB(LR)-RA(LR)                                                 INFRA095
      E2 = AW*(TT-T1)/(PA(LR)-PA(LR-1))                                  INFRA096
      T1 = TT                                                            INFRA097
      IF (LR.EQ.3)  ECP = E2                                             INFRA098
      IF(LR.EQ.2) GO TO 79                                               INFRA099
      DTT(LR-1)=(PA(LR-1)-PA(LR-2))/(PA(LR)-PA(LR-2))*(E2-ECP)+ECP       INFRA100
   79 ECP = E2                                                           INFRA101
   80 CONTINUE                                                           INFRA102
      DTT(1) = 0.                                                        INFRA103
   99 RETURN                                                             INFRA104
  999 PRINT 1, KA                                                        INFRA105
    1 FORMAT ('1 KA GT 20 -- RUN TERMINATED',I5)                         INFRA106
      CALL EXIT                                                          INFRA107
      END                                                                INFRA108
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      SUBROUTINE LINEAR (ITM,ISTEP,NV,NA,I,VAR1, AC1,VAR2, AC2,          LINER000
     1   VAR3, AC3,VAR4, AC4)                                            LINER001
      DIMENSION  STEP(1),VAR1(1),VAR2(1),VAR3(1),VAR4(1),ISTEP(1)        LINER002
      MM = -1                                                            LINER003
      GO TO 19                                                           LINER004
      ENTRY      XINEAR (XTM,STEP,NV,NA,I,VAR1,AC1,VAR2,AC2,VAR3,AC3,    LINER005
     1 VAR4,AC4)                                                         LINER006
      MM = 1                                                             LINER007
   19 IF (NA.LE.1) GO TO 60                                              LINER008
      DO 40 L=2,NA                                                       LINER009
      I = L-1                                                            LINER010
      IF (MM) 25,25,26                                                   LINER011
   26 IF (XTM-STEP(L))131,30,40                                          LINER012
   25 IF (ITM-ISTEP(L)) 31,30,40                                         LINER013
   30 I = L                                                              LINER014
      TIMES = 0.                                                         LINER015
      GO TO 49                                                           LINER016
   40 CONTINUE                                                           LINER017
  131 TSTART = XTM-STEP(I)                                               LINER018
      TFINAL = STEP(I+1)-STEP(I)                                         LINER019
      GO TO 127                                                          LINER020
   31 TSTART = ITM - ISTEP(I)                                            LINER021
      TFINAL = ISTEP(I+1) - ISTEP(I)                                     LINER022
  127 TIMES = TSTART/TFINAL                                              LINER023
   49 GO TO (50,51,52,53),NV                                             LINER024
   53  AC4 = VAR4(I) + (VAR4(I+1) - VAR4(I))*TIMES                       LINER025
   52  AC3 = VAR3(I) + (VAR3(I+1) - VAR3(I))*TIMES                       LINER026
   51  AC2 = VAR2(I) + (VAR2(I+1) - VAR2(I))*TIMES                       LINER027
   50  AC1 = VAR1(I) + (VAR1(I+1) - VAR1(I))*TIMES                       LINER028
      GO TO 1                                                            LINER029
   60 GO TO (61,62,63,64),NV                                             LINER030
   64 AC4 = VAR4(1)                                                      LINER031
   63 AC3 = VAR3(1)                                                      LINER032
   62 AC2 = VAR2(1)                                                      LINER033
   61 AC1 = VAR1(1)                                                      LINER034
      I = 1                                                              LINER035
    1 RETURN                                                             LINER036
      END                                                                LINER037
```

```
      SUBROUTINE SOLAR2 (NP1 ,PA,DUW,PASA,PAAB,EC,TCL,LLC,CSZI,DTDT,     SOLAR000
     1 XIN5,TE,TOPRA,NTOP)                                               SOLAR001
      DIMENSION PA(1),DUW(1),PASA(1),PAAB(1),EC(1),TCL(1),LLC(1),DTDT(1)SOLAR002
      ATWA(AP,AC) = SQRT((.000949*AP+.051)/AC)                           SOLAR003
      CO3 = 980./240.                                                    SOLAR004
      XIO = 1.95/60.                                                     SOLAR005
      COSZ = CSZI                                                        SOLAR006
C   COMPUTE TRANSMISSION THROUGH CLDS  ABOVE  BDY LAYER                  SOLAR007
      VALUE = 1.                                                         SOLAR008
      IF (COSZ.GT.0.17365) GO TO 13                                      SOLAR009
      VALUE = COSZ/.17365                                                SOLAR010
      COSZ = .17365                                                      SOLAR011
   13 TC = 1.                                                            SOLAR012
      XMP = PA(1)/1013.5/COSZ                                            SOLAR013
      LSAV = 0                                                           SOLAR014
      DO 20 I=1,6                                                        SOLAR015
      IF (LLC(I).GT.NTOP) GO TO 21                                       SOLAR016
      IF (LLC(I).LT.NP1) GO TO 18                                        SOLAR017
      K = TCL(I)                                                         SOLAR018
      CALL TRANS(XMP,T2,K)                                               SOLAR019
      TC = TC*(1.-EC(I)*(1.-T2))                                         SOLAR020
      GO TO  20                                                          SOLAR021
   18 LSAV = I                                                           SOLAR022
   20 CONTINUE                                                           SOLAR023
   21 K    = NTOP-1                                                      SOLAR024
      UT = 0.                                                            SOLAR025
      UAB= 0.                                                            SOLAR026
      USC= 0.                                                            SOLAR027
      DTDT(1) = 0.                                                       SOLAR028
      DO 24 I=NP1,K                                                      SOLAR029
      UT = UT+DUW(I)                                                     SOLAR030
      UAB = UAB+PAAB(I)                                                  SOLAR031
   24 USC = USC+PASA(I)                                                  SOLAR032
      UT = UT-DUW(NP1)                                                   SOLAR033
      TPS  = 1.                                                          SOLAR034
      TPA  = 1.                                                          SOLAR035
      IF (UAB.GT.0) TPA  = EXP(-UAB)                                     SOLAR036
      IF (USC.GT.0) TPS  = EXP(-USC)                                     SOLAR037
      TPAM = TPA                                                         SOLAR038
      TPSM = TPS                                                         SOLAR039
      XCV = XIO*COSZ*VALUE                                               SOLAR040
      TOPRA = 0.                                                         SOLAR041
      TCM = TC                                                           SOLAR042
      DO 50 K=1,NP1                                                      SOLAR043
      I = NP1-K+1                                                        SOLAR044
      T1 = 1.041-0.16*ATWA(PA(I  ),COSZ)                                 SOLAR045
      TAU1 = .485+.515*T1                                                SOLAR046
      UT  = UT +DUW (I)                                                  SOLAR047
      TAU2 = .077*(UT/COSZ)**.3                                          SOLAR048
      A = TC*TPA*TPS                                                     SOLAR049
      GNM = XCV*TAU1                                                     SOLAR050
      WNM =-XCV*TAU2                                                     SOLAR051
      T1 = A*(GNM+WNM)                                                   SOLAR052
      IF (K.GT.1) GO TO 31                                               SOLAR053
      TE = T1                                                            SOLAR054
```

```
      XIN5 = TE                                                          SOLAR055
      GO TO 41                                                           SOLAR056
   31 UAB = UAB+PAAB(I)                                                  SOLAR057
      USC = USC+PASA(I)                                                  SOLAR058
      IF (PAAB(I).GT.0) TPAM = EXP(-UAB)                                 SOLAR059
      IF (PASA(I).GT.0) TPSM = EXP(-USC)                                 SOLAR060
      IF (LSAV.EQ.0)  GO TO 29                                           SOLAR061
      IF (LLC(LSAV).NE.I) GO TO 29                                       SOLAR062
      LR = TCL(LSAV)                                                     SOLAR063
      CALL TRANS(XMP,T3,LR)                                              SOLAR064
      TCM = TC*(1.-EC(LSAV)*(1.-T3))                                     SOLAR065
      LSAV = LSAV-1                                                      SOLAR066
   29 T2 = T1*(1.-TC+TCM)                                                SOLAR067
      T3 =  T2*(1.-TPS+TPSM)                                             SOLAR068
      TOPRA = TOPRA+A*(GN-GNM)+0.9*T1*(TC-TCM)+T2*(TPS-TPSM)             SOLAR069
      RAAB = A*(WN-WNM) + 0.1*T1*(TC-TCM)+T3*(TPA-TPAM)                  SOLAR070
      TAU1 = CO3*RAAB/(PA(I)-PA(I+1))                                    SOLAR071
      IF (K.GT.2) DTDT(I+1) = TAU1+(PA(I+1)-PA(I))/(PA(I+2)-PA(I))*      SOLAR072
     1 (DTU-TAU1)                                                        SOLAR073
      XIN5 = T3*(1.-TPA+TPAM)                                            SOLAR074
   41 TPA = TPAM                                                         SOLAR075
      TPS = TPSM                                                         SOLAR076
      TC = TCM                                                           SOLAR077
      GN = GNM                                                           SOLAR078
      WN = WNM                                                           SOLAR079
      DTU = TAU1                                                         SOLAR080
   50 CONTINUE                                                           SOLAR081
      RETURN                                                             SOLAR082
      END                                                                SOLAR083
```

```
      SUBROUTINE XUHN (UW,EW,KUHN)                                      XUHN 000
      T1 = ALOG10 (UW)                                                  XUHN 001
      GO TO (31,33,35,37,39,42),KUHN                                    XUHN 002
   31 IF (T1+4.) 32,33,33                                               XUHN 003
   32 EW = .11288 * ALOG10(1+12.635*UW)                                 XUHN 004
      GO TO 49                                                          XUHN 005
   33 IF (T1+3.) 34,35,35                                               XUHN 006
   34 KUHN = 2                                                          XUHN 007
      EW = 0.104 * T1 + 0.442                                           XUHN 008
      GO TO 49                                                          XUHN 009
   35 IF (T1+1.5) 36,37,37                                              XUHN 010
   36 KUHN = 3                                                          XUHN 011
      EW = 0.121 * T1 + 0.491                                           XUHN 012
      GO TO 49                                                          XUHN 013
   37 IF (T1+1.) 38,39,39                                               XUHN 014
   38 KUHN = 4                                                          XUHN 015
      EW = 0.146 * T1+0.527                                             XUHN 016
      GO TO 49                                                          XUHN 017
   39 IF(T1) 40,41,41                                                   XUHN 018
   40 KUHN = 5                                                          XUHN 019
      EW = 0.161*T1 + 0.542                                             XUHN 020
      GO TO 49                                                          XUHN 021
   41 KUHN = 6                                                          XUHN 022
   42 EW = 0.136 * T1+0.542                                             XUHN 023
   49 RETURN                                                            XUHN 024
      END                                                               XUHN 025
```

```
      SUBROUTINE TRANS(XMP,PS1,NCT)                                     TRANS000
      A = XMP                                                           TRANS001
      NBR = NCT                                                         TRANS002
      GO TO (1,2,3,4,5,6,7,8,9),NBR                                     TRANS003
    1 PS1 = .1626 + .0054 * A                                           TRANS004
      GO TO 98                                                          TRANS005
    2 PS1 = .2684 - .0101 * A                                           TRANS006
      GO TO 98                                                          TRANS007
    3 PS1 = .3658 - .0149 * A                                           TRANS008
      GO TO 98                                                          TRANS009
    4 PS1 = .3658 - .0149 * A                                           TRANS010
      GO TO 98                                                          TRANS011
    5 PS1 = .2363 + .0145 * A                                           TRANS012
      GO TO 98                                                          TRANS013
    6 PS1 = .4130 - .0014 * A                                           TRANS014
      GO TO 98                                                          TRANS015
    7 PS1 = .5456 - .0236 * A                                           TRANS016
      GO TO 98                                                          TRANS017
    8 PS1 = .8717 - .0179 * A                                           TRANS018
      GO TO 98                                                          TRANS019
    9 PS1 = .9055 - .0638 * A                                           TRANS020
   98 PS1 = AMIN1(1.,PS1)                                               TRANS021
      PS1 = AMAX1(0.,PS1)                                               TRANS022
   99 RETURN                                                            TRANS023
      ENTRY      KAPPA(ZIN,XOUT)                                        TRANS024
      DIMENSION AK(6),Z(6)                                              TRANS025
      DATA AK /.637,.351,.235,.165,.116,.0977/                          TRANS026
      DATA Z  /2.0,5.0,10.0,20.0,50.0,100.0/                            TRANS027
      IF(ZIN.LE.2.) GO TO 50                                            TRANS028
      IF(Z(6)-ZIN)15,15,13                                              TRANS029
   15 XOUT=AK(6)                                                        TRANS030
      GO TO 99                                                          TRANS031
   13 DO 10 I=2,6                                                       TRANS032
      IF(ZIN-Z(I))14,10,10                                              TRANS033
   10 CONTINUE                                                          TRANS034
   14 L=I-1                                                             TRANS035
      IU=I                                                              TRANS036
      XOUT=AK(L)-(Z(L)-ZIN)/(Z(L)-Z(IU))*(AK(L)-AK(IU))                 TRANS037
      GO TO 99                                                          TRANS038
   50 XOUT = 1.034 - .5698*ALOG(ZIN)                                    TRANS039
      GO TO 99                                                          TRANS040
      END                                                               TRANS041
```

```
      SUBROUTINE FILES                                                  FILES000
C        THIS ROUTINE DEFINES FILES FOR VARIOUS RUNS WITHOUT            FILES001
C        RECOMPILATIONS OF MAJOR PROGRAMS                               FILES002
      COMMON /TAPBLK/ IUAR96,IUAR97,IUAR98,IUAR99                       FILES003
C   UNIT  95  STORAGE FILE FOR PRINT -- TAPE OR DISK SEQUENTIAL         FILES004
C     DEFINE FILE 95(36,2376,L,IUAR97)      NOT USED FOR SEQUENTIAL     FILES005
C   UNITS 99,96 FOR YY TO STORE FOR COMPUTATION OF GRADIENTS--DIRECT ACCFILES006
      DEFINE FILE 96(36,1488,L,IUAR96)                                  FILES007
C     DEFINE FILE 98(NO. STATIONS,4*NCR,L,IUAR98)                       FILES008
C   UNIT  98  FOR RESTART VARIABLES -- DIRECT ACCESS                    FILES009
      DEFINE FILE 97(36,3012,L,IUAR97)                                  FILES010
      DEFINE FILE 98(36,6868,L,IUAR98)                                  FILES011
C     DEFINE FILE 96/99(NO. STATIONS,4*NWSYY,L,IUAR96/IUAR99)           FILES012
      DEFINE FILE 99(36,1488,L,IUAR99)                                  FILES013
      RETURN                                                            FILES014
      END                                                               FILES015
```

4.0 ANALYSIS PROGRAM FOR THE THREE-DIMENSIONAL BOUNDARY LAYER MODEL

4.1 Introduction

The program is designed to accept a tape written by the three-dimensional boundary layer model in Section 2.0 and to print the simulated results in a variety of formats to permit analysis of the results. The results may be in a time series (t), a map format (x-y), a height space cross section (z-x), and a height time cross section for a horizontal grid point (z-t).

4.2 Card Input

The card input contains one general card and up to four sets of cards. In all cases, a variable indicator is used to define the variable. The variable indicator is listed in Table 1. The analysis sets listed in Table 1 refer to time series (1), map format (2), height space cross sections (3), and height time cross sections (4).

The analysis sets for map format (2) and the height space cross sections (3) have an option to contour print the variable. The value of the contouring parameters is given in Table 2.

TABLE 1

Variable Indicator

Indicator	Valid Analysis Sets	Program Name Section 1.2	Program Name Description
1	4	---	Variables 14-37.
2	4	---	Variables 50-56.
3	1,2,3,4	U	Eastward velocity.
4	↓	V	Northward velocity.
5	↓	T	Temperature.
6	↓	q/s	Humidity/salinity.
7	↓	w	Horizontal velocity.
8	↓	XKU	Vertical momentum coefficient.
9	↓	VVEL	Vertical velocity.
10	↓	RI	Richardson number.
11	↓	DT1	Radiative heating rate.
12	↓	PP1	Pollutant 1.
13	↓	PP2	Pollutant 2.
14	2	RADMX	Artificial heat source.
15	↓	ROW	density of surface.
16	↓	XMQ	Moisture parameter.
17	↓	DEL	Wave steepness.
18	↓	XLAM	Wavelength.
19	1,2	RANS	Downward infrared flux (z_N).
20	↓	RABNS	Upward infrared flux (z_N).
21	↓	RABS	Upward infrared flux (z=0).
22	↓	RAA	Downward infrared flux (z=0).
23	↓	CRNS	Downward solar flux (z_N).
24	↓	CRS	Downward solar flux (z=0).
25	↓	TOUPRA	Upward solar flux (z_N).
26	↓	SRS	Albedo.
27	↓	TAWAS	Eddy stress (z_N).
28	↓	TAWIS	Eddy stress (z=0).
29	↓	TAWWS	Eddy stress (z_1).
30	↓	HAS	Eddy heat flux to atmos.(z_N).
31	↓	HAIS	Eddy heat flux to atmos.(z=0).
32	↓	HSIS	Eddy heat flux to subsfc.(z=0).

Table 1 (Continued). Variable Indicator

Indicator	Valid Analysis Sets	Program Name Section 1.2	Program Name Description
33	1,2	HSS	Eddy heat flux to subsurface (z_1).
34		CES	Eddy water vapor flux into atmosphere (z_N).
35		CEAS	Eddy water vapor flux into atmosphere (z=0).
36		CFNS	Eddy salinity flux into ocean (z=0).
37		CF	Eddy salinity flux to bottom (z_1).
38		H3S	Height of characteristic wave.
39		ETA2	Departure of water surface from mean.
40		XETA2	$\partial\eta/\partial x$.
41		YETA2	$\partial\eta/\partial y$.
42		HEIGHT	See card 20(a), Cols. 25-36 for model input of Section .
43-49			Not used.
50		RSUM(1)	Time sum for latent heat flux.
51		2	Time sum for atmos. heat flux.
52		3	Time sum for subsurface heat flux.
53		4	Time sum for precip. heat flux.
54		5	Time sum for solar heat flux.
55		6	Time sum for infrared heat flux.
56		7	Time sum for artificial heat flux.
57		8	Time sum for outgoing infrared heat flux.
58		9	Net solar (z=N).
59		10	Net TR (z=N).

TABLE 2

Contouring Parameter

IANA	=	0	No grid analysis
		1	Prints and contours
		2	Contours
		3	Prints

Input Deck Setup for Analysis and Gridprint Program

Card Type	Format	Columns	Symbol Integers	Program Designates
0	14I5	4-5	NTPLØ	Number of cards for time series plots ($\leq$ 30)(n.d.).
		9-10	NXYPLØ	Number of cards for maps in X-Y plots ($\leq$ 20)(n.d.).
		14-15	NZXPLØ	Number of cards for height cross sections ($\leq$ 10)(n.d.).
		19-20	NZTPLØ	Number of cards for time cross sections ($\leq$ 10)(n.d.). If "-1", print out entire simulation run and no cards are needed.
		25	MØRE	"0" last data set. "1" more data sets.
		29-30	ITAPE	Tape unit for analysis tape.
		34-35	I95	Tape unit from prediction run. If "0", only analysis tape is used.
		39-40	NFAREN	Temperature units indicator. "0" Centigrade, "1" Fahrenheit, "2" Absolute.

Include only sets that are desired. The number of cards in each set below is shown on Card type 0.

A	14I5	4-5	IXTRA	Total number of print time steps.
		9-10 ⋮ 69-70	MARAY(I)	A(1) is punched for each printed time step (I=1,IXTRA).

Analysis Set 1 will produce: Time series, plots.

1	14I5	4-5	IVAR	Variable indicator from Table 1.
		9-10	IZPLØT	Height level to be plotted (1 < IZPLØT < NX+1)*.

* NX is defined in Section 1.2.

		14-15	ISTAT	Grid point index for horizontal grid points to be plotted. The horizontal grid points are defined from Figure 2 as 1 = point (1,1), 2 = point (1,2), etc.

Analysis Set 2 will produce maps in x,y format.

2	14I5	4-5	IVAR	Variable indicator from Table 1.
		9-10	IZPLØT	Height level to be plotted (1 < IZPLØT < NX+1)*.
		14-15	IANA	Contouring parameter, Table 2.
		19-20	ITISTP	Time step index ($\leq$ 20) (not the time step).

Analysis Set 3 will produce: Height-space cross section.

3	14I5	4-5	IVAR	Variable indicator from Table 1.
		9-10	IANA	Contouring parameter, Table 2.
		14-15	ITISTP	Time step index ($\leq$ 20) (not the time step).
		19-20	I1	Number of horizontal grid points in cross section.
		24-25 29-30 ⋮ 69-70	ISTOUT(I)	Horizontal grid point indices of points in cross section (I=1,I1).

Analysis Set 4 will produce: Height-time cross sections.

4	14I5	4-5	IZTSTA	Horizontal grid point index.
		9-10	I2	Number of variable indicators.
		14-15	IVAR	Variable indicators (1 to I2) from Table 1 ($1 \leq$ IVAR ≤ 13).

---

* NX is defined in Section 1.2.

4.3 FORTRAN Listing for ANALYSIS Program

```
C       ANALYSIS PROGRAM
        COMMON NSTOUT(10),ISTR,IMAX,JMAX,IGRID,IX,DT,REALT,NREDS
        COMMON ITIMES(20)
        COMMON IVAR(30,3),IZPLOT(30,2),ITISTP(20,2),ISTOUT(20,10)
        COMMON ISTAT(30),IANA(30,2),COM(18),Z(30),ZA(30),ISET(20)
        COMMON TRANS(30,20),XYPLO(100,20),ZXPLO(20,30,20),AA(600)
       1  ,BA(30,20),IZTSTA(100),NZTVA(100),IZTVA(100,13)
        DIMENSION MAXA(100),MAXX(100),IIVAR(1),IPOL(13),RSUM(15,40)
        DIMENSION VRNM(126)
        EQUIVALENCE (IIVAR(1),IVAR(1,1))
        EQUIVALENCE (MAXA(1),MAXX(1))
        EQUIVALENCE (AA(1),RSUM(1,1))
        DATA IPOL /0,0,2,2,2,2,3,0,3,3,3,3,3/
        DATA VRNM /4HU    ,4H     ,4HV    ,4H     ,4HT    ,4H     ,4HQ    ,4H
       1   ,4HWSS ,4H     ,4HXKU ,4H     ,4HVVEL,4H     ,4HRI   ,4H     ,4HDT1
       2   ,4H    ,4HPP1 ,4H     ,4HPP2 ,4H     ,4HRADM,4HX     ,4HROW  ,4H
       3   ,4HXMQ ,4H     ,4HDEL ,4H     ,4HXLAM,4H     ,4HRAN  ,4H     ,4HRABN
       4   ,4H    ,4HRAB ,4H     ,4HRAA ,4H     ,4HCRN ,4H     ,4HCRS  ,4H
       5   ,4HTOUP,4HRA  ,4HSRS ,4H     ,4HTAWA,4H     ,4HTAWI,4H     ,4HTAWW
       6   ,4H    ,4HHA  ,4H     ,4HHAI ,4H     ,4HHSI ,4H     ,4HHS   ,4H
       7   ,4HCE  ,4H     ,4HCREA,4H     ,4HCF(0,4H)    ,4HCF(1,4H)    ,4HH3
       8   ,4H    ,4H    E,4HTA2 ,4H   XE,4HTA2 ,4H   YE,4HTA2 ,4HHEIG,4HHT
       9   ,4H    ,4H    ,4H     ,4H    ,4H     ,4H    ,4H     ,4H     ,4H
       1   ,4H    ,4H    ,4H     ,4H    ,4H     ,4HLE S,4HUM   ,4HA SU,4HM
       2   ,4HS SU,4HM   ,4HP SU,4HM    ,4HR(1-,4HA)   ,4HRA S,4HUM   ,4HMAN
       3   ,4HSUM ,4HTG**,4H4    ,4HNET ,4HSOL ,4HNET ,4HIR S,4H     ,4H
       4   ,4H    ,4H    ,4H     ,4H    ,4H     ,4H    ,4H     ,4H     /
C       READ NECESSARY TAPE INFORMATION
   11 READ 1, NTPLO,NXYPLO,NZXPLO,NZTPLO,MORE,ITAPE,I95,NFAREN
        PRINT1, NTPLO,NXYPLO,NZXPLO,NZTPLO,MORE,ITAPE ,I95,NFAREN
    1 FORMAT(14I5)
        IF (I95.GT.0) CALL TAPCHG (I95,ITAPE)
        DO 919 I=1,616
  919 NSTOUT(I) = 0
        IF( NTPLO )22,22,20
C       TIME SERIES
   20 DO 21K=1,NTPLO
        READ 1, IVAR(K,1),IZPLOT(K,1),ISTAT(K)
        PRINT1, IVAR(K,1),IZPLOT(K,1),ISTAT(K)
   21 CONTINUE
   22 IF(NXYPLO)25,25,23
C       X-Y PLOTS
   23 DO 24K=1,NXYPLO
        READ 1, IVAR(K,2),IZPLOT(K,2),IANA(K,1),ITISTP(K,1)
        PRINT1, IVAR(K,2),IZPLOT(K,2),IANA(K,1),ITISTP(K,1)
   24 CONTINUE
   25 IF(NZXPLO)29,29,26
   26 DO 27K=1,NZXPLO
        READ 1, IVAR(K,3),IANA(K,2),ITISTP(K,2),I1,(ISTOUT(IK,K),IK=1,I1)
        PRINT1, IVAR(K,3),IANA(K,2),ITISTP(K,2),I1,(ISTOUT(IK,K),IK=1,I1)
        NSTOUT(K) = I1
   27 CONTINUE
   29 CONTINUE
        IF (NZTPLO.LE.0) GO TO 420
        DO 419 J=1,NZTPLO
        READ 1,IZTSTA(J),I1,(IZTVA(J,I),I=1,I1)
```

```
      PRINT1,IZTSTA(J),I1,(IZTVA(J,I),I=1,I1)
  419 NZTVA(J) = I1
  420 IF(NZTPLO.EQ.-1) GO TO 421
      IF ((NTPLO+NXYPLO+NZXPLO+NZTPLO).LE.0) GO TO 1999
C-READ RECORD (1) AND SET UP CONSTANTS
  421 KK=1
      READ (ITAPE) AA
 2222 FORMAT (1X9E13.5)
      DO 18I=1,18
   18 COM(I) = AA(I)
      IMAX = AA(52)
      JMAX = AA(53)
      IGRID = IMAX * JMAX
      IX = AA(55)
      NP1 = AA(21)
      NM1 = NP1-2
      DT = AA(54)
      DT = DT/60.
      ISTR = AA(56)
      DO 68I=1,20
   68 ITIMES(I) = AA(I+62)
      XD = AA(600)
      NRECS = AA(20)
      DO 51I=1,30
   51 Z(I) = AA(I+21)       /100.
      L = 0
      NX = NP1-1
      DO 32 I=1,NX
      T1 = (Z(I)+Z(I+1))/2.
      IF (I.EQ.IX) GO TO 32
      L = L+1
      ZA(L) = T1
   32 CONTINUE
      KOUNT = 1
      DO 60KK=1,IGRID
      KL = ((IGRID-KK)/IMAX) * IMAX+1+MOD(KK-1,IMAX)
      DO 63 II=1,2
      IF(KOUNT.EQ.1) GO TO 64
      READ (ITAPE,END=72 ) AA
   64 IF(II.EQ.2)GO TO 62
      IJ = 14
      IE = 42
      IS = 82
      KOUNT = 2
      GO TO 61
   62 IJ = 50
      IE = 59
      IS = 0
 1000 FORMAT ('1RADIATION FLUXES FOR STATION',I5,' FOR',18A4/'  TIME',20
     1X,'DT=',F8.3  /'  STEP       RA(Z=N)      RB(Z=N)       RB(Z=0)
     2 RA(Z=0)      SOLAR(Z=N)      SOLAR(Z=0)      SOLAR UP       ALBEDO')
   61 IF(NZTPLO.EQ.-1) GO TO 1061
      IF(NZTPLO.LE.0)  GO TO 161
      DO 162 MI=1,NZTPLO
      IF(IZTSTA(MI).NE.KK) GO TO 162
      MK = NZTVA(MI)
```

```
      DO1162 MJ=1,MK
      IF(IZTVA(MI,MJ).EQ.II) GO TO 1061
 1162 CONTINUE
  162 CONTINUE
      GO TO 161
 1061 GO TO (163,164),II
  163 PRINT 1000, KK,COM,DT
      DO 1001I=1,ISTR
      ISTEP = ITIMES(I)
      PRINT 1002,    ISTEP,AA(I+82),AA(I+102),AA(I+122),AA(I+142),
     1 AA(I+162),AA(I+182),AA(I+202),AA(I+222)
 1001 CONTINUE
      PRINT 1003
 1003 FORMAT(//30X,45HUPPER AND LOWER BOUNDARY AND INTERFACE FLUXES//
     111X,28H(------(DYNES/CM**2)-------),4X,36H(------------(MLY/SEC)-
     2----------),4X,36H(MGM/SEC CM**2)      (MUGM/SEC CM**2),2X,8H(--CM
     3--)/6H  TIME,6X,6HTAW(N),7X,3HTAW,4X,6HTAW(1),6X,4HH(N),9X,1HH,9X,
     41HH,6X,4HH(1),6X,4HE(N),9X,1HE,9X,1HF,6X,4HF(1),4X,6HH(1/3)/6H  ST
     5EP,19X,3HZ=0,26X,4HZ=+0,6X,4HZ=-0,26X,4HZ=+0,6X,4HZ=-0//)
      DO 1004I=1,ISTR
      ISTEP = ITIMES(I)
      PRINT 1005,   ISTEP,AA(I+242),AA(I+262),AA(I+282),AA(I+302),
     1AA(I+322),AA(I+342),AA(I+362),AA(I+382),AA(I+402),AA(I+422),
     2AA(I+442),AA(I+462)
 1004 CONTINUE
      PRINT 1113
 1113 FORMAT(//30X,'ETA2     XETA2     YETA2'/6H  TIME,6X,6H ETA2 ,
     1 7X,5HXETA2,4X,5HYETA2,4X,5H   H3//)
      DO 1114I=1,ISTR
      ISTEP = ITIMES(I)
      PRINT 1005,  ISTEP,AA(I+482),AA(I+502),AA(I+522)
     1   ,AA(I+462)
 1114 CONTINUE
 1005 FORMAT (1X,I4,4X,3F10.4,4F10.3,4F10.4,F8.0)
 1002 FORMAT (1X,I4,8E14.5)
      GO TO 161
  164 PRINT 1006,KK,COM
 1006 FORMAT ('1RSUMS FOR STATION',I5,' FOR',18A4/6H  TIME/'  STEP
     1LE             A              S              P             R(1-A)
     2    RA            MAN           TG**4')
      DO 1007I=1,ISTR
      PRINT 1002, ITIMES(I), (RSUM(K,I),K=1,8)
 1007 CONTINUE
      PRINT 1008
 1008 FORMAT (6X,'NET SOLAR(Z=N) NET IR(Z=N)')
      DO 1009 I=1,ISTR
 1009 PRINT 1002,ITIMES(I),(RSUM(K,I),K=9,10)
C  FOR N. LORD
 1301 FORMAT('DAILY SUMS STATION',I5)
      KI = 1440./DT
      K1 = 0
      DO 1310 I=1,ISTR
      IF(ITIMES(I).LT.KI) GO TO 1310
      K1 = K1 + 1
      DO 1309 K=1,10
 1309 BA(I,K) = RSUM(K,I) - RSUM(K,K1)
```

```
      PRINT 1308,ITIMES(I),(BA(I,K),K=1,5)
      PRINT 1308,KK       ,(BA(I,K),K=6,10)
 1310 CONTINUE
 1308 FORMAT(1X,I5,5E12.4)
      PRINT 1301,KK
  161 DO 40 ICALL=IJ,IE
      IF (II.EQ.1) MA = (ICALL-IJ-5)*20+IS
      IF (II.EQ.2)MA=ICALL-IJ+1
      IF (ICALL.LT.19) MA = ICALL+144
      DO 40 K=1,60
      IF(IIVAR(K).NE.ICALL)GO TO 40
      IF(K.GT.30) GO TO 33
C-SET UP TIME SERIES
      IF(ISTAT(K).NE.KK)GO TO 40
      DO 31 I=1,ISTR
      MM = MA + I
      IF (II.EQ.2) MM = MA+15*I
   31 TRANS(I,K) = AA(MM)
      GO TO 40
C-SET UP XYPLOT FOR VARIABLES  19 NO (Z) DEPENDANCE
   33 I1 = MA + ITISTP(K-30,1)
      IF (II.EQ.2) I1 = MA+(ITISTP(K-30,1))*15-15
      IF(ICALL.EQ.42) I1 = 599
      XYPLO(KL,K-30) = AA(I1)
   40 CONTINUE
   63 CONTINUE
C-SET UP STORE FROM VARIABLES 3-13
      DO 70 ICALL=3,NRECS
C-READ RECORD INTO BA(30,20)
      READ (ITAPE,END=73) BA
      IF(ICALL.EQ.5.OR.ICALL.EQ.7) GO TO 1446
      GO TO 1449
 1446 DO 1450 I=1,NP1
      DO 1450 J=1,ISTR
      IF(ICALL.EQ.5) BA(I,J) = BA(I,J) - 273.16
      IF(ICALL.EQ.7) BA(I,J) = BA(I,J) * .0194254
 1450 CONTINUE
 1449 CONTINUE
      IF (NZTPLO.EQ.-1) GO TO 449
      IF (NZTPLO.LE.0) GO TO 451
      DO 445 I=1,NZTPLO
      IF (IZTSTA(I).NE.KK) GO TO 445
      I1 = NZTVA(I)
      DO 444 J=1,I1
      IF (IZTVA(I,J).EQ.ICALL) GO TO 449
  444 CONTINUE
  445 CONTINUE
      GO TO 451
  449 I2 = ICALL*2-5
      I3 = I2+1
      PRINT 448,VRNM(I2),VRNM(I3),COM,KK,DT
      IF (ICALL.EQ. 8.OR.ICALL.EQ.10) GO TO 1448
      CALL PRT (NP1,IPOL(ICALL),ISTR,Z,BA,ITIMES)
      GO TO 451
 1448 CALL PRT (NM1,IPOL(ICALL),ISTR,ZA,BA,ITIMES)
  451 CONTINUE
```

```
  448 FORMAT ( '1VARIABLE= ',2A4,' FOR ',18A4,' STATION=',I5,' DT=',F5.2
     1 ///' HEIGHT',4X,13(5X4HTIME)/4X'IN',5X,13(5X'STEP'))
      IF(NTPLO.LE.0) GO TO 45
C-TIME SERIES
      DO 44K=1,NTPLO
      IF(IVAR(K,1).NE.ICALL) GO TO 44
      IF(ISTAT(K).NE.KK) GO TO 44
      I1 = IZPLOT(K,1)
      DO 42 I=1,ISTR
   42 TRANS(I,K) = BA(I1,I)
   44 CONTINUE
C-SET UP  X,Y PLOT
   45 IF(NXYPLO.LE.0) GO TO 52
      DO 50 K=1,NXYPLO
      IF(IVAR(K,2).NE.ICALL)GO TO 50
      I1 = IZPLOT(K,2)
      I2 = ITISTP(K,1)
      XYPLO(KL,K) = BA(I1,I2)
   50 CONTINUE
C-SET UP  Z,X PLOT
   52 IF (NZXPLO.LE.0) GO TO 70
      DO 56 K=1,NZXPLO
      IF(IVAR(K,3).NE.ICALL) GO TO 56
      IJ = NSTOUT(K)
      DO 53 I=1,IJ
      IF(ISTOUT(I,K).NE.KK) GO TO 53
      IT = I
   54 I1 = ITISTP(K,2)
      DO 55 M=1,NP1
      ZXPLO(IT,M,K) = BA(M,I1)
   55 CONTINUE
   53 CONTINUE
   56 CONTINUE
   70 CONTINUE
   60 CONTINUE
      REWIND ITAPE
  301 NX = NP1-1
      IF(NTPLO.LE.0) GO TO 311
      DO 110K=1,NTPLO
  110 CALL PLOT(TRANS(1,K),VRNM,K,NFAREN)
  311 IF(NXYPLO.LE.0) GO TO 131
      DO 310I=1,JMAX
      MAXX(I) = 1
  310 MAXX(I+JMAX) = IMAX
      DO 130K=1,NXYPLO
      I1 = 1
      IJ = MIN0(IMAX,11  )
      IPLOT1 = ITISTP(K,1)
      REALT = DT * ITIMES(IPLOT1)
      REALT = REALT/60.
      IZ = IZPLOT(K,2)
  111 PRINT 209, (COM(I),I=1,18)
  209 FORMAT(1H1,18A4)
      IPLOT2 = 2*IVAR(K,2) -5
      PRINT 212, VRNM( IPLOT2),VRNM(IPLOT2+1),ITIMES(IPLOT1),DT,REALT,
     1  Z(IZ),XD
```

```
  212 FORMAT('      X-Y PLOT FOR VARIABLE ',2A4/' TIME STEP=',I5,'  DT=',
     1F6.2,'  REAL TIME=',F6.2,' HOURS  HEIGHT=',F8.1,' M X DIST=',F8.0)
      DO 112I=I1,IJ
  112 ISET(I) = I
      PRINT 213, (ISET(I),I=I1,IJ)
  213 FORMAT(1H0, I15,10I10)
      I2 = I1
      I3 = IJ
      DO 115 JJ=1,JMAX
      J = JMAX-JJ+1
      I2 = (J-1)*IMAX+I1
      I3 = I2+IJ -1
      PRINT 514, J,(XYPLO(M,K),M=I2,I3)
  514 FORMAT (1H0,I5,11F10.3)
  115 CONTINUE
      IF(IMAX.LE.IJ) GO TO 125
      I1 = I1 + 11
      IJ = MIN0(IJ+11,IMAX)
      GO TO 111
  125 CONTINUE
      I1 = IANA(K,1)-2
      IF(IANA(K,1).GE.1) CALL GRIDPR(XYPLO(1,K),IMAX,JMAX,K,1,I1,MAXA,
     1  VRNM(IPLOT2),IMAX,JMAX)
  130 CONTINUE
C     SET UP FOR  Z,X PLOT-PRINT
  131 CONTINUE
      IF (NZXPLO.LE.0)  GO TO 1999
      DO 200 K=1,NZXPLO
      DO 308I=1,NP1
      MAXX(I) = 1
  308 MAXX(I+NP1) = NSTOUT(K)
      I2 = 1
      LOOP = 1
      IF(NSTOUT(K).GT.10) LOOP = 2
      DO 180 J=1,LOOP
      PRINT 209, (COM(I),I=1,18)
      IPLOT1 = ITISTP(K,2)
      IPLOT2 = 2*IVAR(K,3) -5
      REALT = DT * ITIMES(IPLOT1)
      REALT = REALT/60.
      PRINT 216, VRNM(IPLOT2),VRNM(IPLOT2+1),ITIMES(IPLOT1),DT,REALT,
     1  IMAX,JMAX,XD
  216 FORMAT ('0  Z-X PLOT FOR VARIABLE ',2A4/' TIME STEP=',I5,' DT=',F6
     1.2,'  REAL TIME =',F6.2,' HOURS  IMAX=',I5,' JMAX=',I5,'  GRID DIS
     2TANCE =',F8.0,'KM'/'0HEIGHT(M)     STATIONS')
      I3 = MIN0(I2+9,NSTOUT(K))
      PRINT 215,(ISTOUT(I,K),I=I2,I3)
  215 FORMAT(1H0,7X10I11)
      DO 170 M1=1,NP1
      M = NP1-M1+1
  170 PRINT 217, Z(M),(ZXPLO(I,M,K),I=I2,I3)
  217 FORMAT(1H0,F7.1,10F11.3)
      I2 = I2 + 10
  180 CONTINUE
      I1 = IANA(K,2)-2
      IF(IANA(K,2).GE.1) CALL GRIDPR(ZXPLO(1,1,K),NSTOUT(K),NP1,K,2,I1,
```

```
    1 MAXA,VRNM(IPLOT2),20,30)
  200 CONTINUE
 1999 IF(MORE) 999,999,11
   72 PRINT 333,II,KK
  333 FORMAT ('0END OF FILE AFTER RECORD',I5,' AT STATION',I5)
      GO TO 74
   73 PRINT 333,ICALL,KK
   74 REWIND ITAPE
      GO TO 1999
  999 CALL EXIT
      END
```

```
      SUBROUTINE GRIDPR(A,MAXX,MAXJ,KIN,IXOXZ,ICTP,MAXA,VARNUM,          001
     1  IEX,JEX)                                                         002
C  *** IF MAXI LT 0, SPACING IS 1 INCH, POSITIVE .5 INCH                 003
C  *** IF KA  NEG,0, DATA STARTS AT 1,1 OF A,BUT IS ACTUALLY             004
C  *** ON GRID AT KA,KB (WRT 0,0)                                        005
C  *** KA GT 0 INDICATES SUBSET OF ARRAY WRT 0,0                         006
      COMMON NSTOUT(10),ISTR,IMAX,JMAX,IGRID,IX,DT,REALT,NRECS           007
      COMMON ITIMES(20)                                                  008
      COMMON IVAR(30,3),IZPLOT(30,2),ITISTP(20,2),ISTOUT(20,10)          009
      COMMON ISTAT(30),IANA(30,2),COM(18),Z(30),ZA(30),ISET(20)          010
      DIMENSION BAND(20),SCALES(4),VARNUM(1)                             011
      DIMENSION A(IEX,JEX  ),PLINE(115),LINE(115)                        012
      EQUIVALENCE (PLINE(1),LINE(1))                                     013
      DIMENSION MAXA(1)                                                  014
      DATA BAND/4H1   ,4H    ,4H2   ,4H    ,4H3   ,4H    ,4H4   ,4H    ,  015
     1  4H5   ,4H    ,4H6   ,4H    ,4H7   ,4H    ,4H8   ,4H    ,4H9   ,  016
     2  4H    ,4H 0  ,4H    /                                             017
      KA = 0                                                             018
      KB = 0                                                             019
      MAXI = MAXX                                                        020
      SCALES(2) = 1.                                                     021
      SCALES(1) = 0.                                                     022
      IF (ICTP.EQ.0) SCALES(2) = 0.                                      023
C  ABOVE IS JUST CONTOURS,BELOW IS NO CONTOURS                           024
      IF (ICTP.EQ.1) SCALES(4) = 0.                                      025
      IF (ICTP.GT.0) GO TO 810                                           026
      ROW = A(1,1)                                                       027
      YY =  ROW                                                          028
      DO 800 I=1,MAXX                                                    029
      DO 800 J=1,MAXJ                                                    030
      IF (A(I,J).GT.ROW)  ROW = A(I,J)                                   031
      IF (A(I,J).LT.YY)   YY  = A(I,J)                                   032
  800 CONTINUE                                                           033
      XY = (ROW-YY)/18.                                                  034
      IE = YY/XY                                                         035
      SCALES(3) = IE*XY                                                  036
      SCALES(4) = XY                                                     037
  810 IF (MAXI.GT.10.OR.MAXJ.GT.20) GO TO 6                              038
    5 NINT=6                                                             039
      IP6 = -1                                                           040
      M=10                                                               041
      IE = 10                                                            042
      CT=.1                                                              043
      GO TO 7                                                            044
    6 NINT=3                                                             045
      IP6 =  1                                                           046
      M=5                                                                047
      CT=.2                                                              048
      IE = 20                                                            049
    7 KAA = -(KA+1)                                                      050
      ILEFT = KA+1                                                       051
      KBB = KB+MAXJ                                                      052
      KBA = KBB+1                                                        053
   13 IF(MAXI-IE) 14,14,15                                               054
   14 ILOOP = 1                                                          055
      IRIGHT = ILEFT+MAXI-1                                              056
```

```
      GO TO 16                                                          057
   15 ILOOP = (MAXI-1)/IE+1                                             058
      IRIGHT=ILEFT+IE-1                                                 059
   16 BLANK=BAND(20)                                                    060
      I1 = ITISTP(KIN,IXOXZ)                                            061
      ITM = ITIMES(I1)                                                  062
      DO 355 IJK=1,ILOOP                                                063
   40 PRINT 1005,COM,VARNUM(1),VARNUM(2),ITM,DT,REALT                   064
 1005 FORMAT ('1RESULTS OF ',18A4,' FOR ',2A4/' AT TIME STEP',I5,' DT=',  065
     1F5.1,' MINUTES (OR REAL TIME OF ',F10.2,' HOURS)')
      IZ = IZPLOT(KIN,2)                                                067
      IF (IXOXZ.EQ.1) PRINT 1008,Z(IZ)                                  068
 1008 FORMAT(' HEIGHT IS ',F10.1,' METERS' )
      IF (IXOXZ.EQ.2) PRINT 1007                                        070
 1007 FORMAT ('0   STATIONS')                                           071
C     COMPUTE COLUMN INDICES AND OUTPUT A PAGE HEADING                  072
   60 DO 70 I=ILEFT,IRIGHT                                              073
      PLINE(I) = I                                                      074
      IF(IXOXZ.EQ.2) PLINE(I) = ISTOUT(I,KIN)                           075
   70 CONTINUE                                                          076
C  CHANGE PREVIOUS DO LOOP TO ALTER COLUMN HEADING                      077
   81 PRINT 1004, SCALES(2),SCALES(1),SCALES(3),SCALES(4),BAND          078
      IF (IP6) 84,83,83                                                 081
   84 PRINT  905, (PLINE(I),I=ILEFT,IRIGHT)                             082
  905 FORMAT (1XF16.0,10F10.0)                                          083
      GO TO 90                                                          084
   83 PRINT 1006, (PLINE(I),I=ILEFT,IRIGHT)                             085
 1006 FORMAT (1H ,F11.0,20F5.0)                                         086
C     DO-LOOP TO GENERATE OUTPUT FOR EACH ROW ON A PAGE                 087
   90 DO 350 JREV=1,MAXJ                                                088
  100 J = KBA-JREV                                                      089
  110 JINT= KBB-JREV+1                                                  090
      ROW = JINT                                                        091
      IF (IXOXZ.EQ.2) ROW = Z(JINT)                                     092
C   CHANGE ROW FOR ALTERING ROW IDENTIFER                               093
C     DO-LOOP FOR THE NUMBER OF PRINT LINES PER 1/2 INCH ON THE PAGE    094
  120 DO 340 JINT=1,NINT                                                095
C     INITIALIZE A BLANK INTERPOLATED PRINT LINE                        096
  130 DO 140 IPL=1,115                                                  097
  140 PLINE(IPL) = BLANK                                                098
C     CONDITIONS FOR VALUE-PRINTING AND CONTOUR BANDING                 099
  160 IF (JINT-NINT) 162,161,162                                        100
  162 IF (JREV-1) 170,291,170                                           101
  161 IF(SCALES(2))310,170,310                                          102
  170 IF(SCALES(4))180,280,180                                          103
  180 YY=1.-FLOAT(JINT)/FLOAT(NINT)                                     104
  185 IP1=-M                                                            105
C     DO-LOOPS FOR M PRINT CHARACTERS FOR 1/2 INCH HORIZONTALLY         106
  190 DO 270 IINT=1,M                                                   107
  191 IP1=IP1+1                                                         108
  192 IPL=IP1                                                           109
  200 XY=CT*FLOAT(IINT)                                                 110
  210 DO 270 I=ILEFT,IRIGHT                                             111
  215 IPL= IPL+M                                                        112
      IF (IJK-1) 220,220,46                                             113
   46 IF (MAXA(J+MAXJ)-I) 270,231,231                                   114
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```
   47 IF (MAXA(J)-I) 231,270,270                                          115
  220 IF(I-ILEFT) 47,270,47                                               116
C         GENERATING CONTOUR BANDS                                        117
  231 IBAND=1.+(A(I-1,J  )-SCALES(3)+XY*(A(I,J  )-A(I-1,J  )) +YY*        118
     X(A(I-1,J+1  )-A(I-1,J  )) +XY*YY*(A(I-1,J  )+A(I,J+1  )-A(I-1,J+1  119
     X )-A(I,J  ))) /SCALES(4)                                            120
  240 IF(IBAND)270,270,250                                                121
  250 IBAND= MOD(IBAND-1,20)+1                                            122
  260 PLINE(IPL)= BAND(IBAND)                                             123
  270 CONTINUE                                                            124
C     WRITE BLANK OR BANDED LINES                                         125
  280 IF(JINT-NINT)290,281,340                                            126
  281 PRINT 1001,  ROW,PLINE                                              127
 1001 FORMAT (1XF5.0,125A1)                                               128
      GO TO 340                                                           129
  290 IF(IP6)    291,295,295                                              130
  291 PRINT 293,  PLINE                                                   131
  293 FORMAT (6X125A1)                                                    132
      GO TO 340                                                           133
  295 PRINT 1002,  PLINE                                                  134
 1002 FORMAT (6X125A1)                                                    135
  300 GO TO 340                                                           136
C     WRITE GRIDPOINT VALUES                                              137
  310 DO 320 I=ILEFT,IRIGHT                                               138
      IF (A(I,J) .EQ.0.)  A(I,J)=1.E-15                                   139
      T1 = ABS(A(I,J))/A(I,J)*.5                                          140
  321 LINE(I) = SCALES(2)*A(I,J)+SCALES(1)+T1                             141
  320 CONTINUE                                                            142
  330 IF (IP6) 329,331,331                                                143
  329 PRINT 328,    ROW,(LINE(I),I= ILEFT,IRIGHT)                         144
  328 FORMAT (1XF5.0,1H*I9,10(1H*I9),1H*)                                 145
      GO TO 340                                                           146
  331 PRINT 1003,    ROW,(LINE(I),I=ILEFT,IRIGHT)                         147
 1003 FORMAT(1XF5.0,1H*,24(I4,1H*))                                       148
  340 CONTINUE                                                            149
  350 CONTINUE                                                            150
      ILEFT = IRIGHT+1                                                    151
      IP1 = IE+IRIGHT                                                     152
      IPL = KA+MAXI                                                       153
      IRIGHT = MIN0(IP1,IPL)                                              154
  355 CONTINUE                                                            155
  360 RETURN                                                              156
 1004 FORMAT(17H NOS. TRANSFORMED1PE10.2,4H *X+E10.3,2X,13HCONTOUR BASE=  079
     11PE10.3,6H, INT=E10.3,7H BANDS=A1,19(1H,A1)//)                      080
      END                                                                 157
```

```
      SUBROUTINE STOR (ISTR)                                                    001
      DOUBLE PRECISION DT1,PP12,PP22,TT2,U2,V2,W2,YY                            002
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2, TAPCHG1
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE TAPCHG2
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2,VVEL(30)
      COMMON XKU(30),          SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1    ,XLAM,RSUM(15),B1,B2,RADMX2,RADMX1
      COMMON Z(30),ZA(30),DZ(30),DS(30),DUMMY(135),COM(18),VARIN(30)
     1   ,NCS,JMAX,IMAX,NX,NP1,IX,DT,ITIMES(20),IM1,ABC,IP1,NM1,IP2            008
     2   ,IGRID,NRECD,ITAPE                                                    009
      COMMON AB(600),U2S(30,20),V2S(30,20),TT2S(30,20),W2S(30,20)              010
     1 ,WSS(30,20),XKUS(30,20),XKTS(30,20),RIS(30,20),DT1S(30,20)              011
     2  ,PP1S(30,20),PP2S(30,20),RSUMS(15,40)                                  012
      COMMON IUAR97                                                            013
      DIMENSION PP12(30),PP22(30),TT2(30),U2(30),V2(30),W2(30)                 014
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,3),TT2(1))             015
     1  ,(YY(1,4),W2(1)),(YY(1,5),PP12(1)),(YY(1,6),PP22(1))                   016
      IF(ISTR.EQ.1)PRINT 2, AB(20)                                             017
    2 FORMAT (1XE14.5,' AB')                                                   018
      IF (ISTR.GT.1) GO TO 89                                                  019
      AB(57) = IGOGO                                                          S020
      AB(58) = RADMX                                                          S021
      AB(59) = ROW                                                             022
      AB(60) = XMQ                                                             023
      AB(61) = DEL                                                             024
      AB(62) = XLAM                                                            025
      AB(599) = HEIGHT/ 100.
   89 I = ISTR                                                                 026
      AB(I+82) = RANS                                                          027
      AB(I+102) = RABNS                                                        028
      AB(I+122) = RABS                                                         029
      AB(I+142) = RAA * 1.E3                                                   030
      AB(I+162) = CRNS                                                         031
      AB(I+182) = CRS * 1.E3                                                   032
      AB(I+202) = TOUPRA                                                       033
      AB(I+222) = SRS                                                          034
      AB(I+242) = .001 *RSUM(15) * CSOUT(2)                                    035
      AB(I+282) = ROW*XKU(1)*CSOUT(1)                                          036
      AB(I+302) =-.239*RSUM(15)*((TT2(NP1)-TT2(NX))/DZ(NX)+.98E-4)             037
      AB(I+362) = ROW*CW*RSUM(14)*(TT2(2)-TT2(1))/DZ(1)*1.E3                   038
      AB(I+402) = CE * 1.E3                                                    039
      AB(I+382) =-     RSUM(15)*(W2(NP1)-W2(NX))/DZ(NX)                        040
      AB(I+422) = CF * 1.E3                                                    041
      AB(I+442) = ((ROW*RSUM(14)*(W2(2)-W2(1))) / DZ(1))*1.E3
    5 AB(I+262) = .001 * XKU(IP1)*(WS(IP1+1)-WS(IP1))/DZ(IP1)                  043
      AB(I+322) = HAI * 1.E3                                                   044
      AB(I+342) = HSI * 1.E3                                                   045
   15 AB(I+462) = H3                                                           046
      AB(I+482) = ETA2
      AB(I+502) = XETA2 *1.E5
      AB(I+522) = YETA2 * 1.E5
      AB(I+542) = SLOPX
      AB(I+562) = SLOPY
      DO 20K=1,NP1                                                             047
      U2S(K,ISTR) = U2(K)                                                      048
      V2S(K,ISTR) = V2(K)                                                      049
```

```
      TT2S(K,ISTR) = TT2(K)                                          050
      W2S(K,ISTR) = W2(K)                                            051
      WSS(K,ISTR) = WS(K)                                            052
   20 CONTINUE                                                       053
      DO 25K=1,IM1                                                   054
      XKUS(K,ISTR) = XKU(K)                                          055
      XKTS(K,ISTR) = VVEL(K)                                         056
      RIS(K,ISTR) = RI(K)                                            057
   25 CONTINUE                                                       058
      DO 30K=IX,NM1                                                  059
      XKUS(K,ISTR) = XKU(K+1)                                        060
      XKTS(K,ISTR) = VVEL(K)                                         061
      RIS(K,ISTR) = RI(K+1)                                          062
   30 CONTINUE                                                       063
      XKTS(NX,ISTR) = VVEL(NX)                                       064
      XKTS(NP1,ISTR) = VVEL(NP1)                                     065
      DO 40K=1,NP1                                                   066
      DT1S(K,ISTR) = DT1(K)*86400.                                   067
      PP1S(K,ISTR) = PP12(K) / 4.E4
      PP2S(K,ISTR) = PP22(K) / 4.E4
   40 CONTINUE                                                       070
      DO 12K=1,15                                                   S071
   12 RSUMS(K,ISTR) = RSUM(K)                                        072
      RETURN                                                         073
      END                                                           S074
```

```
      SUBROUTINE PLOT(TRANS,VARN,KIN,NFAREN)
      COMMON NSTOUT(10),ISTR,IMAX,JMAX,IGRID,IX,DT,REALT,NRECS                  002
      COMMON ITIMES(20)                                                         003
      COMMON IVAR(30,3),IZPLOT(30,2),ITISTP(20,2),ISTOUT(20,10)                 004
      COMMON ISTAT(30),IANA(30,2),COM(18),Z(30),ZA(30),ISET(20)                 005
      DIMENSION XPLOT(51,20)                                                    006
      DIMENSION TRANS (1), VARN(1),RANGE(51)                                    007
      DIMENSION RANGF(51)
      DATA BLNK/4H    /                                                         008
      DATA ASTRIK/4H   */                                                       009
      DATA ZERO/4H   0/                                                         010
      DATA TEMPF/4HT   /
   18 XSUM = 0.                                                                 011
C     FIND RANGE OF MEAN FOR SELECTED PARAMETER                                 012
      XMAX = TRANS(1)                                                           013
      XMIN = TRANS(1)                                                           014
      DO 73NFAR=1,51
   73 RANGF(NFAR) = BLNK
      DO 74 K = 1,ISTR                                                          015
      IF(TRANS(K).GT.XMAX) XMAX = TRANS(K)                                      016
      IF(TRANS(K).LT.XMIN) XMIN = TRANS(K)                                      017
      XSUM = TRANS(K) + XSUM                                                    018
   74 CONTINUE                                                                  019
 1000 XMEAN = XSUM/ISTR                                                         020
  188 KOUNT = 1                                                                 021
      XINCR = 2.*XSUM/(ISTR*25.)                                                022
      XSUM = 0.                                                                 023
      T2 = 25.                                                                  024
 1001 TOP = XSUM + XINCR * T2                                                   025
      RANGE(1) = TOP                                                            026
      DO910 M=2,51                                                              027
      T1 = M-1                                                                  028
      RANGE(M) = TOP - XINCR * T1                                               029
  910 CONTINUE                                                                  030
      IF(KOUNT.EQ.2) GO TO 913                                                  031
      IF(RANGE(1))911,911,913                                                   032
  911 DO 912 M=1,51                                                             033
  912 RANGE(M) = - RANGE(M)                                                     034
  913 CONTINUE                                                                  035
      DO 9 J=1,ISTR                                                             036
      DO 9 I=1,51                                                               037
      XPLOT(I,J) = BLNK                                                         038
    9 CONTINUE                                                                  039
      DO 14 K=1,ISTR                                                            040
      IF(TRANS(K).LE.RANGE(1)) GO TO 2222                                       041
      XPLOT(1,K) = ZERO                                                         042
      GO TO 14                                                                  043
 2222 IF(TRANS(K).GE.RANGE(51)) GO TO 2223                                      044
      XPLOT(51,K) = ZERO                                                        045
      GO TO 14                                                                  046
 2223 DO 12 I=1,50                                                              047
      IF(TRANS(K).LE.RANGE(I).AND.TRANS(K).GT.RANGE(I+1)) GO TO 11              048
   12 CONTINUE                                                                  049
   11 T3 = (RANGE(I)+RANGE(I+1))/2.                                             050
      IF(TRANS(K).LT.T3) GO TO 13                                               051
      XPLOT(I,K) = ASTRIK                                                       052
```

```
      GO TO 14                                                          053
   13 XPLOT(I+1,K) = ASTRIK                                             054
   14 CONTINUE                                                          055
      ISTA = ISTAT(KIN)                                                 056
      I1 = 2*IVAR(KIN,1)-5                                              057
      PRINT 104,VARN(I1),VARN(I1+1),COM                                 058
  104 FORMAT ('1TIME SERIES OF ',2A4,' FOR ',18A4)                      059
      I2 = IZPLOT(KIN,1)                                                060
      T1 = Z(I2)                                                        061
      IF (I1.EQ.12.OR.I1.EQ.16) T1= ZA(I2)                              062
      PRINT 700, ISTA,DT,T1,XINCR,XMEAN                                 063
  700 FORMAT('   THE FOLLOWING GRAPH IS FROM STATION ',I5,'  TIME STEP I  064
     1S',F6.1,'  MINUTES,  HEIGHT =',F6.1,' METERS' /     '   WITH RANGE
     2INCREMENT COMPUTED ',E12.6,' AND COMPUTED MEAN OF ',E12.6)
      PRINT 119,(ITIMES(I),I=1,ISTR)                                    067
  119  FORMAT (' TIME STEP ',20I5)                                      068
      IF(VARN(I1).EQ.TEMPF.AND.NFAREN.EQ.1) PRINT 1119
 1119 FORMAT(1H+,110X,'FAHRENHEIT')
      IF(VARN(I1).EQ.TEMPF.AND.NFAREN.EQ.2) PRINT 1120
 1120 FORMAT(1H+,110X,' ABSOLUTE ')
      DO 118 I=1,51                                                     069
      PRINT 1117, RANGE(I),(XPLOT(I,K),K=1,ISTR)
      IF(VARN(I1).NE.TEMPF) GO TO  118
      IF(NFAREN.EQ.1) RANGF(I) = (9./5.) * RANGE(I) + 32.
      IF(NFAREN.EQ.2) RANGF(I) = RANGE(I) + 273.16
 1118 PRINT 120, RANGF(I)
  120 FORMAT(1H+,110X,F10.4)
  118 CONTINUE                                                          071
 1117 FORMAT (1XE10.4,20(1XA4))                                         072
      KOUNT = KOUNT + 1                                                 073
      IF(KOUNT.GT.2) GO TO 699                                          074
      XINCR = (XMAX-(XMAX+XMIN) / 2.) / 25.                             075
      XSUM = XMAX                                                       076
      T2 = 0.                                                           077
      IF (XINCR.GT.0.) GO TO 1001                                       078
      PRINT 1                                                           079
    1 FORMAT (' SECOND GRAPH OMITTED--LINEAR')                          080
  699 RETURN                                                            081
      END                                                               082
```

```
      SUBROUTINE TAPCHG (I95,ITAPO)                                          001
C  PROGRAM TO CHANGE FROM PREDICTION TAPE(MULTI-STATION) TO ANALYSIS TAPE     002
C  UNIT I95 IS INPUT TAPE                                                     003
C  UNIT ITAPE/ITAPO IS OUTPUT TAPE                                            004
C  UNIT 97 IS DISK UNIT FOR RECORDERING RECORDS                               005
      DOUBLE PRECISION DT1,PP12,PP22,TT2,U2,V2,W2,YY                         006
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2, TAPCHG1
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE TAPCHG2
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2,VVEL(30)
      COMMON XKU(30),          SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1   ,XLAM,RSUM(15),B1,B2,RADMX2,RADMX1
      COMMON Z(30),ZA(30),DZ(30),DS(30),DUMMY(135),COM(18),VARIN(30)
     1  ,NCS,JMAX,IMAX,NX,NP1,IX,DT,ITIMES(20),IM1,ABC,IP1,NM1,IP2           012
     2  ,IGRID,NRECD,ITAPE                                                  013
      COMMON AB(600),U2S(30,20),V2S(30,20),TT2S(30,20),W2S(30,20)           014
     1 ,WSS(30,20),XKUS(30,20),XKTS(30,20),RIS(30,20),DT1S(30,20)           015
     2  ,PP1S(30,20),PP2S(30,20),RSUMS(15,40)                               016
      COMMON IUAR97                                                         017
      DIMENSION PP12(30),PP22(30),TT2(30),U2(30),V2(30),W2(30)              014
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,3),TT2(1))          019
     1  ,(YY(1,4),W2(1)),(YY(1,5),PP12(1)),(YY(1,6),PP22(1))                020
      DIMENSION MARAY(25)                                                   021
C   DEFINE FILE 97 (STATIONS*PRINT TIME STEPS,4*NCS,L,IUAR97)               022
      DEFINE FILE 97(500,2376,L,IUAR97)
      READ  1, IXTRA,(MARAY(I),I=1,IXTRA)                                   024
      PRINT 1,IXTRA                                                         025
C NO. WORDS IN NCS                                                          026
      NCST = 594
      READ (I95)      (Z(I),I=1,NCST)                                       028
      NCS = NCST                                                            029
      ITAPE = ITAPO                                                         030
      NCS1 = VARIN(1)                                                       031
      JMAX = VARIN(2)                                                       032
      IMAX = VARIN(3)                                                       033
      ABC  = VARIN(4)                                                       034
      NP1  = VARIN(5)                                                       035
      IX   = VARIN(6)                                                       036
      DT   = VARIN(7)                                                       037
      DO 703 I=1,20                                                         038
  703 ITIMES(I) = VARIN(I+7)                                                039
      XD = VARIN(28)
      IM1 = IX-1                                                            040
      IP1 = IX+1                                                            041
      NM1 = NP1-2                                                           042
      NX  = NP1-1                                                           043
      IP2 = IX+2                                                            044
      IGRID = IMAX*JMAX                                                     045
      J=0                                                                   046
      DO 704 I=1,IXTRA                                                      047
  704 J = J+MARAY(I)                                                        048
      NRECD = J*IGRID                                                       049
      DO 708 I=1,18                                                         050
  708 AB(I) = COM(I)                                                        051
      AB(19) = IGRID                                                        052
      AB(20) = ABC                                                          053
      AB(21) = NP1                                                          054
```

```
      DO 709 I=22,51                                                    055
  709 AB(I) = Z(I-21)                                                   056
      AB(52) = IMAX                                                     057
      AB(53) = JMAX                                                     058
      AB(54) = DT                                                       059
      AB(55) = IX                                                       060
      DO 710 I=1,20                                                     061
  710 AB(I+62) = ITIMES(I)                                              062
      AB(600) = XD
      ICOUNT = 0                                                        063
      PRINT 2,COM                                                       064
    2 FORMAT (1X,18A4)                                                  065
      DO 705 J=1,NRECD                                                  066
      READ (195,END=65) (RI(I),I=1,NCST)                                067
      ICOUNT = ICOUNT+1                                                 068
      WRITE (97'ICOUNT) (RI(I),I=1,NCST)                                069
  705 CONTINUE                                                          070
      PRINT 1,NRECD,NCS1,ICOUNT                                         071
      DO 64 I=1,500                                                     072
   64 READ (195,END=67) (RI(J),J=1,NCST)                                073
      PRINT 5                                                           074
    5 FORMAT ('0END OF FILE NOT REACHED AFTER 500 RECORDS')             075
      GO TO 68                                                          076
   65 PRINT 4 , J                                                       077
    4 FORMAT ('1END OF FILE PREMATURE AT RECORD',I7)                    078
      CALL EXIT                                                         079
   67 PRINT 6                                                           080
    6 FORMAT ('0END OF INPUT FILE REACHED')                             081
   68 CALL PRINT (IXTRA,MARAY)                                          082
      PRINT 3                                                           083
    3 FORMAT ('1OUTPUT TAPE WRITTEN')                                   084
      RETURN                                                            085
    1 FORMAT (14I5)                                                     086
      END                                                               087
```

```
      SUBROUTINE PRINT (IXTRA,MARAY)                                    001
      DOUBLE PRECISION DT1,PP12,PP22,TT2,U2,V2,W2,YY                    002
      COMMON RI(30),DT1(30),YY(30,6),SLOPX,SLOPY,HEIGHT,ETA1,ETA2,XETA2, TAPCHG1
     1YETA2,IHT,IANV,IGOG,ETAINX,ETAINY,CSOUT(2),CRS,RAA,TOUPRA,H3,CF,CE TAPCHG2
     2,WS(30),UST,CW,HAI,HSI,RANS,RABNS,RABS,CRNS,TRAUS,XT2,VVEL(30)
      COMMON XKU(30),          SRS,RADMX,IGOGO,ROW,XMQ,DEL
     1    ,XLAM,RSUM(15),B1,B2,RADMX2,RADMX1
      COMMON Z(30),ZA(30),DZ(30),DS(30),DUMMY(135),COM(18),VARIN(30)
     1  ,NCS,JMAX,IMAX,NX,NP1,IX,DT,ITIMES(20),IM1,ABC,IP1,NM1,IP2        008
     2  ,IGRID,NRECD,ITAPE                                               009
      COMMON AB(600),U2S(30,20),V2S(30,20),TT2S(30,20),W2S(30,20)       010
     1 ,WSS(30,20),XKUS(30,20),XKTS(30,20),RIS(30,20),DT1S(30,20)       011
     2  ,PP1S(30,20),PP2S(30,20),RSUMS(15,40)                           012
      COMMON IUAR97                                                     013
      DIMENSION PP12(30),PP22(30),TT2(30),U2(30),V2(30),W2(30)          014
      EQUIVALENCE (YY(1,1),U2(1)),(YY(1,2),V2(1)),(YY(1,3),TT2(1))      015
     1  ,(YY(1,4),W2(1)),(YY(1,5),PP12(1)),(YY(1,6),PP22(1))            016
      DIMENSION MARAY(25)                                               017
      ICOUNT = 1                                                        018
      DO 95L=1,IGRID                                                    019
      ISTR = 0                                                          020
      DO 10 I=1,IXTRA                                                   021
      MIS = MARAY(I)                                                    022
      DO 9 J=1,MIS                                                      023
      ISTR = ISTR+1                                                     024
      READ (97'ICOUNT) (RI(JJ),JJ=1,NCS)                               025
      ICOUNT = ICOUNT + 1                                               026
   41 CALL STOR(ISTR)                                                   027
    9 CONTINUE                                                          028
      IF(I.EQ.IXTRA) GO TO 10                                           029
      NCSP =  MIS *  (IGRID-L)                                          030
      ICOUNT = ICOUNT + NCSP                                            031
      NCSP =  (L-1) *  MARAY(I+1)                                       032
      ICOUNT = ICOUNT + NCSP                                            033
   10 CONTINUE                                                          034
      AB(56) = ISTR                                                     035
      WRITE (ITAPE)   AB                                                036
      WRITE (ITAPE)   RSUMS                                             037
      WRITE (ITAPE)   U2S                                               038
      WRITE (ITAPE)   V2S                                               039
      WRITE (ITAPE)   TT2S                                              040
      WRITE (ITAPE)   W2S                                               041
      WRITE (ITAPE)   WSS                                               042
      WRITE (ITAPE)   XKUS                                              043
      WRITE (ITAPE)   XKTS                                              044
      WRITE (ITAPE)   RIS                                               045
      WRITE (ITAPE)   DT1S                                              046
      IF (ABC.GE.12)  WRITE (ITAPE) PP1S                                047
      IF (ABC.EQ.13)  WRITE (ITAPE) PP2S                                048
      LSKIP =  L *  MARAY(1)                                            049
      ICOUNT = LSKIP + 1                                                050
   95 CONTINUE                                                          051
      END FILE ITAPE                                                    052
      REWIND ITAPE                                                      001
   99 RETURN                                                            002
      END                                                               003
```

```
      SUBROUTINE PRT (NN,I1,ISTR,ZP,UX,ISTEP)                          001
      DIMENSION ZP(1),UX(30,20)    ,ISTEP(1)                           002
      IT = I1+1                                                        003
      IB  = 1                                                          004
      IE  =  ISTR                                                      005
      IF (ISTR.GT.12) IE=12
      PRINT 129, (ISTEP(I),I=1,IE)                                     007
  110 DO 90 I=1,NN                                                     008
      NRI = NN-I+1                                                     009
      GO TO (140,141,142,143),IT                                       010
  140 PRINT 130, ZP(NRI),(UX(NRI,J),J=IB,IE)                           011
      GO TO 90                                                         012
  141 PRINT 131, ZP(NRI),(UX(NRI,J),J=IB,IE)                           013
      GO TO 90                                                         014
  142 PRINT 132, ZP(NRI),(UX(NRI,J),J=IB,IE)                           015
      GO TO 90                                                         016
  143 PRINT 133, ZP(NRI),(UX(NRI,J),J=IB,IE)                           017
   90 CONTINUE                                                         018
      IF(IE.GE.ISTR) GO TO 99
      IB = IE+1
      IE = ISTR                                                        019
      PRINT 128, (ISTEP(I),I=IB,IE)
      GO TO 110                                                        023
   99 RETURN                                                           024
  128 FORMAT ('1PAGE 2',4X,13I9)                                       025
  129 FORMAT (7H METERS,4X13I9)                                        026
  130 FORMAT (1H0,F7.2,3X,13(1XF8.0))                                  027
  131 FORMAT (1H0,F7.2,3X,13(1XF8.1))                                  028
  132 FORMAT (1H0,F7.2,3X,13(1XF8.2))                                  029
  133 FORMAT (1H0,F7.2,3X,13(1XF8.3))                                  030
      RETURN                                                           031
      END                                                             TR032
```

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16. Abstracts

Input deck make-up and FORTRAN IV listings are presented for the numerical model described in Volume I.

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