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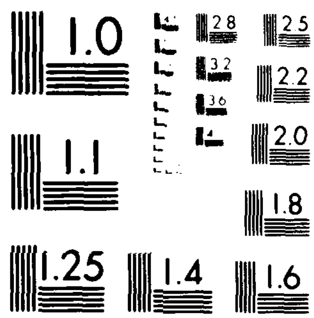

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THE ROSCOE MANUAL

Volume 14A-1-Ambient Atmosphere (Major and Minor Neutral Species and Ionosphere)

Science Applications, Inc.
P.O. Box 2351
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30 June 1979

Final Report for Period 1 January 1976—30 June 1979

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The ROSCOE-Radar ambient atmosphere model has been extensively revised to provide (a) major atmospheric properties and species densities corresponding to either a code-generated or (optional) user-specified latitude- and season-dependent temperature profile below 120-km altitude, (b) an increase from 10 to 19 minor species profiles (O, $O(^1D)$, $O_2(a^1\Delta_g)$, O_3, $N(^4S)$, $N(^2D)$, $N(^2P)$, NO, NO_2, N_2O, CO_2, CO, CH_4, H_2O, OH, HO_2, H, Ar, and He), with some of them having complex dependencies on latitude (or even geographic position in the

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20. ABSTRACT (Continued)

case of water below 5-km altitude), local apparent time, fractional season-year, and solar decimetric flux, (c) (optional) user-specified water-vapor profile, and (d) an ionosphere with e, O^+, NO^+, O_2^+, and N_2^+ as ionized species (>90 km).

Conversion factors for U.S. customary to metric (SI) units of measurement.

To Convert From	To	Multiply By
angstrom	meters (m)	1.000 000 X E -10
atmosphere (normal)	kilo pascal (kPa)	1.013 25 X E +2
bar	kilo pascal (kPa)	1.000 000 X E +2
barn	meter^2 (m^2)	1.000 000 X E -28
British thermal unit (thermochemical)	joule (J)	1.054 350 X E +3
calorie (thermochemical)	joule (J)	4.184 000
cal (thermochemical)/cm^2	mega joule/m^2 (MJ/m^2)	4.184 000 X E -2
curie	*giga becquerel (GBq)	3.700 000 X E +1
degree (angle)	radian (rad)	1.745 329 X E -2
degree Fahrenheit	degree kelvin (K)	$t_K = (t^\circ f + 459.67)/1.8$
electron volt	joule (J)	1.602 19 X E -19
erg	joule (J)	1.000 000 X E -7
erg/second	watt (W)	1.000 000 X E -7
foot	meter (m)	3.048 000 X E -1
foot-pound-force	joule (J)	1.355 818
gallon (U.S. liquid)	meter^3 (m^3)	3.785 412 X E -3
inch	meter (m)	2.540 000 X E -2
jerk	joule (J)	1.000 000 X E +9
joule/kilogram (J/kg) (radiation dose absorbed)	Gray (Gy)	1.000 000
kilotons	terajoules	4.183
kip (1000 lbf)	newton (N)	4.448 222 X E +3
kip/inch^2 (ksi)	kilo pascal (kPa)	6.894 757 X E +3
ktap	newton-second/m^2 (N-s/m^2)	1.000 000 X E +2
micron	meter (m)	1.000 000 X E -6
mil	meter (m)	2.540 000 X E -5
mile (international)	meter (m)	1.609 344 X E +3
ounce	kilogram (kg)	2.834 952 X E -2
pound-force (lbs avoirdupois)	newton (N)	4.448 222
pound-force inch	newton-meter (N·m)	1.129 848 X E -1
pound-force/inch	newton/meter (N/m)	1.751 268 X E +2
pound-force/foot^2	kilo pascal (kPa)	4.788 026 X E -2
pound-force/inch^2 (psi)	kilo pascal (kPa)	6.894 757
pound-mass (lbm avoirdupois)	kilogram (kg)	4.535 924 X E -1
pound-mass-foot^2 (moment of inertia)	kilogram-meter^2 (kg·m^2)	4.214 011 X E -2
pound-mass/foot^3	kilogram/meter^3 (kg/m^3)	1.601 846 X E +1
rad (radiation dose absorbed)	**Gray (Gy)	1.000 000 X E -2
roentgen	coulomb/kilogram (C/kg)	2.579 760 X E -4
shake	second (s)	1.000 000 X E -8
slug	kilogram (kg)	1.459 390 X E +1
torr (mm Hg, 0° C)	kilo pascal (kPa)	1.333 22 X E -1

*The becquerel (Bq) is the SI unit of radioactivity; 1 Bq = 1 event/s.
**The Gray (Gy) is the SI unit of absorbed radiation.

A more complete listing of conversions may be found in "Metric Practice Guide E 380-74," American Society for Testing and Materials.

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SECTION 1

INTRODUCTION

In this volume we describe the ROSCOE-IR model for the major and minor neutral species in the ambient atmosphere and the ionized species in the ambient ionosphere [ROSCOE Model 1]. The overall model consists of 16 subroutines of which three are major subroutines:

a. ATMOSU provides the major neutral species and the the general properties of the ambient atmosphere,

b. SPCMIN, supplemented by Subroutines OZONE, WATER, WVOPT, and H2OSVP, provides the minor neutral species, and

d. IONOSU provides the ambient ionized species and the general properties of the ionosphere.

The principal changes for these three routines in going from ROSCOE-Radar to ROSCOE-IR are summarized below.

The new Subroutine ATMOSU provides for:

a. Replacement of the predetermined fit coefficients for the g/T_M profile by those derived during the initialization phase from specifying a temperature profile and a molecular weight profile.

b. Use of a 0- to 120-km temperature profile for any latitude and season, obtained in Subroutine TEMPZH by linear interpolation of a set of latitude and season profiles based on the U.S. Standard Atmosphere Supplements, 1966 [US-66].

c. Use of a specified universal profile of the molecular-weight function $[(M_{\star}/M)-1] \equiv f = f_{DAY}$, independent of latitude, season, and diurnal variation. (The new f-function is specified by the DD-coefficient array for an 11th-degree polynomial.) However, the nighttime atomic oxygen profile differs from the daytime profile below 90 km and is computed from a separate fit function. The daytime atomic oxygen profile is computed from specification of temperature and molecular-weight profiles instead of being specified directly and entered as data in Subroutine SPCMIN.

d. An option for the user to specify a temperature profile of interest to him (at altitudes z = 0(4)120 km) instead of using the one selected by the code as a function of latitude and season.

e. Elimination of a pressure-correction factor employed in the original model to match the CIRA-1965 [CI-65] conditions at 120-km altitude.

f. Season-dependent conditions at 120-km altitude (the base altitude for the high-altitude diffusion model) instead of constant conditions.

g. An increase of the SNI array to 30 from 6.

The new Subroutine SPCMIN provides for:

a. New altitude profiles of CO, N_2O, CH_4, H, OH, HO_2, $N(^2D)$, $N(^2P)$, and $O(^1D)$.

b. Revised altitude profiles of O_3, H_2O, N, $N(^4S)$, and NO.

The new Subroutine IONOSU provides for:

a. Replacement of the E- and F-region generic molecular ion M^+ by NO^+, N_2^+, and O_2^+.

b. A corresponding change in IONOUP Common.

For simplicity of presentation, we have adopted a flexible definition of which species are major and which are minor. It is hoped that the meaning will always be clear to the reader in the context of the usage.

The overall inputs, some intermediate outputs, and final outputs for Model 1 are given in Table 1-1.

A flow diagram of the 16 subroutines, with their driver routine for development and test problems, is given in Figure 1-1. A brief, simplified description of the working of the 16 subroutines follows.

The Subroutine ATMOSU is initialized on a call to ATMOSU(1, 120.) to set up needed parameters and to evaluate the solar-flux-dependent Fourier coefficients used in computing the time-dependent values of τ (the variable controlling the temperature gradient at the lower boundary (120 km) of the high-altitude model) and T_∞ (the exospheric temperature). In this call the values of the time (HL, hours), the 10.7-cm solar flux (SBAR), and the day-or-night parameter

Table 1-1. Inputs, intermediate outputs, and final outputs for major and minor neutral species and ionosphere for ambient conditions (ROSCOE Model 1).

INPUT

Initialization

Location (geographic colatitude and longitude)

Time (year, month, day, local zone time)

*Kinetic temperature profile ($\leq$ 120 km) for latitude and season

*Moisture profile (mixing ratio, humidity, or dew-point temperature

Operation

Altitude

SOME INTERMEDIATE OUTPUTS

Time:	Universal time, Julian day number, local (apparent) time, index for day or night
Solar Properties:	Solar zenith angle, solar flux at 10.7 cm
Minor Species:	Fit parameters for density profiles

FINAL OUTPUTS

Neutral Species

N_2, O_2, O, Ar, He, CO_2, $N(^4S)$, $N(^2D)$, $N(^2P)$, NO, NO_2, N_2O, O_3, $O_2(^1\Delta_g)$, $O(^1D)$, CO, CH_4, H_2O, OH, HO_2, H

Ionized Species ($\geq$ 90 km)

e, O^+, NO^+, O_2^+, N_2^+

Atmospheric Properties

Pressure, density, density scale height, (gas) temperature, and relative humidity

Ionospheric Properties

Electron (and N_2 vibration) temperature, effective ion-pair production rate

---

*Option for user specification.

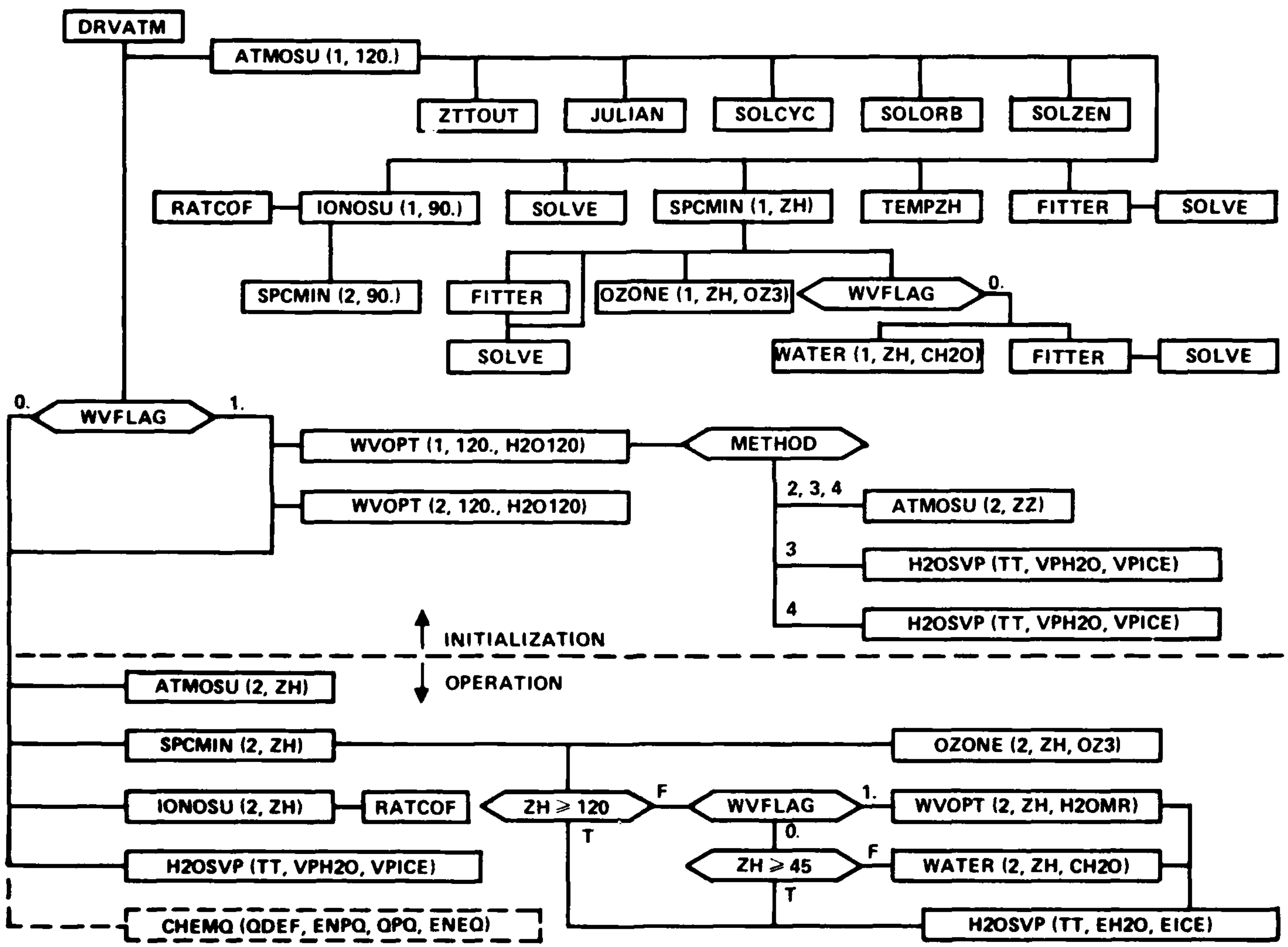

Figure 1-1. Flow diagram of Program DRVATM, Subroutines ATMOSU, SPCMIN, and IONOSU, and their auxiliary routines.

(IDORN) are determined by a series of calls from ATMOSU to five auxiliary subroutines (ZTTOUT, JULIAN, SOLCYC, SOLORB, and SOLZEN) and are passed to ATMOSU through ATMOUP Common.

The working of these five auxiliary routines is as follows:

a. Subroutine ZTTOUT, receiving from TIME Common the input parameters year (IYRS), month (IMONS), day (IDAYS), and zone time (ZT) at east longitude PLON, returns to TIME Common the year, month, day, and mean or universal time (UT) at Greenwich.

b. Subroutine JULIAN, called with the input parameters of year (IYRS), month (IMONS), and day (IDAYS) at north latitude PLAT, returns the Julian day number at the first of the year (YRFJ), the Julian date for vernal equinox (VEQJ), and the Julian day number on the day of interest (DAYJ) through the argument list and the fractional season-year (FYR) and the fractional summer (FST) through TIME Common.

c. Subroutine SOLCYC, called with DAYJ, computes the average 10.7-cm solar flux (SBAR), an input to ATMOSU through ATMOUP Common.

d. Subroutine SOLORB, called with YRFJ, VEQJ, and DAYJ and receiving UT from TIME Common, computes the Greenwich apparent time GAT, placed in TIME Common, and returns the north latitude (SOLLAT) and east longitude (SOLLON) of the subsolar point.

e. Subroutine SOLZEN, called with SOLLAT and SOLLON and receiving PLAT, PLON, and GAT from TIME Common, returns to ATMOUP Common the solar zenith angle (CHI), the day-or-night parameter (IDORN), and the local apparent time (HL); the latter two parameters are used by ATMOSU.

The next step in the initialization of ATMOSU is to generate a fit function (with coefficient array AA) for the ratio g/T_M.

$$\frac{g}{T_M} \equiv \frac{g}{T}\frac{M}{M_*} \equiv \frac{g}{T(1+f_{DAY})} \equiv \frac{g}{T(1+f)} .$$

This objective is achieved by:

a. Developing a fit function (with coefficient array DD) by ATMOSU calling FITTER with the data-statement values of f specified in ATMOSU,

b. Evaluating g/[T(1+f)] in ATMOSU, after calling Subroutine TEMPZH to get a kinetic temperature profile, TZH(N). Subroutine TEMPZH, as directed by flag TPFLAG read by Program DRVATM and passed through ZHTEMP Common, will either (if TPFLAG = 0.0) interpolate the data base [US-66] for latitude and season or (if TPFLAG $\neq$ 0.0) read a tabular temperature profile TZH(N) provided by the user.

c. Calling Subroutine FITTER to obtain the coefficient-array AA.

After an initialization call from ATMOSU to SPCMIN(1,ZH), fit parameters are determined for O (nighttime only) and CO_2 and several other initializations are made; eventually, an initialization call is made to IONOSU(1,ZH). During the initialization of SPCMIN, 13 calls to FITTER and six (direct) calls to SOLVE are made to determine the fit coefficients for the day and night profiles of the minor species N, $N(^2D)$, NO, $O_2(^1\Delta_g)$, CO, CH_4, O_3, NO_2, H_2O, H, OH, HO_2, $O(^1D)$, and N_2O. SPCMIN also makes initializing calls to Subroutines OZONE and (if WVFLAG = 0.0) WATER. (If the user does not want the water profile provided by the code, his setting the flag WVFLAG $\neq$ 0.0 will enable Subroutine WVOPT to read a user-provided water profile according to one of four methods specified by the flag METHOD = 1, 2, 3, 4.)

Subroutine FITTER, called from both ATMOSU and SPCMIN with values Y(I) of the dependent variable at NPTS values of the independent variable X(I), the degree NO of the polynomial used as the fitting function, an index IKIND denoting whether it is the dependent variable itself or its natural logarithm that is to be fitted, and an index ISIGN denoting negative or positive exponents in the polynomial, returns the polynomial coefficients determined by the method of least squares.

Subroutine SOLVE, called from Subroutines ATMOSU, SPCMIN, and FITTER with elements A(I,J) of a matrix of constant coefficients, returns the solutions of NO simultaneous linear algebraic equations.

The three major subroutines are ready for use after they have been initialized. On subsequent calls to ATMOSU(2,ZH), with ZH the altitude in kilometers, ATMOSU uses ATMOUP Common to return the pressure (PP), the mass density (RHO), the temperature (TT), the number densities of six species (SNI(I), I = 1,6), and the density scale height (HRHO).

On subsequent calls to SPCMIN(2,ZH), ATMOUP Common is used to return the number densities of 16 minor species (SNI(I), I = 7, 8, 13-24, 26, and 27) and the relative humidity (SNI(25)). On subsequent calls to IONOSU(2,ZH), ATMOUP Common is used to return the number densities of the five charged species (SNI(I), I = 9-11, 28, 29) and the electron (and N_2 vibration) temperature (SNI(12)) and IONOUP Common is used to return these same quantities (with different names) and the effective ion-production rate (QDEF).

Finally, another new routine for ROSCOE-IR, H2OSVP, is available to compute the saturated vapor pressure of water vapor over a plane surface of (1) water for the temperature range from 173.15 to 373.15°K (-100 to +100°C) and (2) ice for the temperature range from 173.15 to 273.15°K (-100 to 0°C). Values of zero are returned for the parameters outside the indicated temperature ranges and a message is printed if the routine is called outside the indicated range.

SECTION 2

AMBIENT ATMOSPHERE AND MAJOR NEUTRAL SPECIES

2-1 INTRODUCTION

The main subroutine for the ambient atmosphere and the major neutral species is ATMOSU. It is based on the Subroutine ATMOS originally developed by R.W. Lowen [Lo-73a] and later modified for ROSCOE-Radar [HS-75]. (The reader may refer to Lo-73a or, better, to HS-75 in which Lo-73a is reproduced with comments, revisions, and extensions.) For the manner in which ATMOSU is used in ROSCOE-IR, see Figure 2-1 for a simplified flow diagram and Table 2-1 for a summary of inputs and outputs.

2-2 THE AMBIENT ATMOSPHERE MODEL FOR ROSCOE-IR

2-2.1 Background

To understand the present model, it is useful to recall that used for ROSCOE-Radar. The ambient atmosphere model for ROSCOE-Radar [Vol. 14a] consisted of a low-altitude portion ($z < 120$ km) and a high-altitude portion ($z \geq 120$ km), appropriately joined at 120 km to provide a smooth transition. The overall model was based mainly on the CIRA-1965 [CI-65] model atmosphere, but was supplemented by use of the U.S. Standard-1962 model atmosphere since CIRA-1965 is not defined below 30-km altitude. The key to the low-altitude portion was an analytic specification of an altitude profile of the ratio g/T_M (where g is the acceleration due to gravity and T_M is the molecular-scale temperature) which permitted one to obtain the pressure (p) from an analytic integration of the hydrostatic equation [HS-75, p. 19, Equation (3)]. One then obtained the density (ρ) from the perfect gas law

$$\rho = \frac{M_*}{R} \frac{g}{T_M} \frac{p}{g} \tag{1}$$

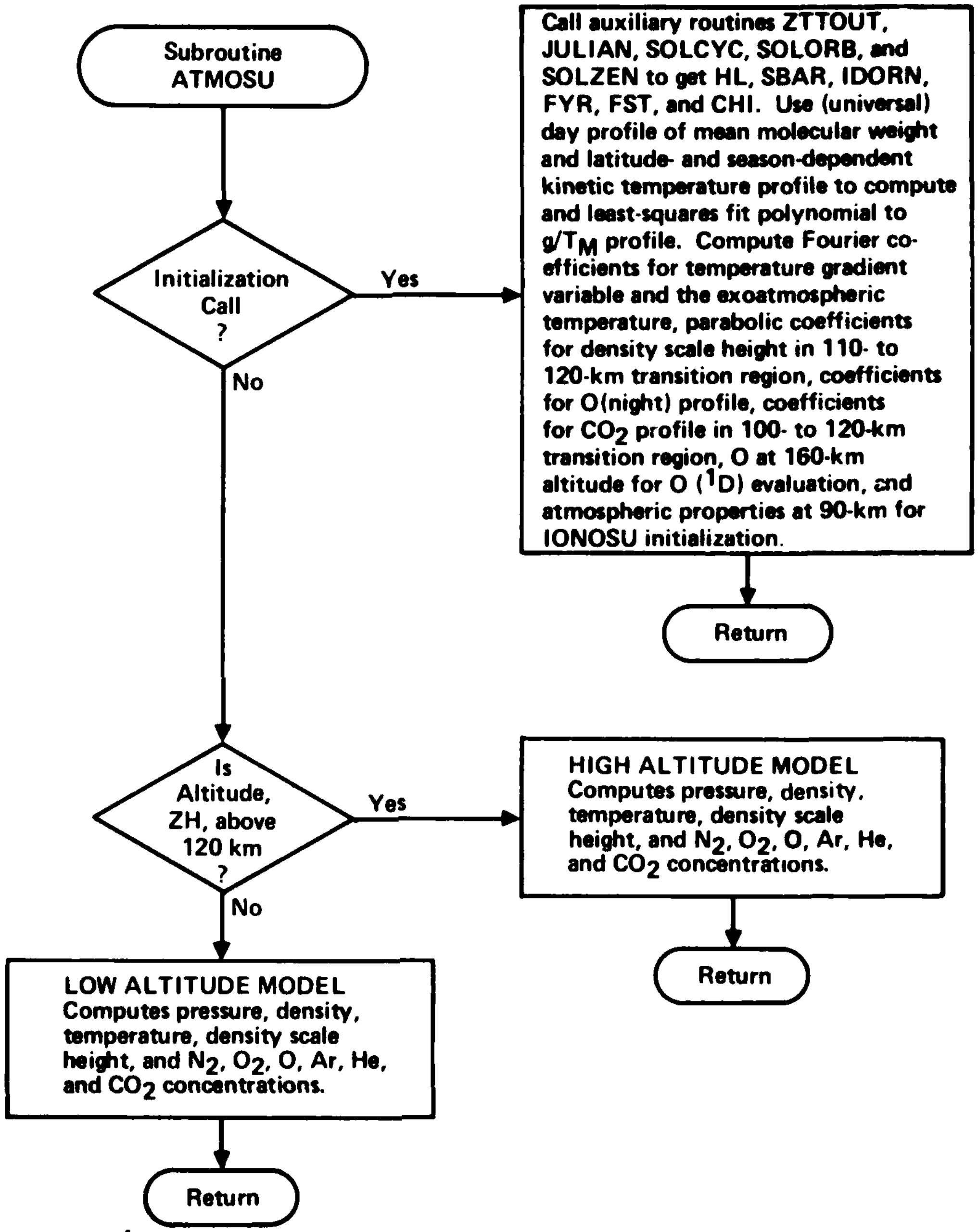

Figure 2-1. Flow diagram of Subroutine ATMOSU.

Table 2-1. Input and output variables for Subroutine ATMOSU.

INPUT VARIABLES

Argument List

JJ	-	Calculation flag If { JJ = 1: calculate initialization parameters JJ = 2: calculate atmospheric properties.
ZH	-	Altitude of interest (km).

ALTODN Common

ALTKM(47)	-	The array of altitudes at which minor species are specified as data in SPCMIN.
ONITE(18)	-	The nighttime O-values specified as data in SPCMIN.
CO2(25)	-	The CO_2-values specified as data in SPCMIN.

ATMOUP Common

HL	-	Local time (hrs).
SBAR	-	Average 10.7-cm solar flux [10^{-22} W/(m^2 Hz)].
IDORN	-	Parameter for day or night. If COSCHI is the cosine of the zenith angle of the sun at point P, IDORN is 1 for daytime, i.e., IF(COSCHI.GE.0.0), and is -1 for nighttime, i.e., IF(COSCHI.LT.0.0).

TIME Common

IYRS	-	Number of the year in the 1900's (e.g., 1974 becomes 74) at east longitude PLON.
IMONS	-	Number of the month (e.g., February becomes 2) at east longitude PLON.
IDAYS	-	Day of the month at east longitude PLON.
ZT	-	Zone time for the 15-degree longitude interval containing PLON (decimal hours).
PLAT	-	North latitude of point P (say, grid origin) (radians).
PLON	-	East longitude of point P (say, grid origin).

(Continued)

Table 2-1. (Cont'd)

ZHTEMP Common	
NZHT	- The number of altitudes in the ZHT array; set in SPCMIN to be 31
TZH(31)	- The kinetic temperatures at altitudes ZHT(31); provided by Subroutine TEMPZH
ZHT(31)	- The altitudes at which the kinetic temperatures are specified; set in Subroutine TEMPZH
OUTPUT VARIABLES	
ALTODN Common	
S3ZOD	- O density at 160-km altitude for use in evaluating $O(^1D)$ in SPCMIN
ATMOUP Common	
PP	- Pressure (dynes/cm^2)
RHO	- Density (g/cm^3)
TT	- Temperature (°K)
SNI(1)	- N_2 concentration (1/cm^3)
SNI(2)	- O_2 concentration (1/cm^3)
SNI(3)	- O concentration (1/cm^3)
SNI(4)	- Ar concentration (1/cm^3)
SNI(5)	- He concentration (1/cm^3)
SNI(6)	- CO_2 concentration (1/cm^3)
HRHO	- Density scale height (km)
FEHSEQ	- Fractional error in hydrostatic equilibrium
TIME Common	
RHO5KM	- Mass density of dry air at 5-km altitude for use in Subroutine WATER

and the kinetic temperature (T) from

$$T = \frac{M}{M_*} \frac{T_M}{g} g \qquad (2)$$

where M is the mean molecular weight and M_* is the value of M at sea level (28.96 g/mole). The mean molecular weight (M) was obtained from

$$\frac{M}{M_*} \equiv \frac{1}{1 + f} \equiv \frac{1}{1 + M_*[O]/2L\rho} , \qquad (3)$$

where L is Avogadro's number, by specifying a (daytime) profile of the atomic oxygen density [O]. The species densities were obtained from the law of partial pressures and the assumption of perfect mixing. Since there was just one specification of g/T_M, the low-altitude portion of the atmosphere model was independent of latitude, season, and diurnal conditions. The high-altitude portion depended on both diurnal and solar-cycle conditions.

In planning for ROSCOE-IR, we recognized the need to account for the latitude and seasonal dependence of the atmospheric temperature below 120 km. The only data base with such information is the U.S. Standard Atmosphere Supplements-1966 [US-66]. Thus, in the ambient atmosphere model for ROSCOE-IR, we start with latitude- and season-dependent (kinetic) temperature profiles and we must ultimately obtain a latitude- and season-dependent profile of g/T_M, if we want to exploit the main structure of the atmosphere model for ROSCOE-Radar. However, there must be some other modifications. For example, $f \equiv f_{Day}$ will be prescribed and postulated not to have a latitude, season, or diurnal variation. This assumption implies:

a. $(M/M_*)_{Night}$ will be approximated by $(M/M_*)_{Day}$, as in ROSCOE-Radar,

b. $[O]_{Day}$ will be computed from

$$[O]_{Day} = 2\,L\rho f/M_* \equiv 2\,n_* f , \qquad (4)$$

c. $[O]_{Night}$ will be computed directly from fit functions, as in ROSCOE-Radar.

2-2.2 Kinetic Temperature Data and Interpolation

2-2.2.1 Temperature Data

The temperature data, dependent on latitude and season but diurnally-independent, are from US-66, with locations as indicated in Table 2-2. The data are collated in Table 2-3 and plotted in Figures 2-2a through 2-2d.

Provision has been made for the user to read in his own preferred temperature profile at $z = 0(4)120$ km, accomplished by setting TPFLAG $\neq$ 0.0 which enables Subroutine TEMPZH to read the desired data.

2-2.2.2 Interpolation in Latitude

The procedure for interpolating the data base is, first, to derive summer and winter tabular temperature profiles at the latitude of interest, according to the following rules:

LATBND	Use
1	The single temperature profile for 15° latitude for both winter and summer.
2,3,4,5	The winter and summer profiles at the two boundaries of the latitude band and interpolate linearly on latitude to obtain the new winter and summer profiles.
6	The winter and summer temperature profiles for 75° latitude.

2-2.2.3 Interpolation in Season

If LATBND > 1, determine the temperature profile for the calendar date of interest by linearly interpolating between January and July temperature profiles, with proper account of northern and southern hemispheres. To do this, we:

(1) Determine a parameter F_{ST} where

F_{ST} = fraction of summer temperature to be used in the linear combination of summer- and winter-temperature profiles

= fraction of July temperature in northern latitudes.

= fraction of January temperature in southern latitudes.

F_{ST} is evaluated in Subroutine JULIAN.

Table 2-2. Location of temperature data.

LATBND	Latitude Range	Location in US-66 for Temperature Profile at Boundary of Band
		15°N Annual [0(4)116 km][a] pp. 99,101
1	$0 \leq \phi < 15$	
		15°N Annual [0(4)116 km][a] pp. 99,101
2	$15 \leq \phi < 30$	
		30°N {January [0(4)116 km][a] pp. 103,105 July [0(4)116 km][a] pp. 107,109}
3	$30 \leq \phi < 45$	
		45°N {January [0(4)116 km][a] pp. 111,113 July [0(4)116 km][a] pp. 115,117}
4	$45 \leq \phi < 60$	
		60°N {January [0(4)116 km][a] pp. 123,125 July [0(4)116 km][a] pp. 135,137}
5	$60 \leq \phi < 75$	
		{75°N January [0(4)28 km][b] p. 139 60°N January [32(4)116 km][a] p. 125}[a]
		{75°N July [0(4)28 km] p. 145 60°N July [32(4)116 km]}[a,c] p. 137
6	$75 \leq \phi \leq 90$	
		{Same as 75 boundary}

[a] 120-km value obtained by extrapolation.

[b] 0-km value changed from 249.22 to 254.0°K.
28-km value changed from 207.65 to 212.5°K.

[c] 32-km value changed from 238.47 to 241.0°K.

Table 2-3. Kinetic temperature profile data from US-66.

z	15°N	30°N		45°N		60°N		≈75°N	
km	Annual	January	July	January	July	January	July	January	July
0.	302.59	288.52	304.58	272.59	296.22	257.28	288.45	254.0	278.92
4.	277.44	268.44	277.87	255.79	273.57	247.81	265.87	239.89	262.09
8.	250.37	242.32	252.41	231.72	248.28	220.55	239.18	217.86	235.87
12.	223.64	216.40	224.42	218.66	222.30	217.15	225.15	213.25	228.65
16.	197.02	205.91	203.15	216.67	215.65	216.56	225.15	210.05	230.15
20.	206.71	207.92	211.75	215.15	219.17	214.17	225.15	207.65	230.15
24.	219.23	216.90	219.90	215.15	223.94	211.79	226.56	207.65	230.71
28.	227.94	224.83	227.83	215.85	229.49	214.06	232.52	212.5	235.48
32.	236.63	232.74	235.74	219.02	237.81	218.03	238.47	218.03	241.0
36.	245.32	242.14	245.14	230.92	247.64	224.76	250.18	224.76	250.18
40.	253.99	251.62	254.62	243.17	257.52	234.65	262.05	234.65	262.05
44.	262.66	261.08	264.08	255.41	267.39	244.53	272.48	244.53	272.48
48.	270.15	269.15	272.15	265.65	275.65	254.40	276.82	254.40	276.82
52.	269.24	268.14	271.14	265.65	275.65	260.15	277.15	260.15	277.15
56.	261.39	260.28	263.28	258.63	266.87	257.30	271.99	257.30	271.99
60.	253.10	252.04	254.79	250.77	257.05	250.89	262.73	250.89	262.73
64.	239.40	239.90	239.91	242.93	244.52	248.93	244.26	248.93	244.26
68.	225.72	227.77	225.04	234.76	226.89	246.97	225.83	246.97	225.83
72.	212.06	215.66	210.19	226.54	209.28	241.12	207.41	241.12	207.41
76.	198.41	203.56	195.36	218.34	191.69	232.51	189.01	232.51	189.01
80.	184.78	191.47	180.54	210.14	174.12	223.91	170.64	223.91	170.64
84.	177.10	191.10	172.50	201.89	165.10	215.27	161.71	215.27	161.71
88.	177.05	191.04	172.45	199.54	165.06	206.63	161.66	206.63	161.66
92.	179.50	199.56	175.71	201.02	169.98	205.55	167.51	205.55	167.51
96.	185.77	211.72	183.55	210.50	180.96	212.70	179.67	212.70	179.67
100.	190.70	222.43	190.03	218.58	190.51	218.49	190.39	218.49	190.39
104.	205.98	237.88	209.16	232.65	214.04	230.24	217.12	230.24	217.12
108.	229.78	256.88	237.66	250.58	246.42	245.33	252.57	245.33	252.57
112.	253.25	275.76	265.72	268.65	278.60	261.48	288.06	261.48	288.06
116.	315.82	304.46	322.72	301.06	329.46	297.50	334.14	297.50	334.14
120.	379.70	333.30	379.70	333.30	379.70	333.30	379.70	333.30	379.70

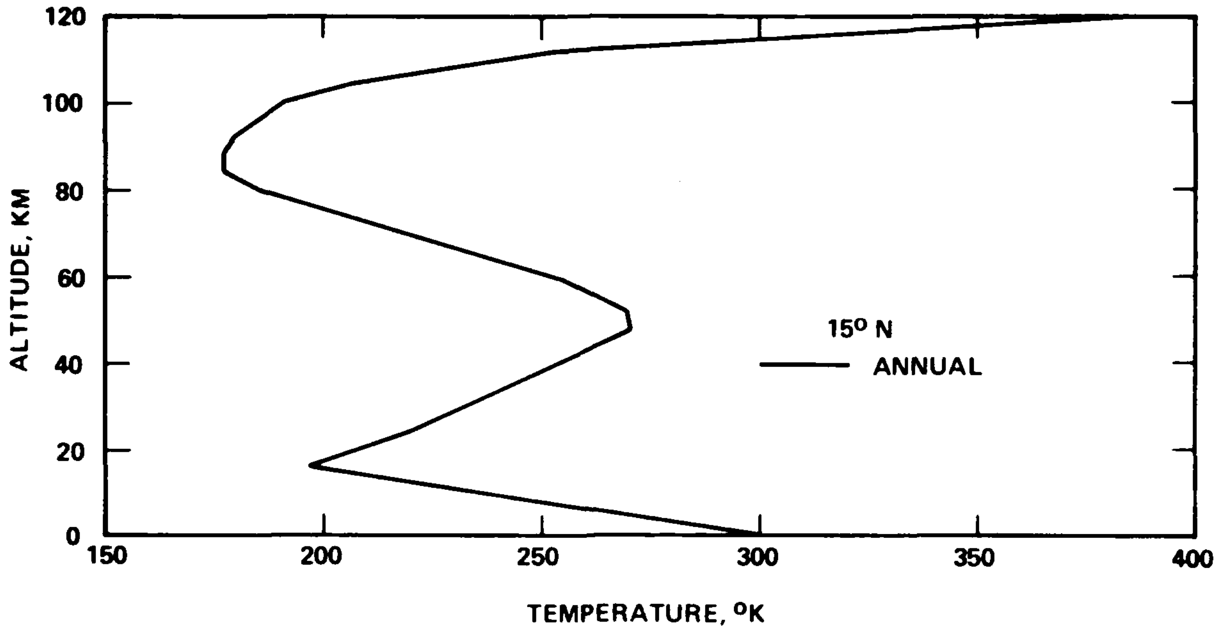

Figure 2-2a. Adopted data for temperature profile at 15°N latitude.

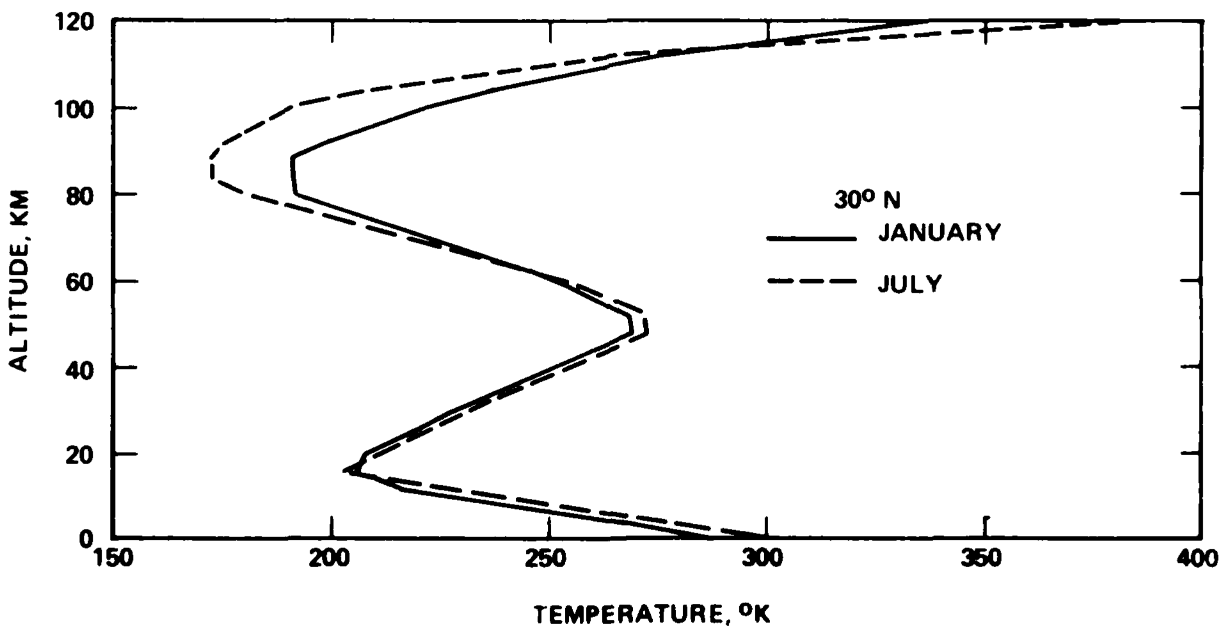

Figure 2-2b. Adopted data for temperature profile at 30°N latitude.

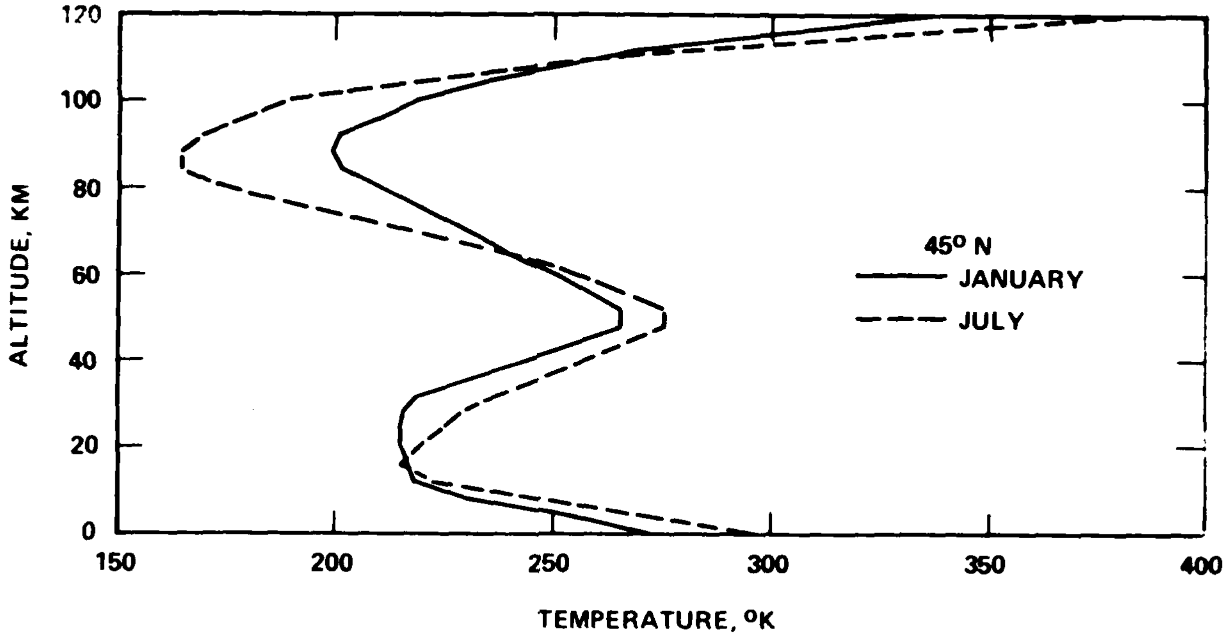

Figure 2-2c. Adopted data for temperature profile at 45°N latitude.

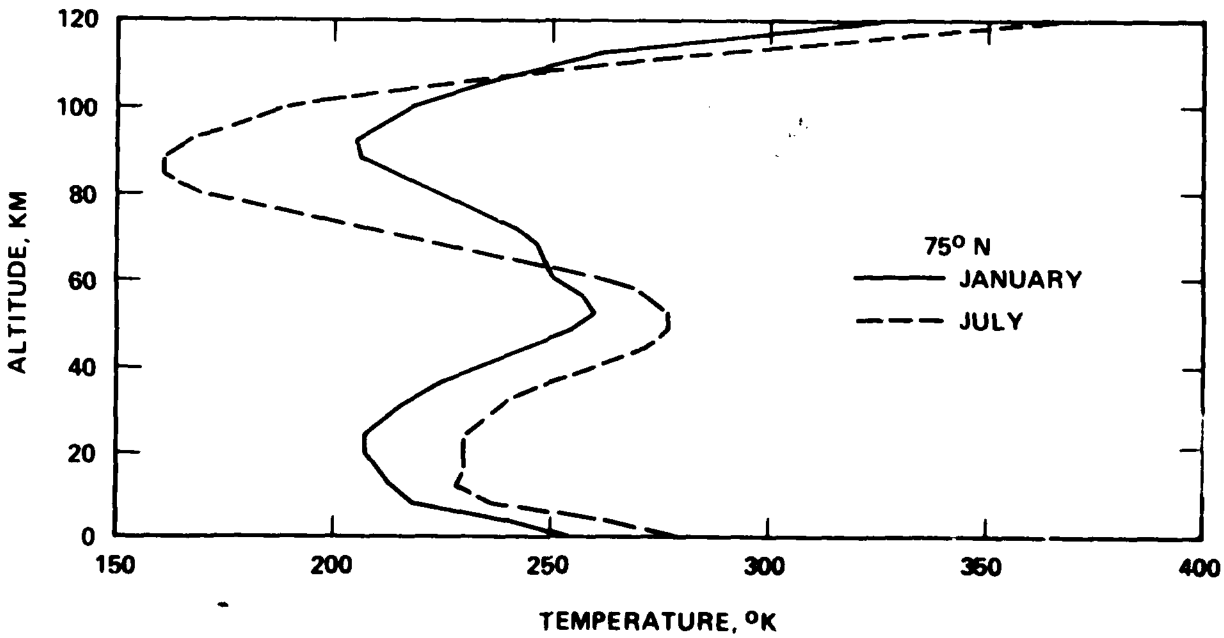

Figure 2-2d. Adopted data for temperature profile at 75°N latitude.

(2) Compute the temperature at given altitude from

$$T = F_{ST} T_{summer} + (1 - F_{ST}) T_{winter} \quad . \tag{5}$$

A test of our adopted procedure for linear seasonal interpolation is made for the 45°N latitude data where we have compared the average of the January and July values with the spring/fall value given by US-66. See Table 2-4 and Figure 2-3.

Table 2-4. Comparison of the mean of the January and July temperature profiles from US-66 with the mid-latitude spring/fall temperature profile from US-66.

z, km	45°N Mean[a]	Midlat. Spring/Fall[b]	z, km	45°N Mean[a]	Midlat. Spring/Fall[b]	z, km	45°N Mean[a]	Midlat. Spring/Fall[b]
0	284.40	288.15	44	261.40	261.40	88	182.30	190.54
4	264.68	262.17	48	270.65	270.65	92	185.50	191.44
8	240.00	236.22	52	270.65	270.65	96	195.73	197.77
12	220.48	216.65	56	262.75	263.63	100	204.54	202.73
16	216.16	216.65	60	253.91	255.77	104	223.34	213.02
20	217.16	216.65	64	243.72	243.20	108	248.50	226.75
24	219.54	220.56	68	230.82	227.53	112	273.62	241.09
28	222.67	224.53	72	217.91	214.07	116	315.26	298.43
32	228.42	228.49	76	205.01	202.34	120	356.50	355.19
36	239.28	239.28	80	192.13	190.65			
40	250.34	250.35	84	183.49	190.60			

[a]Average of January and July values.

[b]US-66, pp. 119,121.

2-2.3 Mean Molecular-Weight Profile

The mean molecular-weight profile, M, is specified by the function

$$f = \frac{M_*}{M} - 1 \tag{6a}$$

$$= \frac{M_*[O]_{Day}}{2L_0} \quad , \tag{6b}$$

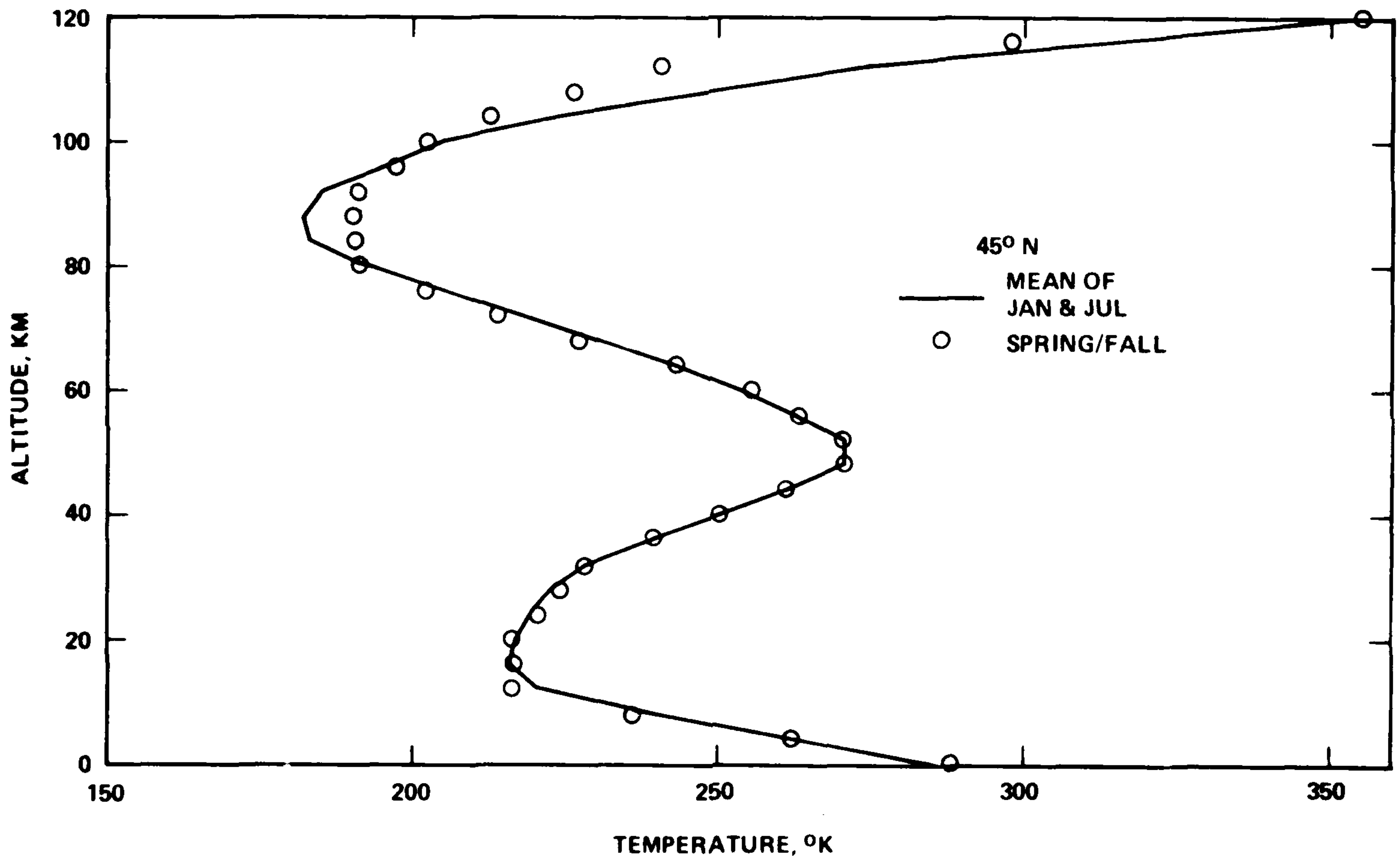

Figure 2-3. Comparison of the rean of the January and July temperature profiles from US-66 with the midlatitude spring/fall temperature profile from US-66.

taken to be independent of latitude, season, and diurnal variation. The adopted profile, given in Table 2-5 and plotted in Figure 2-4, is obtained as follows:

1. For z = 0(4)92 km,

   a. Take $[O]_{Day}$ from data base for ROSCOE-Radar (set as data statement in Subroutine SPCMIN [HS-75]).

   b. Take air density, ρ, from US-66 (pp. 119,121, Table 5.1, 45° latitude, spring/fall).

   c. Compute f from Equation (6b).

2. For z = 96(4)120 km,

   a. Take M from US-66 (p. 16, Table 2.3, spring/fall).

   b. Compute f from Equation (6a).

2-2.4 Molecular-Scale Temperature

For the interpolated temperature profile of interest, T, and the value of $M_*/M \equiv 1 + f$ derived from the fit function for f, the molecular-scale temperature is computed from

$$T_M = (M_*/M)T = (1 + f)T , \qquad z = 0(4)120 \text{ km} . \qquad (7)$$

2-2.5 The Ratio g/T_M

Tabular values of the ratio

$$g/T_M , \qquad z = 0(4)120 \text{ km} , \qquad (8)$$

are computed, followed by fitting the tabular data by the 11th-degree polynomial

$$\frac{g}{T_M} = \sum_{k=0}^{11} g_k z^k , \qquad 0 \le z \le 120 \text{ km} . \qquad (9)$$

Table 2-5. Molecular weight function adopted for Subroutine ATMOSU in ROSCOE-IR.

z, km	f	z, km	f	z, km	f	z, km	f
0	1.14(-17)	32	1.59(-10)	64	3.83(-6)	96	1.05(-2)
4	1.47(-16)	36	1.12(-9)	68	6.33(-6)	100	2.40(-2)
8	5.95(-16)	40	5.90(-9)	72	1.19(-5)	104	3.65(-2)
12	3.86(-15)	44	2.61(-8)	76	3.20(-5)	108	4.78(-2)
16	3.47(-14)	48	9.14(-8)	80	8.62(-5)	112	5.85(-2)
20	2.71(-13)	52	2.76(-7)	84	2.44(-4)	116	6.82(-2)
24	2.56(-12)	56	7.24(-7)	88	7.11(-4)	120	7.66(-2)
28	2.15(-11)	60	1.88(-6)	92	2.38(-3)		

2-2.6 Computation of the Major-Species Quantities

Having obtained an analytic fit function for g/T_M, one can compute the quantities for the major species almost as they are computed in HS-75, with the following exceptions:

a. Pressure will be computed from Equation (3) on p. 19 of HS-75 and not by use of the pressure-correction factor on p. 21 of HS-75.

b. $[O]_{Day}$, computed in HS-75 and currently from

$$[O]_{Day} = 2n_* \left(\frac{M_*}{M} - 1\right) \equiv 2n_* \, f_{Day} \equiv 2n_* f \ , \qquad (10)$$

will now be latitude- and season-dependent because n_* (the total number density if no dissociation) is latitude- and season-dependent. This situation differs from that in HS-75, where $[O]_{Day}$ was input and used to help determine f.

c. $[O]_{Night}$, as in HS-75, is set equal to $[O]_{Day}$ for $90 \le z \le 120$ km and is computed from a fit function for $z < 90$ km (see Table 4-2).

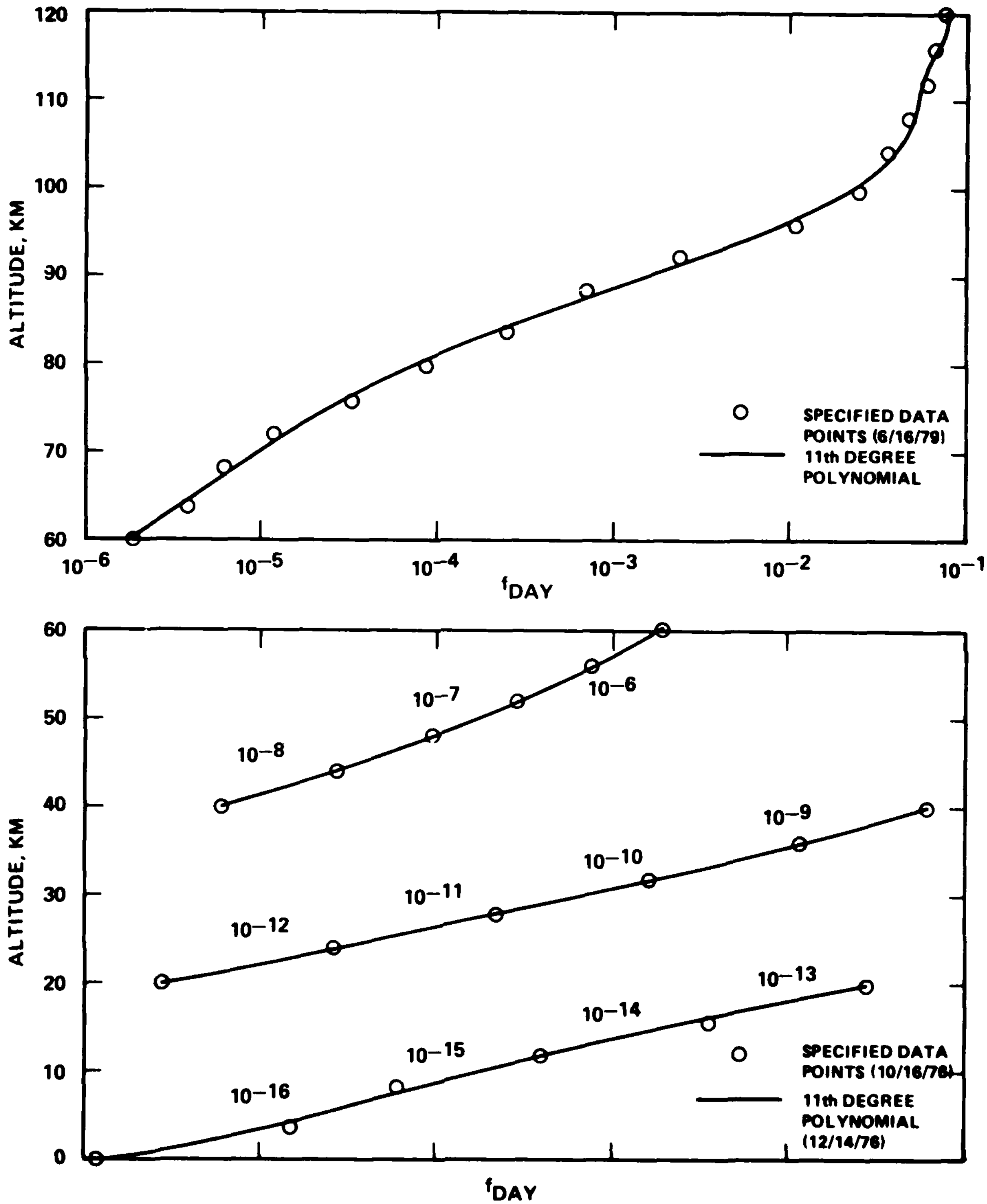

Figure 2-4. Adopted molecular-weight-function profile and fit function.

SECTION 3

AUXILIARY SUBROUTINES FOR ATMOSU AND SPCMIN

3-1 INTRODUCTION

The purpose of the five auxiliary subroutines ZTTOUT, JULIAN, SOLCYC, SOLORB, and SOLZEN is to convert inputs that are convenient for the user to the inputs required by ATMOSU, SPCMIN, and IONOSU. It is assumed the user will locate his coordinate system in space and time by stating the geographic north latitude and east longitude, the date, and zone time (based on 15-degree intervals of longitude) in a 24-hour system. These auxiliary routines determine the universal time, Julian day number, local (apparent) time, the solar zenith angle viewed from the origin, an index denoting day or night, and the 10.7-cm solar flux.

These subroutines (except ZTTOUT) had their origin in the AFWL WORRY code (where they were known as JULIAN, SOLCY, ORB, and ZSOL) and were revised when they were incorporated into the early-version ROSCOE code [LL-75]. These routines, to which ZTTOUT was added, were further revised and laden with comment cards under the contractual effort for the ROSCOE-Radar code [HS-75]. For ROSCOE-IR, most of these subroutines underwent only minor changes.

Subroutine TEMPZH, a new routine for ROSCOE-IR, determines the temperature profile used in Subroutine ATMOSU, from either a stored data base or one supplied by the user via card input.

Subroutines FITTER and SOLVE are used in providing least-squares polynomial fit functions.

3-2 SUBROUTINE ZZTOUT

Subroutine ZTTOUT converts a Gregorian calendar date (specified by stating the year in the 20th century (IYRS), the month (IMONS), and the day (IDAYS)) and zone time (ZT) at a given east longitude (PLON) to the Gregorian calendar date and mean (or universal) time (UT) at Greenwich.

For ROSCOE-IR we have corrected the computation of the zone description (ZD) when ZD should be zero and revised TIME Common.

See Table 3-1 for a summary of inputs and outputs for Subroutine ZTTOUT.

3-3 SUBROUTINE JULIAN

Subroutine JULIAN converts a Gregorian calendar date (specified by stating the year in the 20th century (IYRS), the month (IMONS), and the day (IDAYS)) to Julian day number (DAYJ) for use by Subroutine SOLORB.

In going from ROSCOE-Radar to ROSCOE-IR, we deleted the variables KYRS, KMONS, and KDAYS from the argument list since these variables are now supplied through TIME Common where they are known as IYRS, IMONS, and IDAYS.

The new Subroutine JULIAN also computes, taking account of season reversal in the southern hemisphere, (1) the variable FYR, the fractional season-year, needed for the new water vapor and ozone models and (2) the variable FST, the fractional summer, needed for the seasonal interpolation between the summer and winter temperature profiles which are input as data for the revised low-altitude major-species model.

See Table 3-2 for a summary of inputs and outputs for Subroutine JULIAN.

3-4 SUBROUTINE SOLCYC

Subroutine SOLCYC computes the 10.7-cm solar flux (SBAR), an input to ATMOSU through ATMOUP Common, based on an assumed sinusoidal 11-year (or 4018-day) variation. The maximum value of 250 for SBAR, associated with Model 9 of the CIRA-65 atmosphere, has been assigned the date of 1 June 1958. The minimum value of 65 for SBAR is associated with Model 1 of the CIRA-65 atmosphere.

See Table 3-3 for a summary of inputs and outputs for Subroutine SOLCYC.

Table 3-1. Input and output variables for Subroutine ZTTOUT.

INPUT VARIABLES		
Argument List		
None		
TIME Common		
IYRS	-	Number of the year in the 1900's (e.g., 1974 becomes 74) at east longitude PLON
IMONS	-	Number of the month (e.g., February becomes 2) at east longitude PLON
IDAYS	-	Day of the month at east longitude PLON
ZT*	-	Zone time for the 15-degree longitude interval containing PLON (decimal hours)
PLON	-	East longitude of point P (radians)
OUTPUT VARIABLES		
Argument List		
None		
TIME Common		
IYRS	-	A possibly revised value of the input parameter, corresponding to Greenwich
IMONS	-	A possibly revised value of the input parameter, corresponding to Greenwich
IDAYS	-	A possibly revised value of the input parameter, corresponding to Greenwich
UT	-	Universal time corresponding to the zone time ZT (decimal hours)

* A value of 24.0, treated by the code as illegal, should be input as 0.0 on the next day.

Table 3-2. Input and output variables for Subroutine JULIAN.

INPUT VARIABLES

Argument List

None

TIME Common

IYRS	-	Number of the year in the 1900's (e.g., 1974 becomes 74) in the Greenwich time zone)
IMONS	-	Number of the month (e.g., February becomes 2) in the Greenwich time zone
IDAYS	-	Day of the month in the Greenwich time zone
PLAT	-	North latitude of point P (radians)

OUTPUT VARIABLES

Argument List

YRFJ	-	Julian day number (a half integer) at 0 hours UT on January 1 of the year of interest
VEQJ	-	Julian date for vernal equinox
DAYJ	-	Julian day number (a half integer) at 0 hours UT on the day of interest

TIME Common

FYR	-	Fractional season-year, being zero on 1 January in the northern hemisphere and zero on 1 July in the southern hemisphere
FST	-	Fractional summer, being one on 1 July and zero on 1 January in the northern hemisphere and reversed in the southern hemisphere

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Table 3-3. Input and output variables for Subroutine SOLCYC.

INPUT VARIABLES		
Argument List		
DAYJ	-	Julian day number (a half integer) at 0 hours UT on the day of interest
Common		
None		
OUTPUT VARIABLES		
Argument List		
None		
ATMOUP Common		
SBAR	-	Average 10.7-cm solar flux [1.0E-22 W/(m^2 Hz]

3-5 SUBROUTINE SOLORB

Subroutine SOLORB computes the north latitude (SOLLAT) and east longitude (SOLLON) of the apparent (actual motion) subsolar point, given the Julian day number at 0-hours UT on 1 January of the year of interest (YRFJ), the Julian date at which vernal equinox occurs (VEQJ), the Julian day number at 0-hours on the day of interest (DAYJ), and the universal time (UT).

In going from ROSCOE-Radar to ROSCOE-IR, we have defined a new variable (DELJUT) to avoid loss of significance in computing SOLLON on a small-word machine and revised the argument in the equation-of-time, consistent with its definition.

See Table 3-4 for a summary of inputs and outputs for Subroutine SOLORB.

Table 3-4. Input and output variables for Subroutine SOLORB.

INPUT VARIABLES

Argument List

YRJF	-	Julian day number (a half integer) at 0 hours UT on January 1 of the year of interest
VEQJ	-	Julian date for vernal equinox
DAYJ	-	Julian day number (a half integer) at 0 hours UT on the day of interest

TIME Common

UT	-	Universal time corresponding to zone time ZT (decimal hours)

OUTPUT VARIABLES

Argument List

SOLLAT	-	North latitude of subsolar point (radians)
SOLLON	-	East longitude of subsolar point (radians)

TIME Common

GAT	-	Greenwich apparent time (decimal hours)

3-6 SUBROUTINE SOLZEN

Subroutine SOLZEN computes CHI and COSCHI, the cosine of the solar zenith angle CHI at a point P, given the geographic north latitude (PLAT) and east longitude (PLON) of the point P and the north latitude (SOLLAT) and east longitude (SOLLON) of the subsolar point. The day-or-night parameter IDORN is +1 for daytime, i.e., if COSCHI $\geq$ 0.0, and is -1 for nighttime. The local apparent time (HL) is also computed from the Greenwich apparent time (GAT) and the east longitude of the point P (PLON).

See Table 3-5 for a summary of inputs and outputs for Subroutine SOLZEN.

Table 3-5. Input and output variables for Subroutine SOLZEN.

INPUT VARIABLES

Argument List

- SOLLAT - North latitude of subsolar point (radians)
- SOLLON - East longitude of subsolar point (radians)

TIME Common

- PLAT - North latitude of point P (say, grid origin) (radians)
- PLON - East longitude of point P (radians)

OUTPUT VARIABLES

Argument List

None

ATMOUP Common

- IDORN - Parameter for day or night. If COSCHI is the cosine of the zenith angle of the sun at point P, IDORN is 1 for daytime, i.e., IF(COSCHI.GE.0.0), and is -1 for nighttime, i.e., IF(COSCHI.LT.0.0)
- HL - Local apparent time (decimal hours, e.g., 2230 hours becomes 22.50 hours)

TIME Common

- CHI - Zenith angle of the sun at point P (radians)

3-7 SUBROUTINE TEMPZH

Subroutine TEMPZH determines the temperature profile (tabular, 0(4)120 km) by interpolating the data base [US-66] for latitude and season, to be used as input to the major atmospheric species model for the low-altitude range from 0- to 120-km altitude. The user may bypass the code's specification of temperature profile in the low-altitude (0- to 120-km) region by (1) requiring the driving program to set TPFLAG to a nonzero value, which is transferred to Subroutine TEMPZH through ZHTEMP Common, and (2) allowing Subroutine TEMPZH to read the user-specified profile at altitudes 0.0(4.0)120.0 km.

See Table 3-6 for a summary of inputs and outputs for Subroutine TEMPZH.

3-8 SUBROUTINE FITTER

A brief description of the operation of Subroutine FITTER is given in Section 1. A summary of inputs and outputs for Subroutine FITTER is given in Table 3-7.

3-9 SUBROUTINE SOLVE

A brief description of the operation of Subroutine SOLVE is given in Section 1. A summary of inputs and outputs for Subroutine SOLVE is given in Table 3-8.

Table 3-6. Input and output variables for Subroutine TEMPZH.

INPUT VARIABLES		
Argument List		
None		
TIME Common		
PLAT	-	North latitude of point P (radians)
FST	-	Fraction of summer temperature profile to be used with (1.-FST) of the winter temperature profile for a given day of the year at a given latitude
ZHTEMP Common		
TPFLAG	-	Flag for optional treatment of temperature profile = 0.0 normal treatment ≠ 0.0 optional treatment, allowing Subroutine TEMPZH to read the user-specified profile at altitudes z = 0(4)120 km
Card Input (optional)		
TZH(I), I=1,31	-	Temperature profile specified by user at altitudes z = 0(4)120 km
OUTPUT VARIABLES		
Argument List		
None		
ZHTEMP Common		
TZH(I), I=1,31	-	Temperature profile, determined by interpolation of the data base [US-66] for latitude and season, used as input to the major atmospheric species model for the low-altitude range from 0- to 120-km altitude

Table 3-7. Input and output variables for Subroutine FITTER.

INPUT VARIABLES

Argument List

NPTS - Number of data points

X(I) - Values of the independent variable, e.g., altitude (km)

Y(I) - Values of the dependent variable, e.g., species concentration (cm^{-3})

NO - Degree of polynomial to be fitted

IKIND - Index for kind of equation to be fitted

= 1 if equation is $\ln(Y) = \sum_{n=0}^{NO} A_n X^n$

= 2 if equation is $Y = \sum_{n=0}^{NO} A_n X^n$

ISIGN - Index for sign of exponents

= 1 for negative exponents

= 2 for positive exponents

Common

None

OUTPUT VARIABLES

Argument List

Z(J) - The least-squares fit coefficients. Z(1) corresponds to A_o, Z(2) to A_1, etc.

Common

None

Table 3-8. Input and output variables for Subroutine SOLVE.

INPUT VARIABLES		
Argument List		
A(I,J)	-	Element (I,J) of matrix of constant coefficients for NO simultaneous linear algebraic equations
NO	-	The number of equations
Common		
None		
OUTPUT VARIABLES		
Argument List		
X(K)	-	The least-squares fit coefficients. These are the same as the output Z(K) from FITTER.

SECTION 4

MINOR NEUTRAL SPECIES

4-1 SUBROUTINE SPCMIN

ROSCOE-IR requires many more neutral species than ROSCOE-Radar and an improved description of some of those included in ROSCOE-Radar.

The ROSCOE-IR high-altitude chemistry module [Volume 11-1] requires the minor neutral species O, CO_2, CO, $N(^4S)$, $N(^2D)$, $N(^2P)$, NO, NO_2, $O_2(^1\Delta_g)$, O_3, H, OH, HO_2, H_2O, and He (in practice, however, CO_2, CO, H_2O, and He are nonreacting species). The ROSCOE-IR low-altitude external chemistry module [Volume 11-1] requires the minor neutral species O, CO_2, $N(^4S)$, $N(^2D)$, NO, NO_2, $O_2(^1\Delta_g)$, O_3, H, OH, HO_2, and H_2O. (The additional species CO, CH_4, and N_2O were initially requested but they are not used.) All-altitude profiles for diurnal conditions are provided for O, CO_2, and He in Subroutine ATMOSU. Subroutine SPCMIN provides (either directly or indirectly) the profiles for the remaining species listed above.

The inputs and outputs for Subroutine SPCMIN are summarized in Table 4-1. The nature of the functions used for fitting the adopted data-base values [Volumes 14b and 14c] in various altitude ranges is given in Tables 4-2 through 4-18 for O, $O(^1D)$, $O_2(^1\Delta_g)$, O_3, N, $N(^2D)$, $N(^2P)$, NO, NO_2, N_2O, CO_2, CO, CH_4, H_2O, OH, HO_2, and H, respectively.

4-2 OZONE

Our model for altitude profiles of the O_3 mass-mixing ratio has been specified as a function of latitude and season [My-78, Section 3]. The altitude dependence of the O_3 mass-mixing ratio ($m_R(O_3)$) is treated by using a transition boundary at 55-km altitude. Below 55 km, the model accounts for the variation of $m_R(O_3)$ with altitude, latitude, and season. The model predicts:

(text continues on p. 61)

Table 4-1. Input and output variables for Subroutine SPCMIN.

INPUT VARIABLES

Argument List

KK	-	Calculation flag = 1, calculate initialization parameters = 2, calculate atmospheric properties
ZH	-	Altitude of interest (km)

ATMOUP Common

IDORN	-	Index for day or night = +1, day = -1, night

TIME Common

PLAT	-	North latitude of point P (radians)

DATA

ALTKM(47)	-	Altitudes (z=0(5)230 km) at which minor species densities are specified as data
ANODAY(21)	-	Noontime data-base values of [NO] at altitudes 0(5)100 km at 50° latitude
ANONIT(21)	-	Midnight data-base values of [NO] at altitudes 0(5)100 km at 50° latitude
AN2DDN(41)	-	Data-base values of the basic component ($T_2(z)$) of the N(^{2}D) densities between 125- and 200-km altitude, augmented by 25 zeros below 125 km
AN4SDN(33)	-	Data-base values of the basic component ($T_1(z)$) of the N densities between 100- and 160-km altitude, augmented by 20 zeros below 100 km
CH4PCC	-	Factor used (3.75369008E+16) with total mass density (g/cm^3) to convert CH_4 mass-mixing ratio (ppmm) to molecules/cm^3
COMPCC	-	Factor used (2.14992030E+16) with total mass density (g/cm^3) to convert CO mass-mixing ratio (ppmm) to molecules/cm^3
CO2(25)	-	Data-base values of [CO_2] at altitudes 0(5)120 km

(Continued)

Table 4-1. (Cont'd)

DAHDAY(21)	- Noontime data-base values of [H] at altitudes 0(5)100 km
DAHNIT(21)	- Midnight data-base values of [H] at altitudes 0(5)100 km
DATCO(31)	- Data-base values of CO mass-mixing ratio (ppmm) at altitudes 0(5)150 km
DN2O(12)	- Selected values of N_2O volume-mixing ratio (ppbv) at altitudes 0(5)55 km
DOHDAY(21)	- Noontime data-base values of [OH] at altitudes 0(5)100 km
DOHNIT(21)	- Midnight data-base values of [OH] at altitudes 0(5)100 km
HO2DAY(21)	- Noontime data-base values of [HO_2] at altitudes 0(5)100 km
HO2NIT(21)	- Midnight data-base values of [HO_2] at altitudes 0(5)100 km
H2ODN(21)	- Data-base values of H_2O mass-mixing ratio (ppmm) at altitudes 20(5)120 km
H2OPCC	- Factor used (3.34260935E+16) with total mass density (g/cm^3) to convert H_2O mass-mixing ratio (ppmm) to $molecules/cm^3$
NALTMH	- Two plus the number of altitudes (NMTH=23) between 10 and 120 km used to fit CH_4 mass-mixing ratios
NALTNO	- Number of altitudes (21) between 0 and 100 km used to fit daytime NO densities at 50° latitude
NALTO2	- Number of altitudes (11) between 0 and 50 km used to fit daytime $O_2(^1\Delta_g)$ densities
NALT2D	- Number of altitudes (16) between 125 and 200 km used to fit the basic component ($T_7(z)$) of the $N(^2D)$ densities
NALT4S	- Number of altitudes (13) between 100 and 160 km used to fit the basic component ($T_1(z)$) of the N densities
NDEGNO	- Degree of the polynomial (12) used to fit the daytime NO densities between 0 and 100 km at 50° latitude
NDEG2D	- Degree of the polynomial (6) used to fit the basic component ($T_7(z)$) of the $N(^2D)$ densities between 125 and 200 km

(Continued)

Table 4-1. (Cont'd)

NDEG4S	-	Degree of the polynomial (5) used to fit the basic component ($T_1(z)$) of the N densities between 100 and 160 km
NDGH2O	-	Degree of the polynomial (12) used to fit the H_2O mass-mixing ratio (ppmm) between 20 and 120 km
NDGMTH	-	Degree of the polynomial (11) used to fit the CH_4 mass-mixing ratio (ppmm) at altitudes 0(5)120 km
NDGNO2	-	Degree of the polynomial (12) used to fit the daytime NO_2 densities between 0 and 160 km
NDGO2D	-	Degree of the polynomial (10) used to fit the daytime $O_2(^1\Delta_g)$ densities between 0 and 50 km
NKMH2O	-	Number of altitudes (21) between 20 and 120 km used to fit H_2O mass-mixing ratios (ppmm)
NKMNO2	-	Number of altitudes (33) between 0 and 160 km used to fit the daytime NO_2 densities
ONITE(18)	-	Midnight data-base values of [O] at altitudes 0(5)85 km
OZ3PCC	-	Factor used (1.25459271E+22) with total mass density (g/cm^3) to convert O_3 mass-mixing ratio (kg/kg) to $molecules/cm^3$
O1DDAY(33)	-	Noontime data-base values of $[O(^1D)]$ at altitudes 0(5)160 km
O2SDGD(47)	-	Noontime data-base values of $[O_2(^1\Delta_g)]$ at altitudes 0(5)230 km
O2SDGN(47)	-	Midnight data-base values of $[O_2(^1\Delta_g)]$ at altitudes 0(5)230 km
O3DAY(26)	-	Noontime data-base values of O_3 mass-mixing ratio (ppmm) at altitudes 55(5)120 km, augmented by an assigned value at 125 km to facilitate fitting
O3NIT(27)	-	Midnight data-base values of O_3 mass-mixing ratio (ppmm) at altitudes 55(5)120 km, augmented by two assigned values at 125 and 130 km to facilitate fitting
PI	-	3.141592653590
SMETH(25)	-	Data-base values of CH_4 mass-mixing ratio (ppmm) at altitudes 0(5)120 km

(Continued)

Table 4-1. (Cont'd)

SNO2D(33)	-	Noontime data-base values of [NO_2] at altitudes 0(5)160 km
SNO2N(33)	-	Midnight data-base values of [NO_2] at altitudes 0(5)160 km

OUTPUT VARIABLES

Argument List

None

ATMOUP Common

SNI(7)	-	N concentration ($1/cm^3$)
SNI(8)	-	NO concentration ($1/cm^3$)
SNI(13)	-	$O_2(^1\Delta_g)$ concentration ($1/cm^3$)
SNI(14)	-	O_3
SNI(15)	-	NO_2
SNI(16)	-	H_2O
SNI(17)	-	H
SNI(18)	-	OH
SNI(19)	-	HO_2
SNI(20)	-	CO
SNI(21)	-	N_2O
SNI(22)	-	CH_4
SNI(23)	-	$N(^4S)$
SNI(24)	-	$N(^2D)$
SNI(25)	-	Relative humidity, percent
SNI(26)	-	$O(^1D)$ concentration ($1/cm^3$)
SNI(27)	-	$O(^2P)$ concentration ($1/cm^3$)

ALTODN Common

ALTKM(47)	-	See input
ONITE(18)	-	See input
CO2(25)	-	See input (Note that the CO_2 densities from 0- to 100-km altitude are reset in Subroutine ATMOSU by using a constant volume-mixing ratio of 3.2×10^{-4}.)

(Continued)

Table 4-2. Fit functions for O density profiles.

Altitude Range, km	Description
	Day
0 - 120	ATMOSU low-altitude model
>120	ATMOSU high-altitude model
	Night[a,b]
0 - 60	Constant at data-point value
60 - 75	Exponential, with slope determined by data points at 60 and 75 km
75 - 85	Exponential-like function with altitude-dependent scale height so determined that function passes through data points at 75, 80, and 85 km
85 - 90	Exponential, with slope determined by data point at 85 km and low-altitude-model value at 90 km
90 - 120	ATMOSU low-altitude model
>120	ATMOSU high-altitude model

[a] My-75, Table 2-5.

[b] Fits are made in Subroutine ATMOSU.

Table 4-3. Fit functions for $O(^1D)$ density profiles.[a]

Altitude Range, km	Description
	Day
0 - 47	Exponential-like function (lower-limited to 1.0) with altitude-dependent scale height so determined that function passes through data points at 25, 40, and 47 km
47 - 80	Exponential-like function with altitude-dependent scale height so determined that function passes through data points at 47, 65, and (assigned value of 10 at) 80 km
80 - 100	Exponential, with slope determined by data points at 80 and 100 km and passing through assigned value of 10 at 80 km
100 - 120	Exponential-like function, with altitude-dependent scale height so determined that function passes through data points at 100, 110, and 120 km
120 - 160	Exponential, with slope determined by data points at 120 and 160 km and passing through data point at 120 km
>160	Proportional to O,[b] $[O(^1D)] = \{[O(^1D)]/[O]\}_{160}[O(z)]$
	Night
>0	Constant, at assigned value of 1.0

[a] My-78, Table 9-1.

[b] This procedure makes $[O(^1D)]$ dependent on the time and solar flux to the extent that [O] is dependent on these parameters.

Table 4-4. Fit functions for $O_2(^1\Delta_g)$ density profiles.[a]

Altitude Range, km	Description[b]
Day	
0 - 50	10th-degree polynomial (coefficients DD) to match data points at 0(5)50 km
50 - 75	Exponential, determined by data points at 50 and 75 km
75 - 90	5th-degree polynomial, determined by data points at 75(5)90 km and derivatives of 50-to-75 km fit-function at 75 km and ≥90-km function at 90 km
≥90	Exponential, determined by data points at 90 and 105 km
Night	
0 - 70	Constant at data-point value
70 - 80	Exponential, determined by data points at 70 and 80 km
80 - 100	5th-degree polynomial, determined by data points at 80(5)95 km and values of daytime fit-function and its derivative at 100 km
>100	Daytime fit-function

[a] My-75, Table 3-1.

[b] Unchanged from HS-75, Table 14.

Table 4-5. Fit functions for O_3 mass-mixing ratio profiles.

Altitude Range, km	Description
	Day or Night
0 - 55	New model, latitude- and season-dependent[a]
	Day[b]
55 - 75	5th-degree polynomial (coefficients TO3(I)), to match data points at 55(5)75 km and the (zero) derivative of the 0- to 55-km fit-function at 55 km
75 - 90	5th-degree polynomial (coefficients UO3(I)), to match data points at 75(5)90 km and derivatives of 55- to 75-km fit-function at 75 km and ≥90-km fit-function at 90 km
≥90	Exponential, determined by data points at 90 and 105 km
	Night
55 - 70	5th-degree polynomial (coefficients VO3(I)), to match data points at 55(5)70 km, the (zero) derivative of the 0- to 55-km fit-function at 55 km, and the derivative of the 70- to 75-km fit-function at 70 km
70 - 75	Exponential, determined by data points at 70 and 75 km
75 - 90	5th-degree polynomial (coefficients WO3(I)), to match data points at 75(5)90 km and derivatives of 70- to 75-km fit-function at 75 km and ≥90-km fit-function at 90 km
≥90	Exponential, determined by data points at 90 and 105 km

[a] My-78, Section 3.

[b] My-75, Section 4.2 and HS-75, Table 15.

Table 4-6. Fit function for N density profiles.[a]

Altitude Range, km	Description
	<u>Day or Night</u>
$z \geq 0$	Analytic expression[b] dependent on altitude, local apparent time, latitude, fractional season-year, and solar decimetric flux. Five factors include an altitude-dependent basic factor (T_1), latitudinal factor with diurnal variation (T_2), seasonal factor ($\exp(T_3)$), diurnal factor with altitudinal and latitudinal variations ($\exp(T_4)$), and solar-flux factor (T_5)
	<u>$T_1(z)$</u>
0 - 100	Exponential function, passing through the fit-function value at 100 km
100 - 160	5th-degree polynomial, determined by least squares (coefficients CC) for data points at 100(5)160 km
> 160	Exponential function, passing through the fit-function value at 160 km
	<u>$T_2(L,t)$</u>
≥ 0	Analytic expression dependent on latitude and local apparent time
	<u>$T_3(f)$</u>
≥ 0	Analytic expression dependent on fractional season-year
	<u>$T_4(t,z,L)$</u>
≥ 0	Analytic expression factorable into an expression dependent on the local apparent time and the latitude and an expression dependent on the altitude
	<u>$T_5(F)$</u>
≥ 0	Analytic expression dependent on solar decimetric flux

[a] My-78, Section 12.

[b] My-78, Section 12, Equations (1) through (5).

Table 4-7. Fit functions for $N(^2D)$ density profiles.[a]

Altitude Range, km	Description
	Day or Night
≥0	Analytic expression[b] dependent on altitude, local apparent time, and (through a dependence on the total nitrogen atom density) on latitude, fractional season-year, and solar decimetric flux
	SNI(7) and $T_1(z)$
≥0	These functions are given by the formulas for the total nitrogen atom densities
	$T_7(z)$
0 - 125	Exponential function, passing through the fit-function value at 125 km
125 - 200	6th-degree polynomial, determined by least squares (coefficients BB) for data points at 125(5)200 km
>200	Exponential function, passing through the fit-function value at 200 km
	$T_8(t)$
≥0	Analytic expression dependent on the local apparent time

[a] My-78, Section 13.

[b] My-78, Section 13, Equations (1) and (2).

Table 4-8. Fit functions for $N(^2P)$ density profiles.[a]

Altitude Range, km		Description
	Day or Night	
0 - 119.9		$R_{2P2D} \equiv [N(^2P)]/[N(^2D)] = 0.01$
>119.9		$R_{2P2D} = 5.5 \times 10^{-4} P_{2P2D} e^{900/z}$
		$P_{2P2D} = 0.01$

[a] In the absence of information on the ambient density of $N(^2P)$, B.F. Myers has offered an estimate based on simplifying assumptions: (1) $[N(^2P)]$ and $[N(^2D)]$ are in steady state, (2) the production rate of $N(^2P)$ is a factor $P_{2P2D} \approx 0.01$ times that for $N(^2D)$, (3) the collisional deactivation rate of $N(^2P)$ is the same as that for $N(^2D)$, (4) the radiative decay rate of $N(^2D)$ is small compared with its collisional decay rate, (5) the altitude profile of the ratio $R_{2P2D} \equiv [N(^2P)]/[N(^2D)]$, computed by using nominal rate coefficients, can be approximated by the expression $5.5 \times 10^{-4} \times P_{2P2D} \times \exp(900/z)$ for $z \gtrsim 120$ km, at which altitude $R_{2P2D} = 0.01$.

Table 4-9. Fit functions for NO density profiles.[a]

Altitude Range, km	Description
	Day[b]
0 - 100	12th-degree polynomial, determined by least squares (coefficients AA) for data ponts at 0(5)100 km
	Night[b]
0 - 50	Constant at data-point value of 1.0
50 - 60	Exponential-like function (lower-limited to 1.0), with altitude-dependent scale height so determined that function passes through data points at 50, 55, and 60 km
60 - 85	Exponential, determined by data point at 60 km and daytime polynomial fit-function at 85 km
85 - 100	Daytime fit-function
	Day or Night
>100	Analytic expression dependent on altitude, local apparent time, latitude, and solar decimetric flux [My-78, Section 11, Equation (6)]

[a] My-78, Section 11.

[b] For both day and night, we add to the logarithm of the NO density a latitude-dependent term with an altitude-dependent coefficient. Without the latitude-dependent term, the fit functions apply to a 50° latitude. See My-78, Section 11, Equation (8).

Table 4-10. Fit functions for NO_2 density profiles.[a]

Altitude Range, km	Description[b]
	Day
0 - 160	12th-degree polynomial, determined by least squares (coefficients HH) for data points at 0(5)160 km
>160	Exponential, with slope determined by fit-function values at 140 and 160 km, and passing through fit-function value at 160 km
	Night
0 - 55	$[NO_2]_{night} = [NO]_{day} + [NO_2]_{day} - [NO]_{night}$
55 - 65	Exponential, with slope determined by fit function at 55 km, and passing through data point at 65 km
65 - 82	Exponential, with slope determined by data point at 65 km and by daytime fit-function value at 82-km altitude
>82	Daytime fit function

[a] My-75, Table 7-1.

[b] Unchanged from HS-75, Table 16.

Table 4-11. Fit functions for N_2O volume-mixing ratio profiles[a]

Altitude Range, km	Description
	Day or Night[b]
0 - 55	8th-degree polynomial, determined by least squares (coefficients CN2O) for volume-mixing-ratio data-points at 0(55)55 km
>55	Constant at volume-mixing ratio data-point

[a] My-78, Table 10-2.

[b] This profile, obtaining at high latitude, must be multiplied by a latitude-dependent factor which itself is altitude-dependent. See My-78, Section 10, Equation (2).

Table 4-12. Fit functions for CO_2 volume-mixing ratio profiles.[a]

Altitude Range, km	Description[b]
	Day or Night[c]
0 - 100	Constant volume-mixing ratio of 0.00032 in ATMOSU low-altitude model
100 - 120	6th-degree polynomial, to match ATMOSU low-altitude-model value at 100 km and data points at 105(5)120 km and derivatives of low-altitude-model function at 100 km and ATMOSU high-altitude-model function at 120 km
>120	ATMOSU high-altitude model

[a] My-75, Table 8-1.

[b] Unchanged from HS-75, Table 10.

[c] Fits are made in Subroutine ATMOSU.

Table 4-13. Fit functions for CO mass-mixing ratio profiles.[a]

Altitude Range, km	Description
	Day or Night
0 - 150	13th-degree polynomial determined by least squares (coefficients EE) for data points at 0(5)150 km
>150	Exponential, passing through fit function at 150 km

[a] My-78, Table 5-1.

Table 4-14. Fit functions for CH_4 mass-mixing ratio profiles.[a]

Altitude Range, km	Description
	Day or Night
0 - 10	Constant, at fit-function value at 10 km
10 - 120	11th-degree polynomial, determined by least squares (coefficients FF) for data points at 10(5)120 km
>120	Exponential, passing through fit function at 120 km

[a] My-78, Table 4-1.

Table 4-15. Fit functions for H_2O mass-density and mass-mixing ratio profiles.[a]

Altitude Range, km	Description
	<u>Day or Night</u>
0 - 5	Analytic fit functions for water vapor mass density (g/m^3), expressed as the sum of a mean and a seasonal term, $[H_2O] = \mathrm{Mean}(\alpha, z) + \mathrm{Season}(f, \alpha, z)$, where α = type of moisture region (six in total, distributed among 11 geographic regions), f = fraction of season-year, and z = altitude.
5 - 14	Interpolation between natural logarithm of mass-mixing ratio (ppmm) values at 5 and 14 km
14 - 45	Analytic fit functions for water vapor mass-mixing ratio, expressed as the sum of a mean and a seasonal term, $m_R = \mathrm{Mean}(\text{with transition at latitude } L \gtrsim 28^\circ \text{ for } z \gtrsim 30\text{ km}) + \mathrm{Season}(f, L, z \lesssim 20\text{ km})$
45 - 120	12th-degree polynomial for natural logarithm of mass-mixing ratio (ppmm), determined by least squares (coefficients GG) for data points at 20(5)120 km
>120	Exponential, $m_R(z) = m_R(120)\exp[-0.0575(z-120)]$, where $m_R(120)$ is determined from the fit function from 45 to 120 km

[a] My-78, Section 2.

Table 4-16. Fit functions for OH density profiles.[a]

Altitude Range, km	Description
	Day or Night
0 - 80	7th-degree polynomial, determined by least squares (coefficients CCOH) for data points at 0(5)80 km
80 - 100	Exponential, with slope determined by fit-function value at 80 km and passing through assigned value (60 for day and 190 for night) at 100 km
>100	Analytic expression, passing through fit-function value at 100 km

[a] My-78, Table 6-1.

Table 4-17. Fit functions for HO_2 density profiles.[a]

Altitude Range, km	Description
	Day or Night
0 - 65	Polynomial (6th degree for day, 7th degree for night), determined by least squares (coefficients CHO2) for data points at 0(5)65 km
65 - 75	Exponential, with slope determined by fit-function value at 65 km and data-point value at 75 km
75 - 100	Product of two functions: (1) Exponential, with slope determined by data point values at 75 and 95 km and (2) $10^{F(z)}$ where F(z) is given by $F(z) = \begin{cases} 1.0 - 0.2 \lvert z-80 \rvert, & 75 \le z \le 85 \\ 0, & z > 85 \end{cases}$. Product-function passes through data-point values at 75 and 95 km
>100	Exponential, passing through fit-function value at 100 km with prescribed slope

[a] My-78, Table 7-1.

Table 4-18. Fit functions for H density profiles.[a]

Altitude Range, km	Description
Day	
0 - 35	Exponential (lower-limited to 1.0) with slope determined by data points at 30 and 35 km and passing through data point at 30 km
35 - 40	Exponential, with slope determined by data points at 35 and 40 km and passing through data point at 35 km
40 - 86	Exponential, with slope determined by data point at 40 and assigned value of 9.0×10^7 at 86 km and passing through data point at 40 km
Night	
0 - 74	Constant, at assigned value of 1.0
74 - 86	Exponential-like function (lower-limited to 1.0 in range below about 74.265 km), with altitude-dependent scale height so determined that function passes through data points at 75, 80, and 86 km
Day or Night	
86 - 100	Exponential, with slope determined by data points at 86 and 100 km and passing through data point at 86 km
>100	Sum of exponential and power law, adjusted to pass through data point at 100 km

[a] My-78, Table 8-1.

(1) An increase in the total O_3 content of the atmosphere with increasing latitude,

(2) A general increase in the maximum O_3 partial pressure with increasing latitude and an associated decrease in the altitude of the maximum,

(3) A decrease in the O_3 partial pressure above about 24 km with increasing latitude,

(4) A seasonal dependence the variation of which is a maximum in the altitude range between 15 and 35 km (depending on latitude), and

(5) A variation in the seasonal maximum with changing altitude.

Above 55 km, the model accounts for the altitude and day-to-night variation of $m_R(O_3)$, but does not (explicitly) treat seasonal or geographical effects. (However, the major-species model (Section 2) uses a temperature profile that is latitude- and season-dependent; hence, there is a corresponding dependence for the total mass density and the number density of minor species, such as O_3, specified in terms of mixing ratios.) The model does not include (small) longitudinal variations, day-to-day fluctuations, or long-term trends.

A guide to the principal features of the ozone model is given in Table 4-19. Figure 4-1 is a simplified flow chart of the operational phase of the O_3-portion of Subroutine SPCMIN, mainly for altitudes above 55 km; the nature of the fit functions evaluated here is given in Table 4-5.

Subroutine OZONE computes the latitude and season dependence of the mass-mixing ratio of O_3 for altitudes from 0 to 55 km by evaluating Equation (14) and its supporting equations (principally, Equation (11)) in Section 3 of My-78. The inputs and outputs for Subroutine OZONE are summarized in Table 4-20.

Table 4-19. Features of ozone model [My-78].

Subroutine	Altitude Range, km	Dependent Variable	Explicit[a] Independent Variables: Latitude	Season	Diurnal	Altitude	Data Base Reference
OZONE[b]	$0 \geq z \geq 55$	Mixing Ratio[e,f]	Yes[c]	Yes[c,d]		Yes	US-76, Dütsch, CIAP Mono.1
SPCMIN	$55 < z \leq 120$	Mixing Ratio[e]			Yes[c]	Yes	Myers [My-75]
SPCMIN	$z > 120$	Mixing Ratio[e]			Yes[c]	Yes	Myers [My-75]

[a] Major-species model depends on latitude and season; conversion from mixing ratio to absolute values will reflect this dependence.

[b] Subroutine OZONE is called from Subroutine SPCMIN.

[c] Initialization is performed.

[d] Maximum seasonal variation between 15- and 35-km altitude.

[e] Subroutine SPCMIN converts from mass-mixing ratio m_R(kg O_3/kg air) to molecules/cm^3 = $m_R \rho_{air} 10^{-6}/m_{O_3}$ before outputting SNI(14).

[f] The form of the expression is m_R = Mean(L,z) + Season(f,L,z) where L = latitude, f = fractional season-year, and z = altitude.

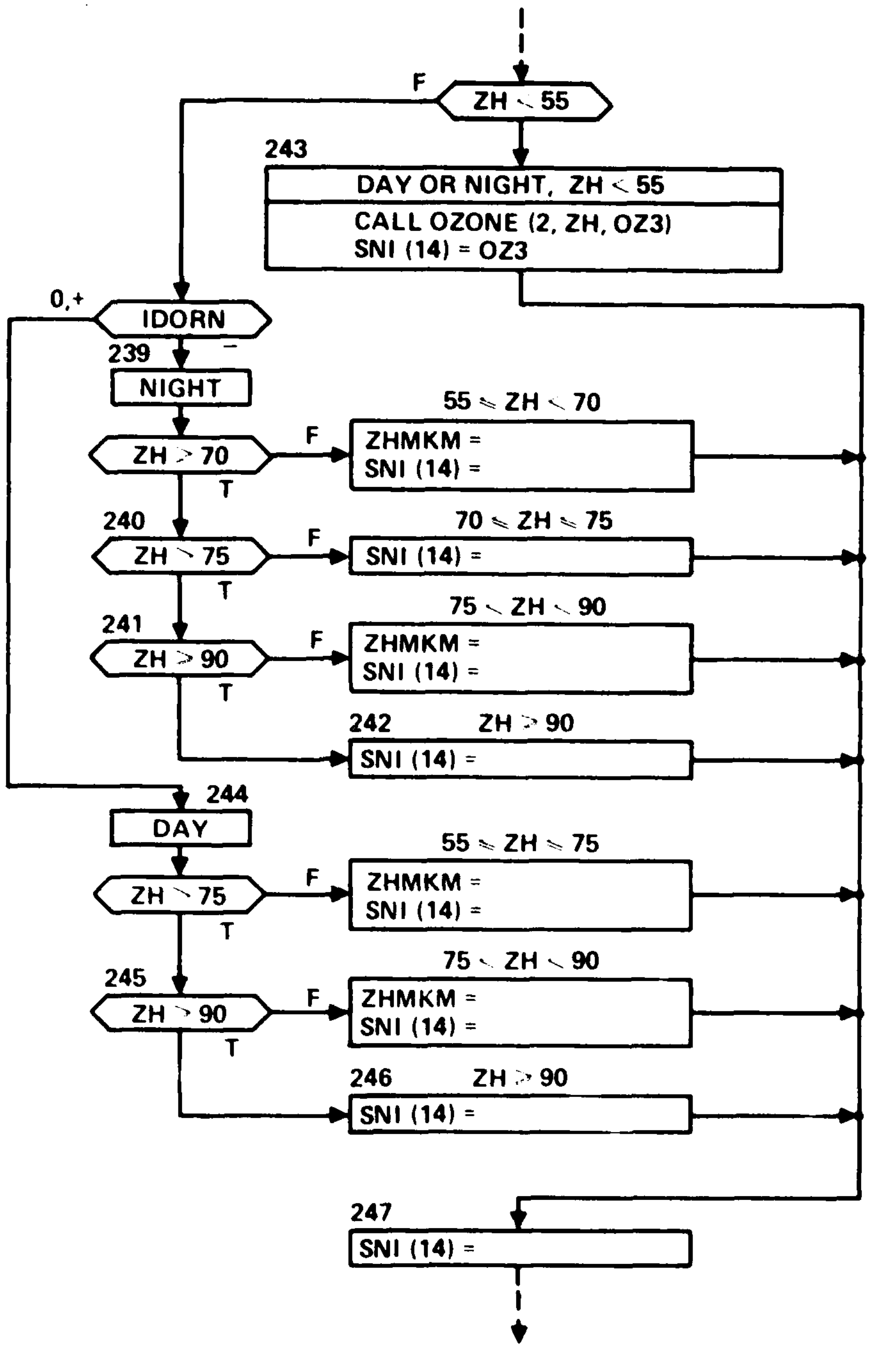

Figure 4-1. Flow chart for the O_3-portion of Subroutine SPCMIN during its operational phase.

Table 4-20. Input and output variables for Subroutine OZONE.

INPUT VARIABLES		
Argument List		
KK	-	Calculation flag = 1, calculate initialization parameters = 2, calculate O_3 mass-mixing ratio for 0- to 55-km altitude
ZKM	-	Altitude of interest, from 0 to 55 km
TIME Common		
PLAT	-	North latitude of point P (radians)
FYR	-	Fractional season-year, being 0 on 1 January in northern hemisphere and on 1 July in southern hemisphere
OUTPUT VARIABLE		
Argument List		
OZ3	-	O_3 mass-mixing ratio at altitude ZKM (kg/kg)

4-3 WATER

4-3.1 The Coded Model

Our model for altitude profiles of H_2O density, as a function of latitude, longitude, and season, is given in Section 2 of My-78 and may be summarized thusly. The altitude dependence of the H_2O density is treated by using transition boundaries at 5- and 14-km altitude. For the 0- to 5-km altitude range, the Earth's surface is divided into 11 geographic zones with six types of quasi-homogeneous moisture regions (a significant reduction from the NASA data-base model having hundreds of geographic zones and 45 homogeneous moisture regions); in each region the seasonal dependence is included. For the 5- to 14-km altitude region, H_2O densities are determined by interpolating the mixing ratios at 5- and 14-km altitude. At and above 14-km altitude, we include a seasonal dependence which (1) decreases with increasing altitude and vanishes for altitudes above about 20 km, and (2) has a latitude-dependent phase shift due to the influx of water vapor from the tropical troposphere into the lower stratosphere. An associated transition region at about 30° latitude vanishes for altitudes above about 30 km where a single mixing-ratio profile obtains.

Table 4-21 summarizes the geographic regions used in modeling the 0- to 5-km altitude moisture regions. Figure 4-2 gives a simple guide to the H_2O model, with the principal features as shown in Table 4-22.

Figure 4-3 is a simplified flow chart of the operational phase of the H_2O-portion of Subroutine SPCMIN; the nature of the fit functions evaluated here is given in Table 4-15.

Subroutine WATER computes the longitude, latitude, and season dependence of water vapor for altitudes from 0 to 45 km by evaluating the equations in Section 2 of My-78. The inputs and outputs for Subroutine WATER are summarized in Table 4-23.

4-3.2 Option for User-Specified H_2O Profile

To supplement our H_2O density model, we provide to the ROSCOE user an option whereby he can input his own profile of interest. To implement this option the user inputs a value greater than 0.0 for

Table 4-21. Summary of regions used in modeling 0- to 5-km altitude moisture regions.

	Number of Regions		Latitude Distribution of Moisture Regions					
			0° - 30°		30° - 60°			60° - 90°
Latitude Range	Geographic	Moisture	Wet	Dry	Wet	Intermed.	Dry	Dry
90N - 60N	1	1						X
60N - 30N	4	3			X	X	X	
30N - 30S	3	2	X	X				
30S - 60S	2	2			X	X		
60S - 90S	1	1						X
	Total = 11							

$0 \leq z \leq 5$ KM

$|H_2O|$ = MEAN (α, z)
+ SEASON (f, α, z)

EQUATION (1), SECTION 2 [My –78]

α = TYPE OF MOISTURE REGION
(6, IN 11 GEOGRAPHIC ZONES)

f = FRACTION OF YEAR

z = ALTITUDE

$5 < z < 14$ KM

$|H_2O|$ = INTERPOLATE

EQUATIONS (3a) & (3b), SECTION 2 [My –78]

$z > 14$ KM

$|H_2O|$ = MEAN (WITH BOUNDARY AT $L \approx 30°$
FOR $z \gtrsim 30$ KM)
+ SEASON (f, L, $z \lesssim 20$ KM)

EQUATIONS (5) & (7), SECTION 2 [My –78]

Figure 4-2. Simple guide to the H_2O model.

Table 4-22. Features of water vapor model [My-78].

Subroutine	Altitude Range, km	Dependent Variable	Explicit[a] Independent Variables				Data Base Reference
			Longitude	Latitude	Season	Altitude	
WATER[h]	$0 \le z \le 5$	Absolute Humidity[b,c]	Yes[d]	Yes[d]	Yes[d]	Yes	NASA [SG-71, SF-72b]
	$5 < z < 14$	Mixing Ratio[c]	(yes)[d,e]	Yes[d]	Yes[d]	Yes	Interpolation
	$14 \le z \le 45$	Mixing Ratio[c]		Yes[f]	Yes[g]	Yes	Harries [Ha-76e]
SPCMIN[i]	$45 < z \le 120$	Mixing Ratio[c]				Yes[d]	45-70, Interpolation >70, Myers [My-75]
	$z > 120$	Mixing Ratio[c]				Yes	Myers [My-75]

[a] Major-species model depends on latitude and season; conversion from mixing ratio to absolute values will reflect this dependence.

[b] In g/m^3; WATER converts to ppmm = $(g_{H_2O}/m^3)/(g_{dry\ air}/cm^3)$ before returning to SPCMIN.

[c] In ppmm; SPCMIN converts to molecules/cm^3 = $(\text{ppmm})\rho_{air}10^{-6}/m_{H_2O}$ before outputting SNI(16).

[d] Initialization is performed.

[e] Because 5-km values used in interpolation depends on longitude.

[f] Two-latitude region for $z \lesssim 30$ km with transition at $\approx 30°$ latitude.

[g] Seasonal dependence for $z \lesssim 20$ km.

[h] WATER called from SPCMIN.

[i] SPCMIN called from ATMOSU.

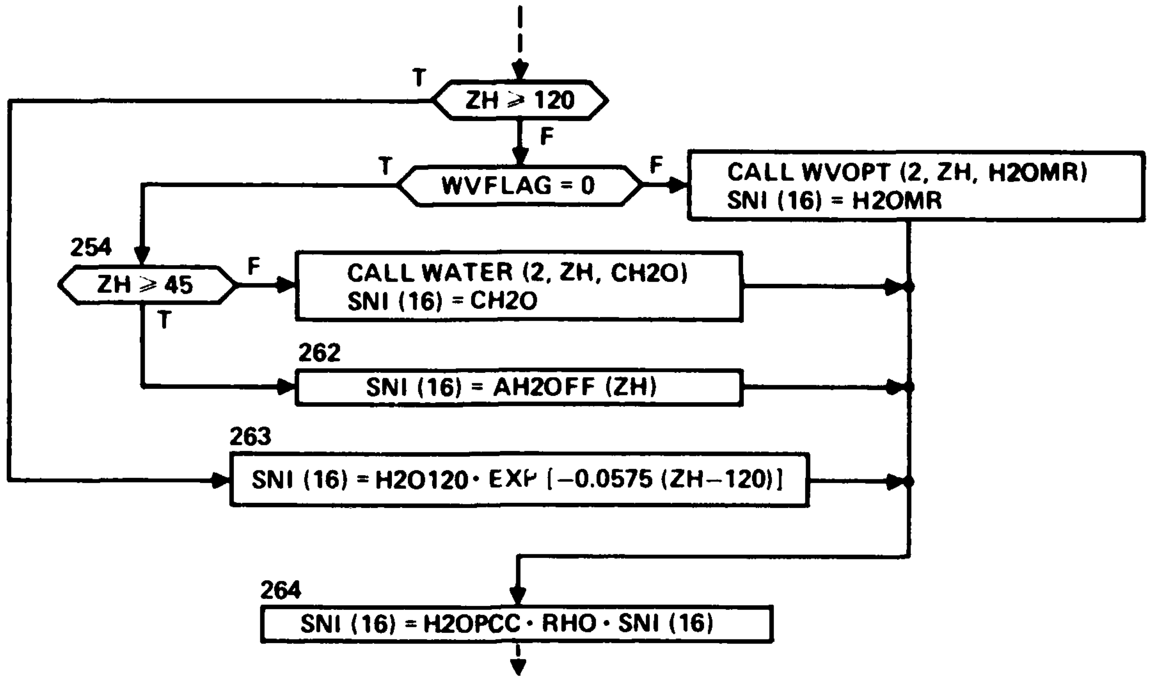

Figure 4-3. Flow chart for the H_2O-portion of Subroutine SPCMIN during its operational phase.

Table 4-23. Input and output variables for Subroutine WATER.

INPUT VARIABLES

Argument List

KK	-	Calculation flag = 1, calculate initialization parameters = 2, calculate H_2O mass-mixing ratio for 0- to 45-km altitude
ZH	-	Altitude of interest, from 0 to 45 km

ATMOUP Common

RHO	-	Mass density of dry air (g/cm^3)

TIME Common

PLAT	-	North latitude of point P (radians)
PLON	-	East longitudinal of point P (radians)
FYR	-	Fractional season-year, being 0 on 1 January in northern hemisphere and on 1 July in southern hemisphere
RHO5KM	-	Mass density of dry air at 5-km altitude (g/cm^3)

OUTPUT VARIABLE

Argument List

H2O	-	Mass-mixing ratio of H_2O at altitude ZH (ppmm)

WVFLAG. (The normal value of 1.0 is necessary for WVFLAG so that Subroutine SPCMIN can call Subroutine WATER during the initialization phase.) For WVFLAG ≠ 0.0, Subroutine WVOPT is allowed to read water data in one of four optional forms according to METHOD = 1,2,3,4, which we will discuss below. But first, it is anticipated that the user will be most interested in using his own low-altitude data over the altitude range from HH(1) = 0.0 to HH(NOP), but he must also actually read in data over the remaining higher-altitude range from HH(NOP+1) to HH(NZH) = 120.0. If the user has no personal preference for data in the higher-altitude range, he may find it convenient to use the data in a data statement in Subroutine SPCMIN, given at altitudes 20(5)120 km and in units of parts per million by mass (ppmm).

In considering what options should be available, note that Huschke [Hu-59, p. 462] states that a radiosonde measures pressure, temperature, and humidity. (Since humidity is not further specified, it could be any measure of the water-vapor content, such as absolute humidity, relative humidity, specific humidity, mixing ratio, or dew-point temperature.)

Before proceeding, we digress for the benefit of some readers to discuss various ways of expressing the water-vapor content of moist air. We have a need for some or possibly all of them and the conversion relations.

1. Water-Vapor Number Density

$$[H_2O] = H_2O \text{ molecules/cm}^3 .$$

The corresponding vapor pressure at temperature T is

$$p_w = [H_2O]kT \text{ dyne/cm}^2 \quad (1a)$$

$$= 10^{-3} [H_2O]kT \text{ mb} \quad . \quad (1b)$$

2. Absolute Humidity

$$\rho_{H_2O} = (\text{grams of } H_2O)/m^3 \quad ,$$

also called vapor concentration or vapor density. Note the convention of using m^{-3} and not cm^{-3}. The corresponding vapor pressure at temperature T is

$$p_w = 10^{-6}\ \rho_{H_2O}(g/m^3)\ \frac{N_A}{M_{H_2O}}\ kT \quad dyne/cm^2 \tag{2a}$$

$$= 10^{-6}\ \rho_{H_2O}(g/m^3)\ \frac{R}{M_{H_2O}}\ T \quad dyne/cm^2 \tag{2b}$$

where N_A = Avogadro's number, R = gas constant, and M_{H_2O} = molecular weight of water vapor.

3. Mass-Mixing Ratio

r_m = the dimensionless ratio of the mass of water vapor to the mass of dry air, sometimes expressed in units of parts per million by mass, i.e.,

$$r_m(ppmm) = (g_{H_2O}/m^3)/(g_{dry\ air}/cm^3 \tag{3a}$$

$$= \rho_{H_2O}(g/m^3)/\rho_{dry\ air}(g/cm^3) \quad . \tag{3b}$$

4. Relative Humidity

U_w = the dimensionless ratio of the actual vapor pressure (p_w) to the saturation vapor pressure (e_w), usually expressed in percent, i.e.,

$$U_w = 100\ p_w/e_w \quad . \tag{4}$$

At temperatures less than 0°C, the relative humidity is evaluated with respect to water, not ice [Li-71, p. 348].

5. Dew Point (or dew-point temperature)

T_d = the temperature to which a given parcel of air must be cooled at constant pressure and constant water-vapor content in order for saturation to occur. At the dew-point temperature the saturation vapor pressure of the parcel equals the actual vapor pressure of the contained water vapor.

Since most of our H_2O modeling is done in terms of mass-mixing ratios, we decided that the general technique should be one in which the user specifies tabular data in terms of either mass-mixing ratios or quantities from which mass-mixing ratios can be computed by the code. The options selected are:

Option 1. Mass-Mixing Ratio. The user reads in values of the water-vapor mass-mixing ratio expressed in units of parts per million by mass (ppmm). For this option no further preprocessing is required.

Option 2. Absolute Humidity. The user reads in values of the absolute humidity, ρ_{H_2O} (grams H_2O/m^3). The desired values of mass-mixing ratio are computed from Equation (3b).

Option 3. Relative Humidity. The user reads in values of the relative humidity (in percent), U_w. The desired values of mass-mixing ratio are computed from the following steps:

a. Compute saturated vapor pressure (over water), e_w(mb), from Subroutine H2OSVP.

b. Compute vapor pressure from

$$p_w(\text{mb}) = 0.01\ U_w e_w \quad . \tag{4a}$$

c. Compute the absolute humidity from

$$\rho_{H_2O}(\text{g/m}^3) = \frac{10^9\ p_w(\text{mb})}{(R/M_{H_2O})T} \quad . \tag{2c}$$

d. Compute the mass-mixing ratio from Equation (3b).

Option 4. Dew Point. The user reads in values of the dew-point temperature (T_d). The desired values of the mass-mixing ratio are computed from the following steps:

a. Compute the vapor pressure ($p_w(T_d)$), which equals the saturation vapor pressure ($e_w(T_d)$) at the dew-point temperature (T_d), by using Subroutine H2OSVP.

b. Compute the absolute humidity from Equation (2c).

c. Compute the mass-mixing ratio from Equation (3b).

Since most of our H_2O modeling is done in terms of mass-mixing ratio r_m(ppmm), the outputs from Subroutine SPCMIN (which are independent of the value of WVFLAG) can be derived as follows:

1. <u>Water-Vapor Number Density ($[H_2O]$, molecules/cm^3)</u>

Compute the number density

$$[H_2O] = 10^{-6}\ r_m(\text{ppmm})\ \rho_{\text{dry air}}(g/cm^3)\ N_A/M_{H_2O}. \qquad (5)$$

2. <u>Relative Humidity (U_W, percent)</u>

   a. Compute vapor pressure (p_w(mb)), from Equation (1b).

   b. Compute saturation vapor pressure (e_w(mb)) by using Subroutine H2OSVP.

   c. Compute relative humidity (U_w) from Equation (4).

In the above discussion we have mentioned Subroutine H2OSVP several times. This subroutine computes the saturation vapor pressure of water vapor over a plane surface of (1) water for the temperature range from 173.15 to 373.15°K (-100 to +100°C) and (2) ice for the temperature range from 173.15 to 273.15°K (-100 to 0°C). Values of zero are returned for the parameters outside the indicated temperature ranges and a message is printed if the routine is called outside the indicated range.

The formula used for the water reference is a third degree polynomial given by Wexler [We-76, Equation (16b)] as an approximation to his Equation (15) for the natural logarithm of the vapor pressure (in Pascals) of water in the range from 0 to 100°C but used here also in the extrapolated region from 0 to -100°C. The basic formula for the ice reference is that given by Goff [Go-63a, Equation (5)]. However, to simplify the computation we have fitted a sixth-degree polynomial (EWDEI) to the ratio e_w/e_i, where e_i is the saturated vapor pressure over ice as given by Goff [Go-63a, Equation (5)], and compute e_i from the expression

$$e_i = e_w/\text{EWDEI}. \qquad (6)$$

The input and output variables for Subroutines WVOPT and H2OSVP are given in Tables 4-24 and 4-25.

Table 4-24. Input and output variables for Subroutine WVOPT.

INPUT VARIABLES

Argument List

JJ	-	Calculation flag = 1, initialization call = 2, normal operation call
HKM	-	Altitude of interest (km) (used only if JJ = 2)

ATMOUP Common

RHO	-	Air density (g/cm^3)
TT	-	Temperature (°K)

VPC Common

METHOD	-	Flag indicating one of four options for treatment of water vapor = 1, data values in parts per million by mass (ppmm) = 2, data values in absolute humidity (g/m^3) = 3, data values in relative humidity (percent; 10 percent is input as 10., not 0.10) = 4, data values in dew-point temperature (°K) NOTE: For METHOD = 2,3,4, the subroutine converts the first NOP values of the data into parts per million by mass, during initialization.

DATA Read In

HH(N)	-	Altitude array 0.0 to 120.0 km
WVC(N)	-	H_2O data using one of the four options. For N=1,NOP, data have dimensions dictated by the option used. For N=NOP+1,NZH, data have dimensions of parts per million by mass. NOP=NZH is a valid input condition.

OUTPUT VARIABLE

Argument List

H2OMR	-	Water vapor content of moist air in units of parts per million by mass at altitude HKM

Table 4-25. Input and output variables for Subroutine H2OSVP.

INPUT VARIABLES		
Argument List		
TEMP	-	Temperature (°K)
DATA Quantities		
AA(I)	-	Coefficients in third-degree polynomial for EH2O ≡ e_w, given by Wexler [We-76, Equation (16b)]
BB(I)	-	Coefficients in sixth degree polynomial for EWDEI used to fit the ratio EH2O/EICE ≡ e_w/e_i, in the range from 0 to -100°C
OUTPUT VARIABLES		
Argument List		
EH2O	-	Saturation vapor pressure over water (millibar = 1000 dyne/cm^2 = 100 Pascal)
EICE	-	Saturation vapor pressure over ice (mb)

4-4 PLOTS OF MINOR NEUTRAL SPECIES PROFILES

Comparisons of the fit-function values with the data-base values [Volumes 14c and 14b] of minor species densities are given in Figures 4-4 through 4-20. Normally, circles and triangles are used to denote the data-base values for day and night conditions, respectively. Data-base values originally specified as mixing ratios [My-78] have been converted to particle number densities here so that all profiles would be in terms of number densities. Where the day and night values do not differ, only the circles are shown. The fit-function values, obtained from the sample problems for which the output is given in Section 6, are plotted as the solid curves for daytime conditions and dashed curves for the nighttime conditions. If the daytime and nighttime values do not differ, only the solid curves are shown. For those species with dependencies on local apparent time (t), geographical position (or latitude, L), fractional seasonal-year (f), or solar decimetric flux (F), the legends normally give the specific conditions, taken from the sample problems in Section 6.

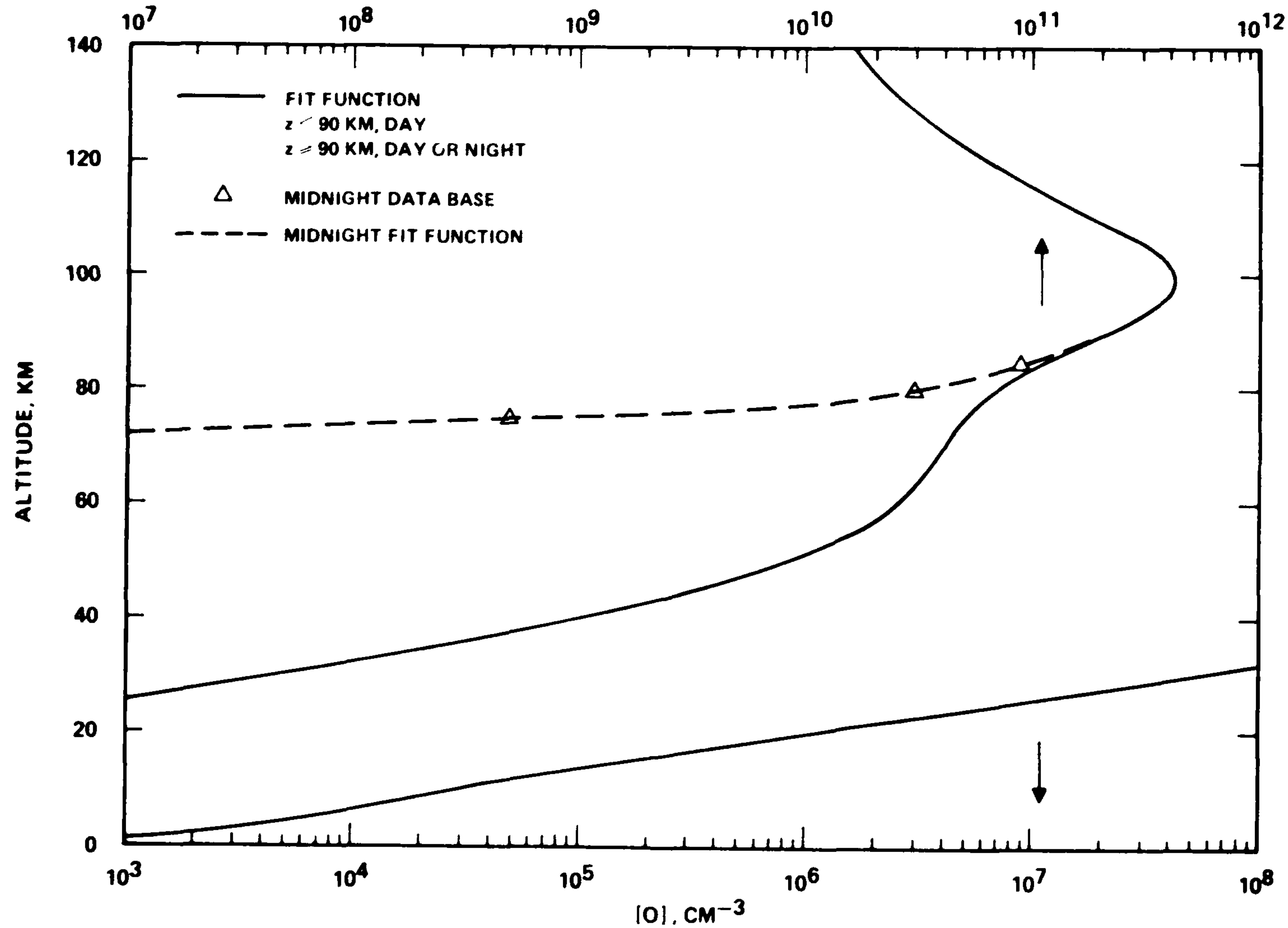

Figure 4-4. O density profile.

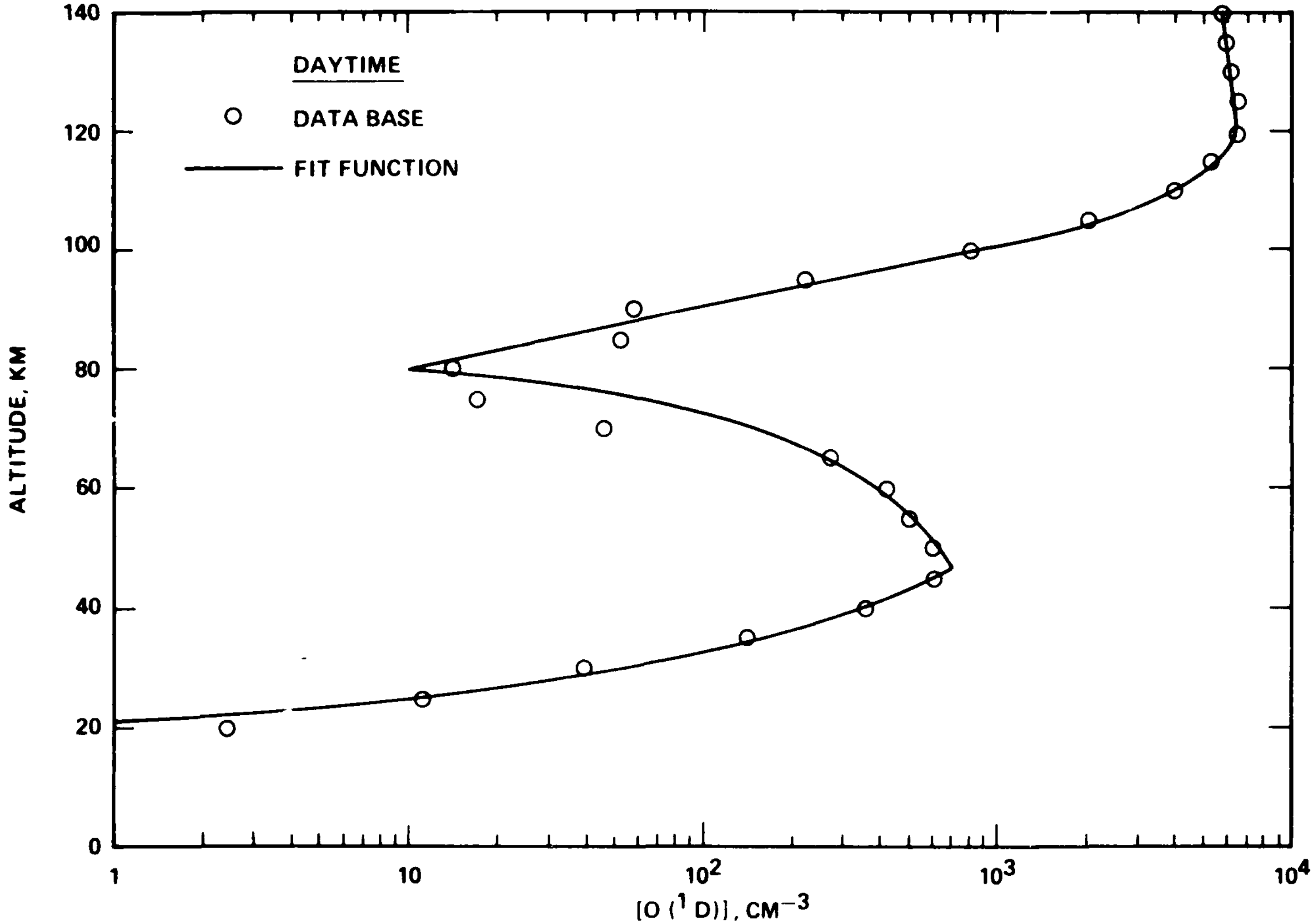

Figure 4-5. $O(^1D)$ density profile.

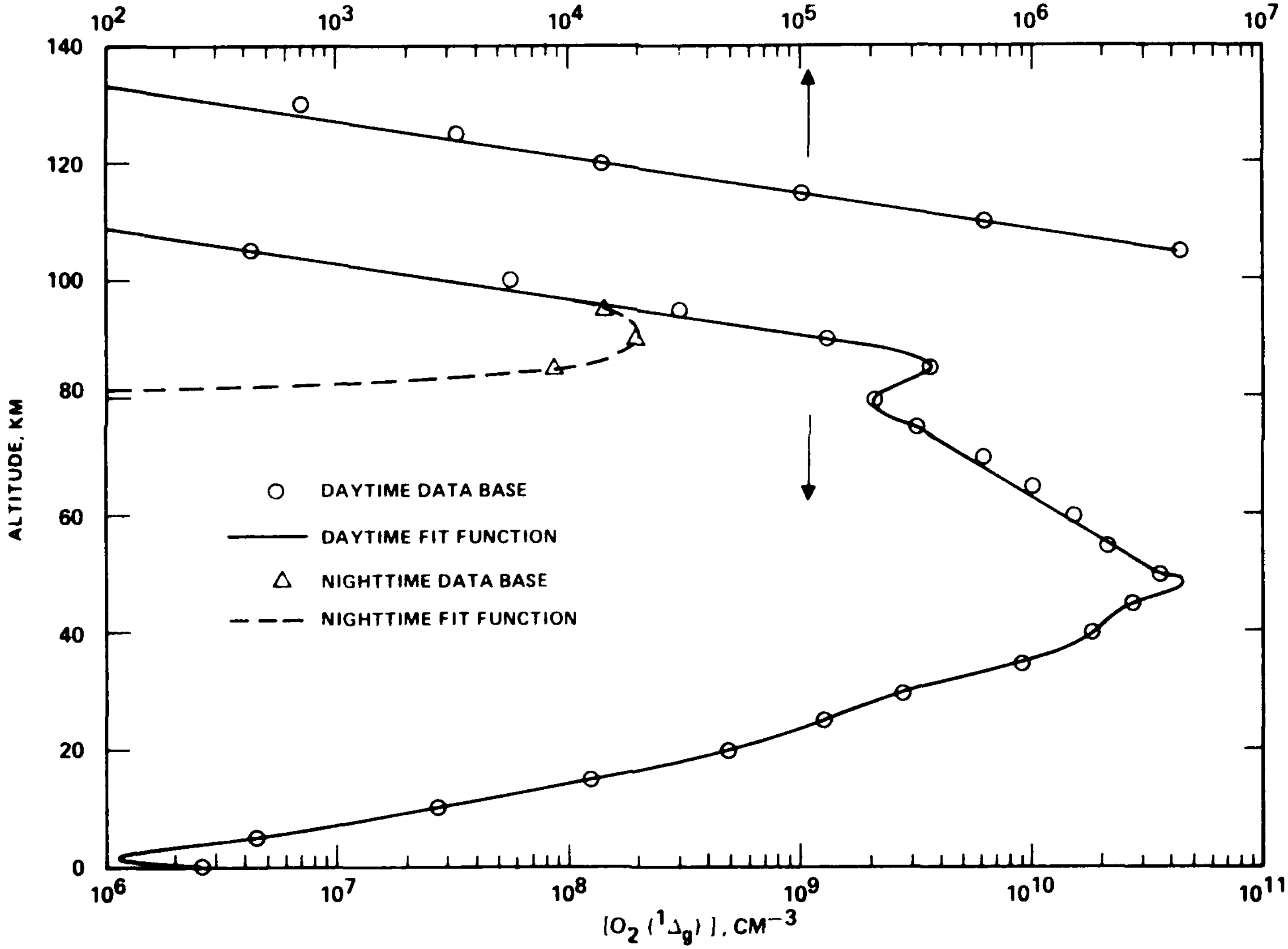

Figure 4-6. $O_2(^1\Delta_g)$ density profile.

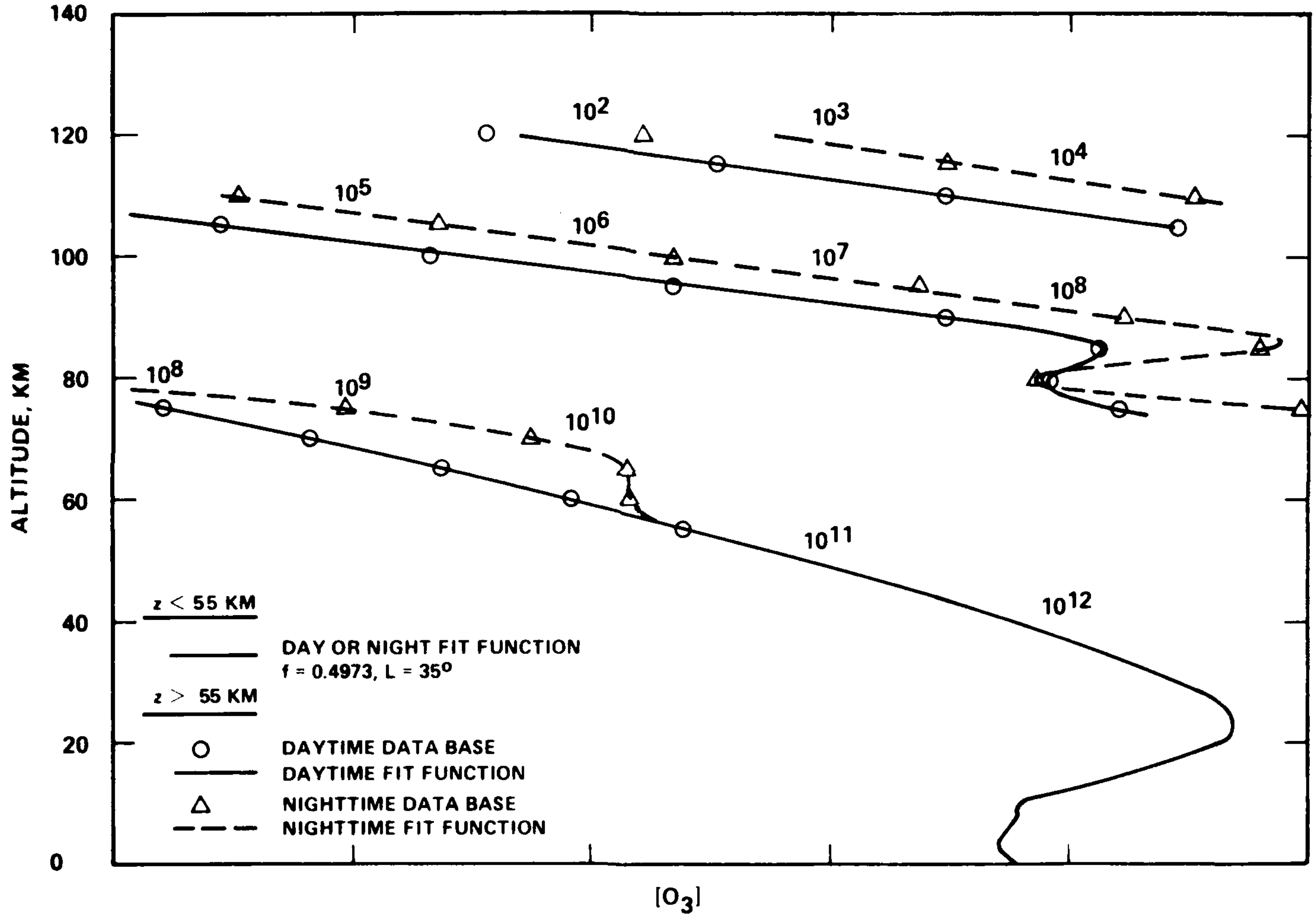

Figure 4-7. O_3 density profile.

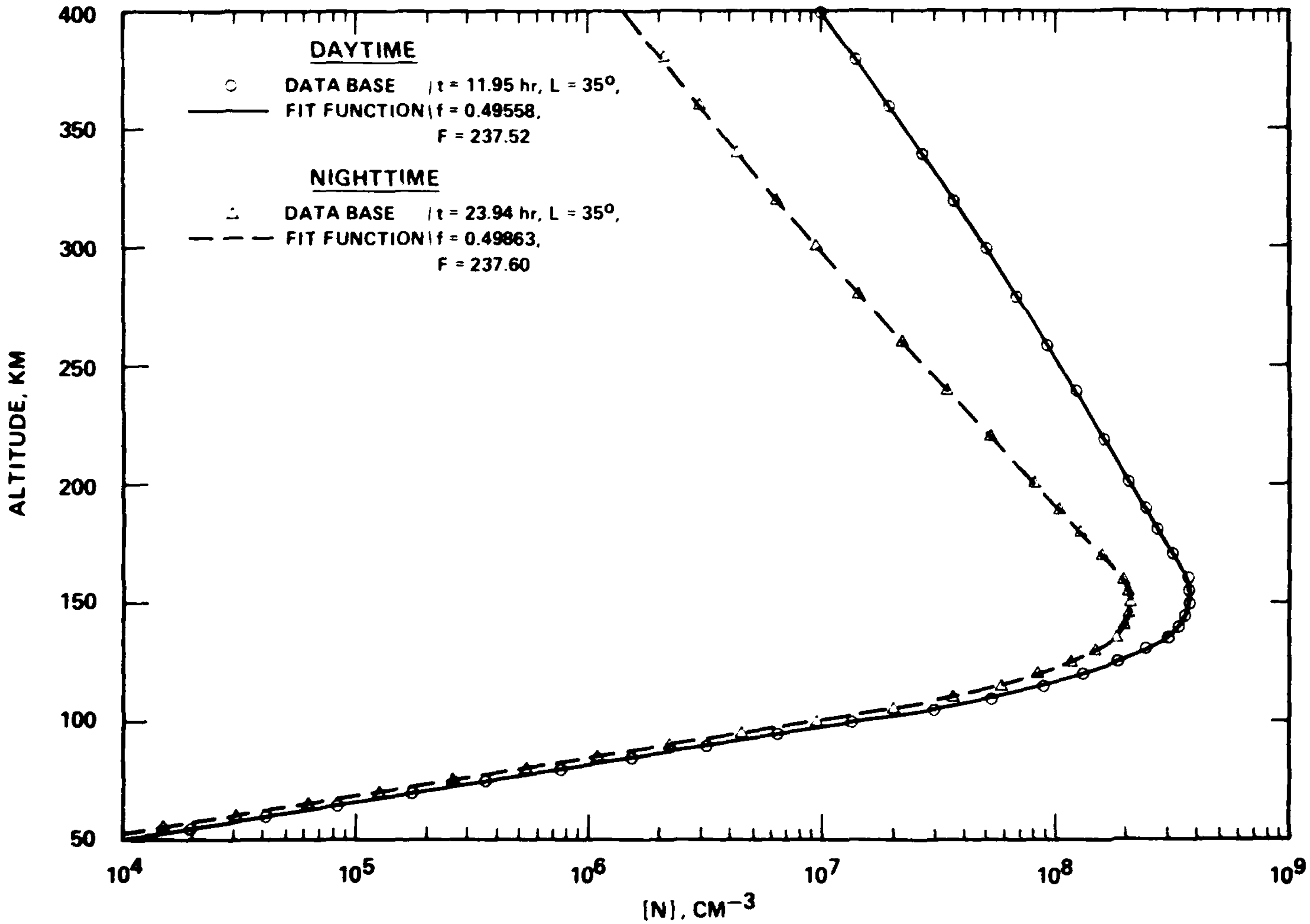

Figure 4-8. N density profile.

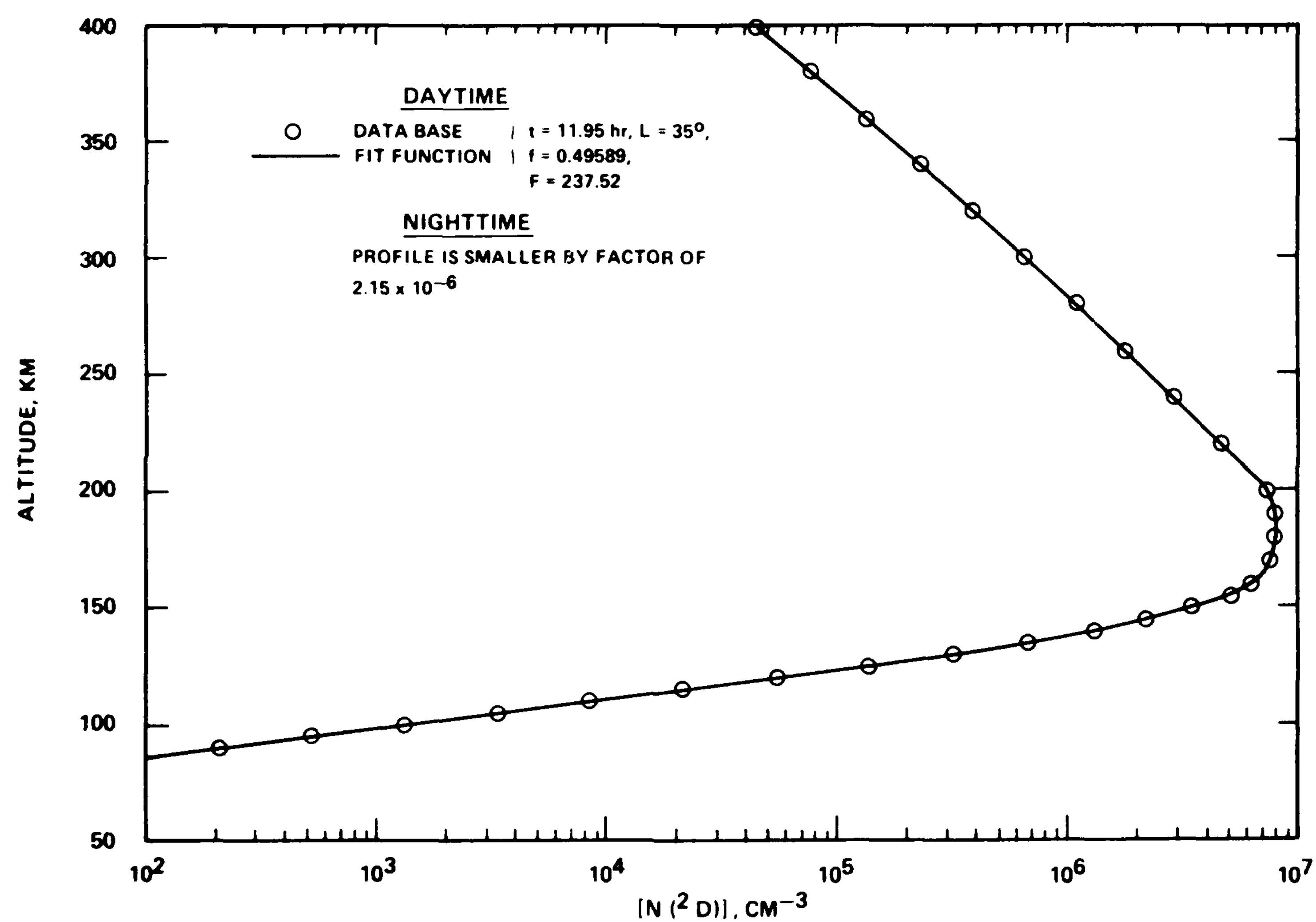

Figure 4-9. $N(^2D)$ density profile.

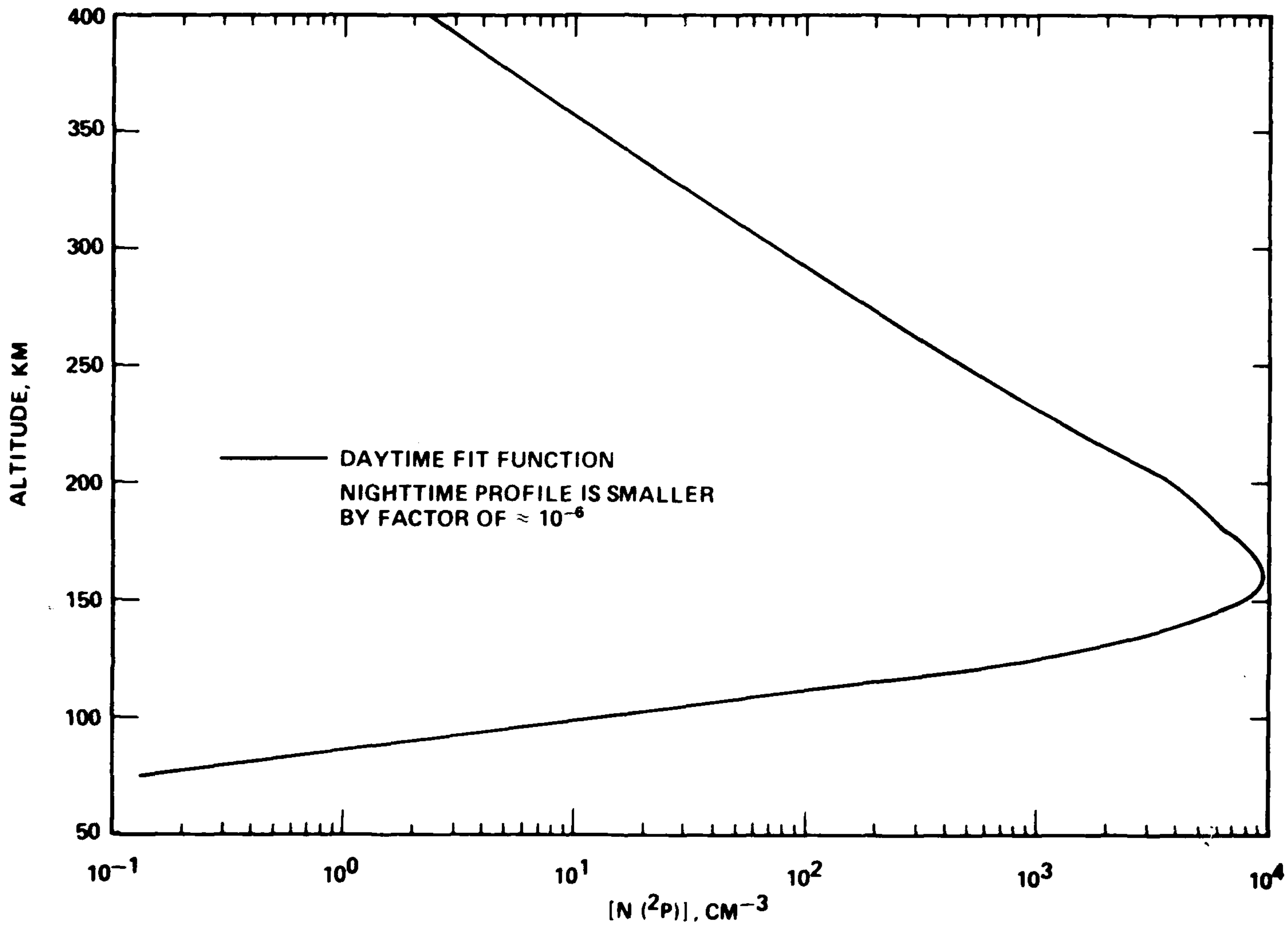

Figure 4-10. $N(^2P)$ density profile.

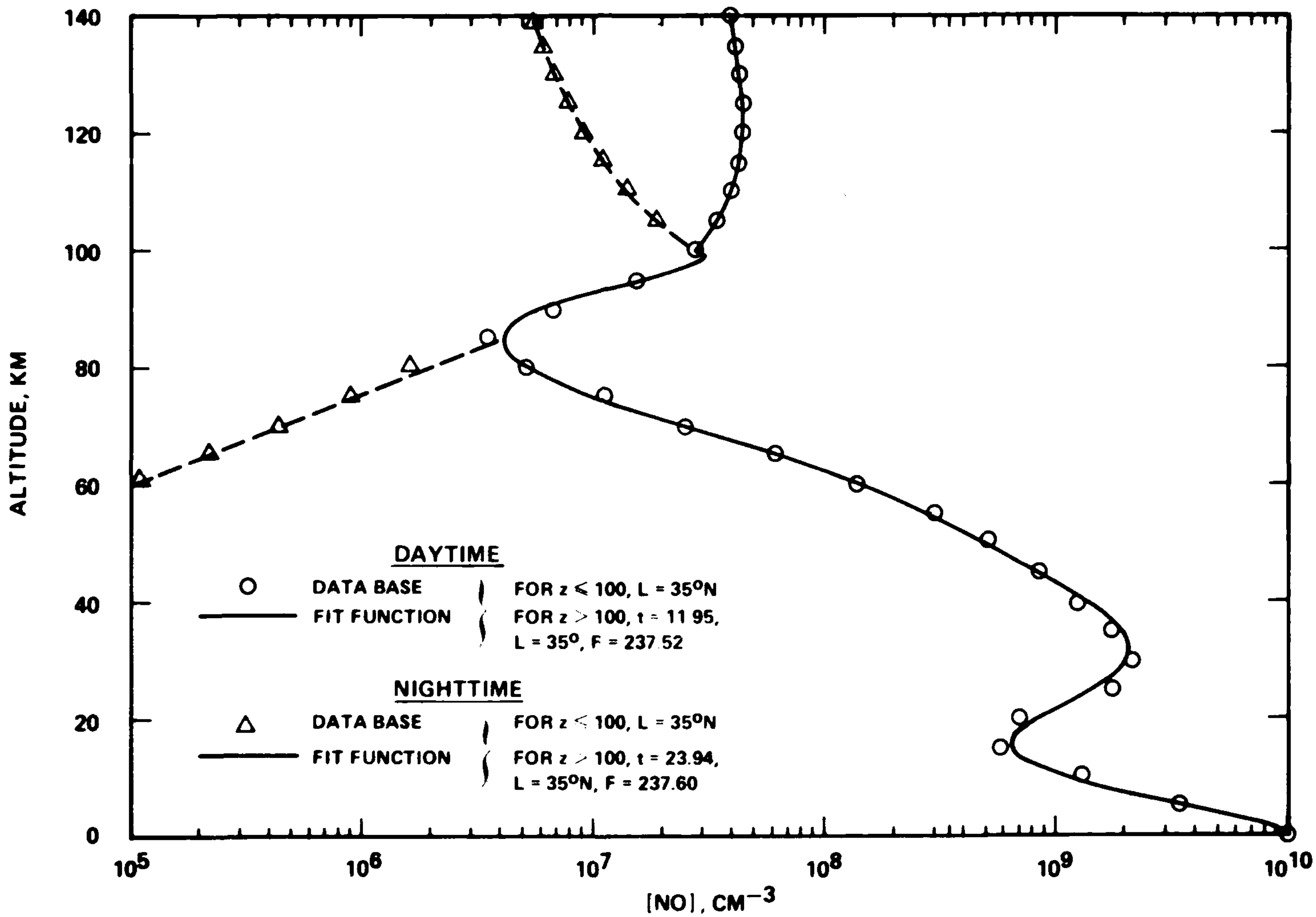

Figure 4-11. NO density profile.

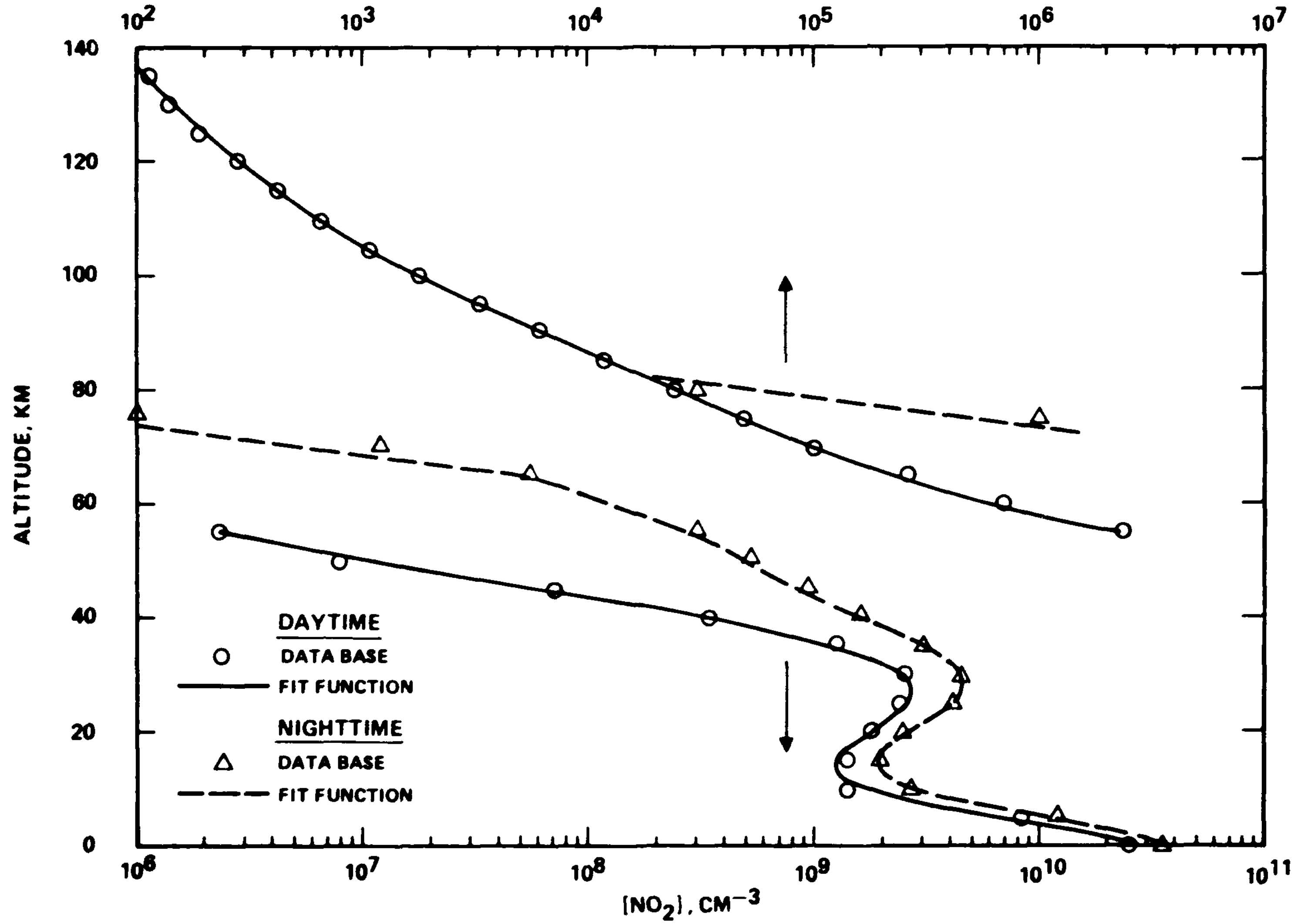

Figure 4-12. NO_2 density profile.

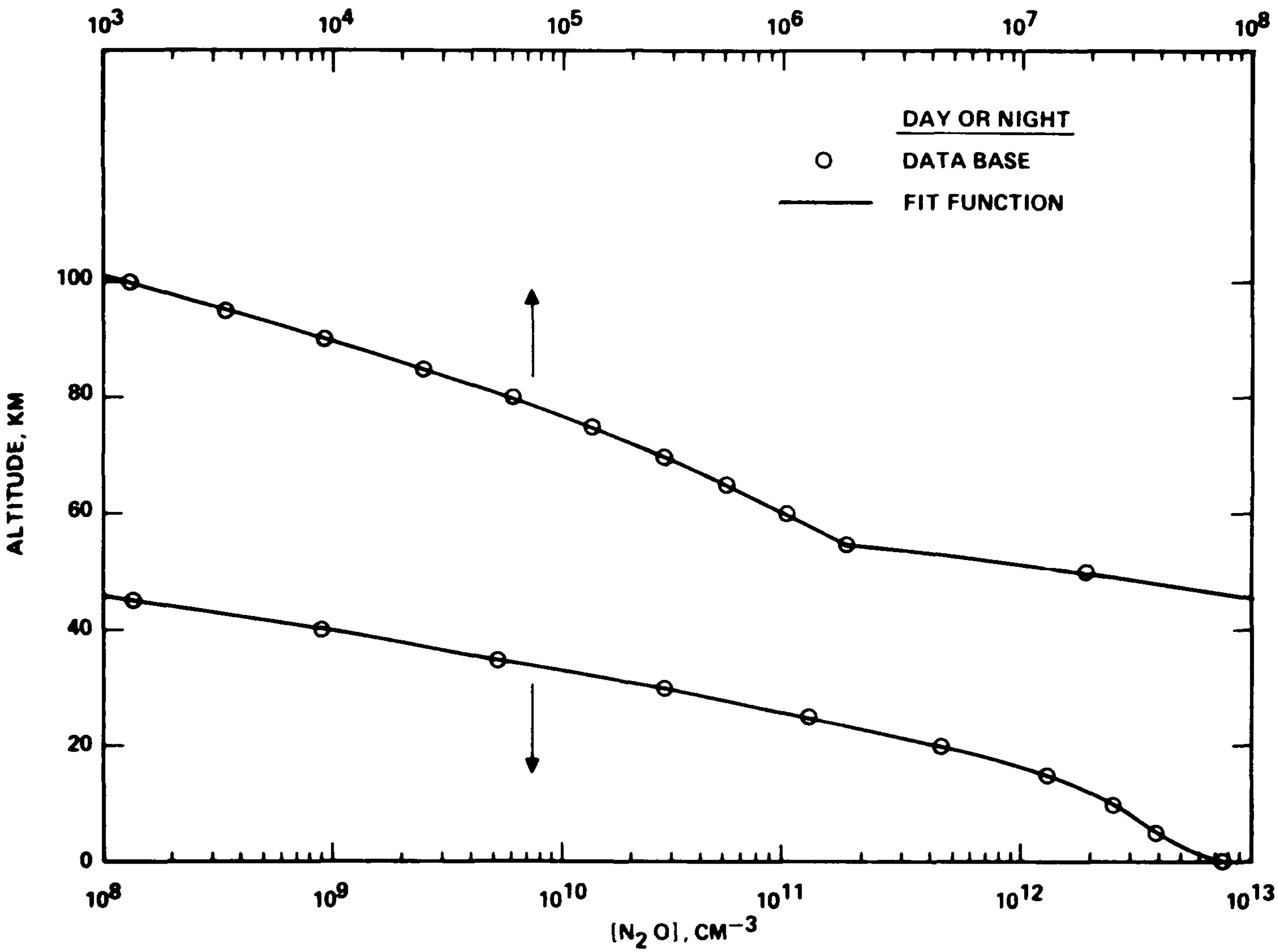

Figure 4-13. N_2O density profile.

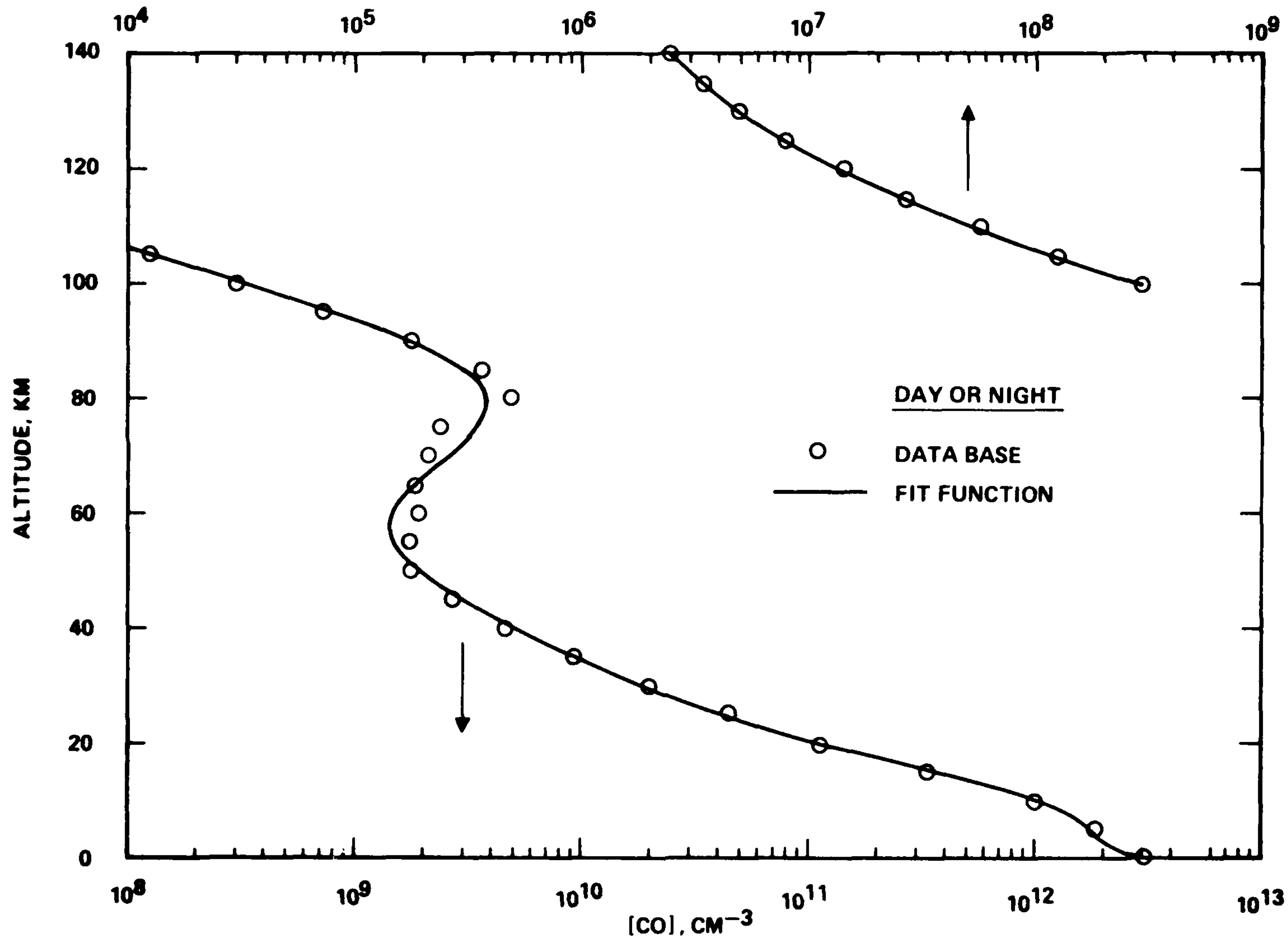

Figure 4-14. CO density profile.

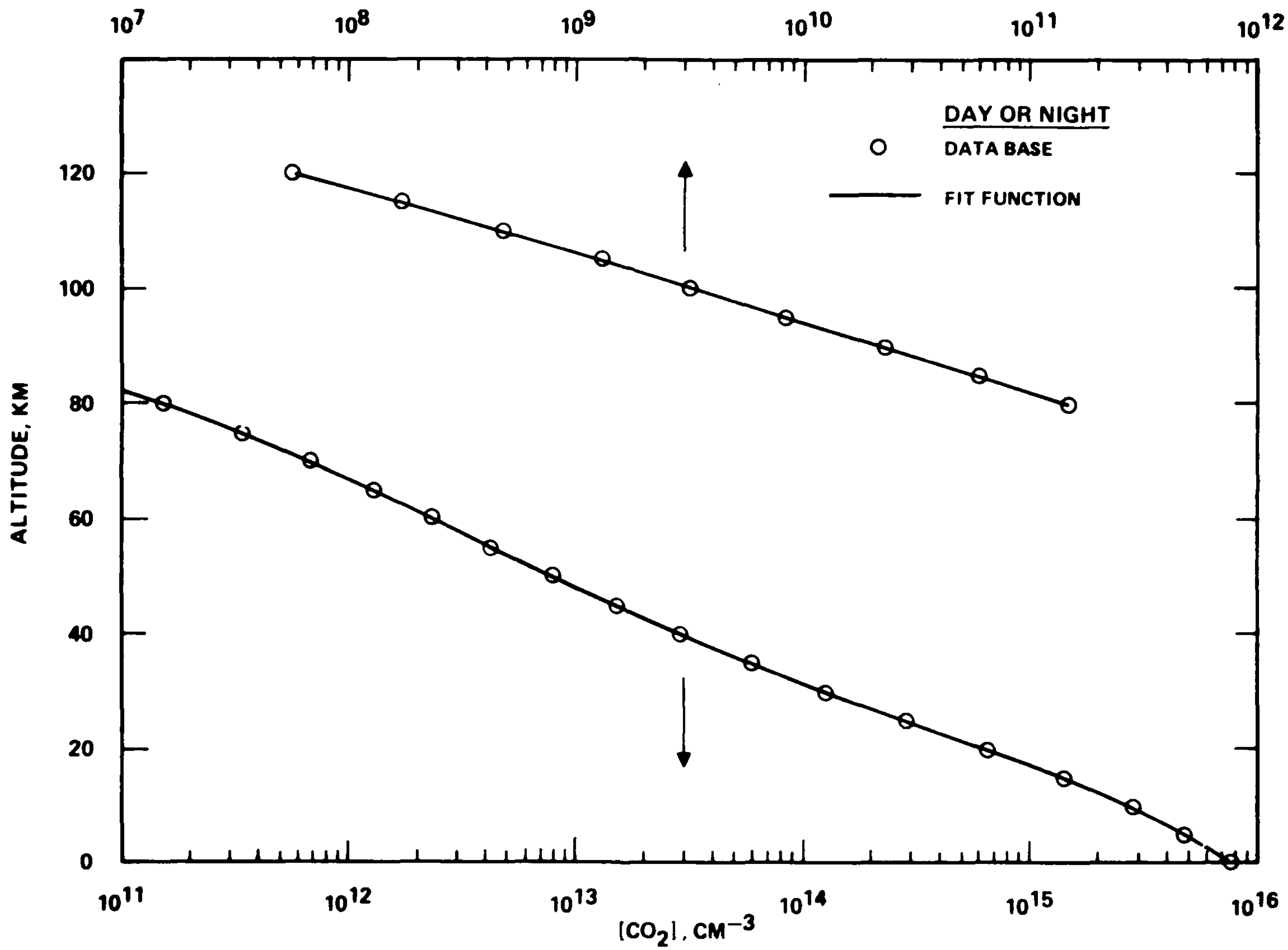

Figure 4-15. CO_2 density profile.

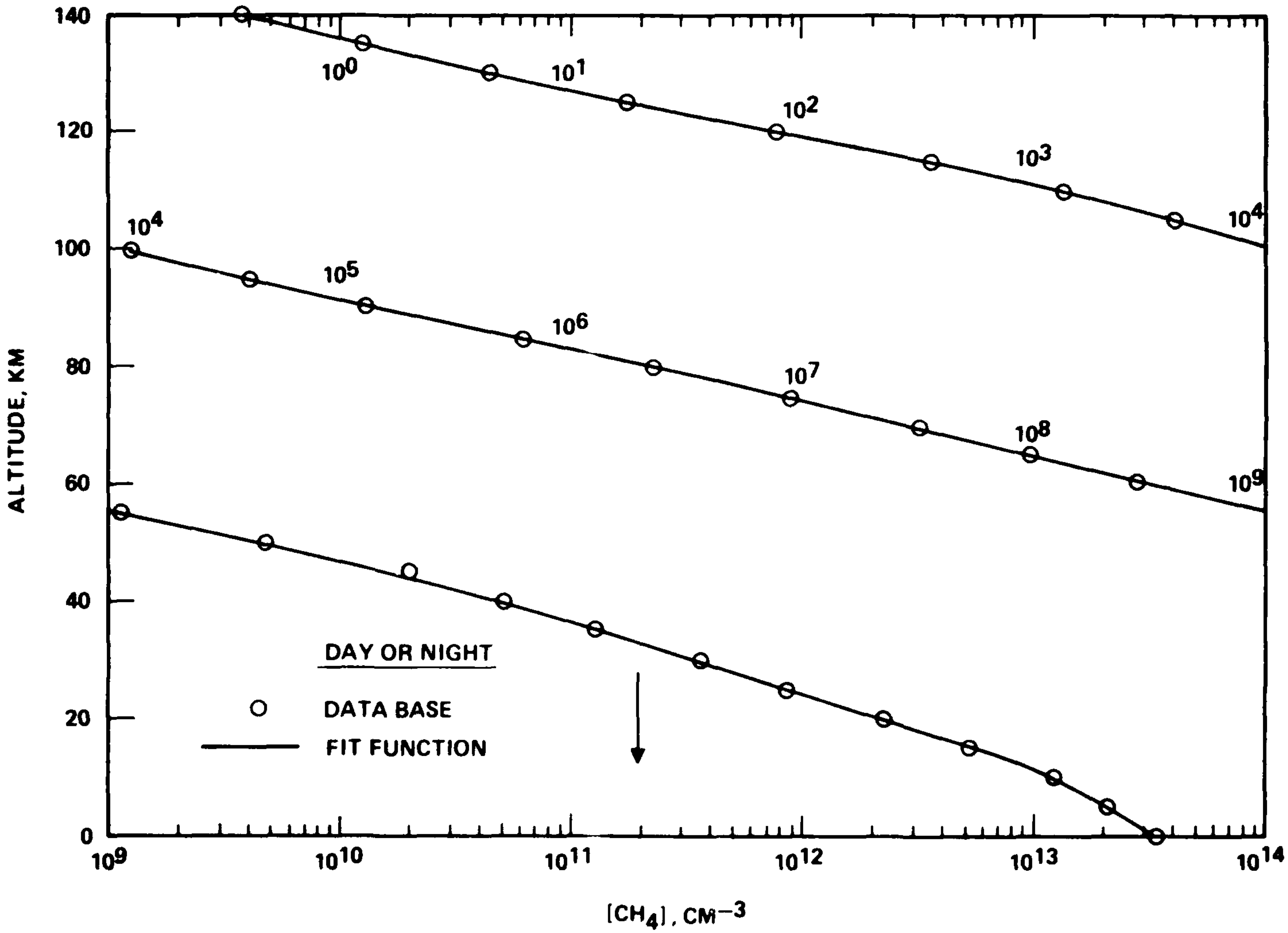

Figure 4-16. CH_4 density profile.

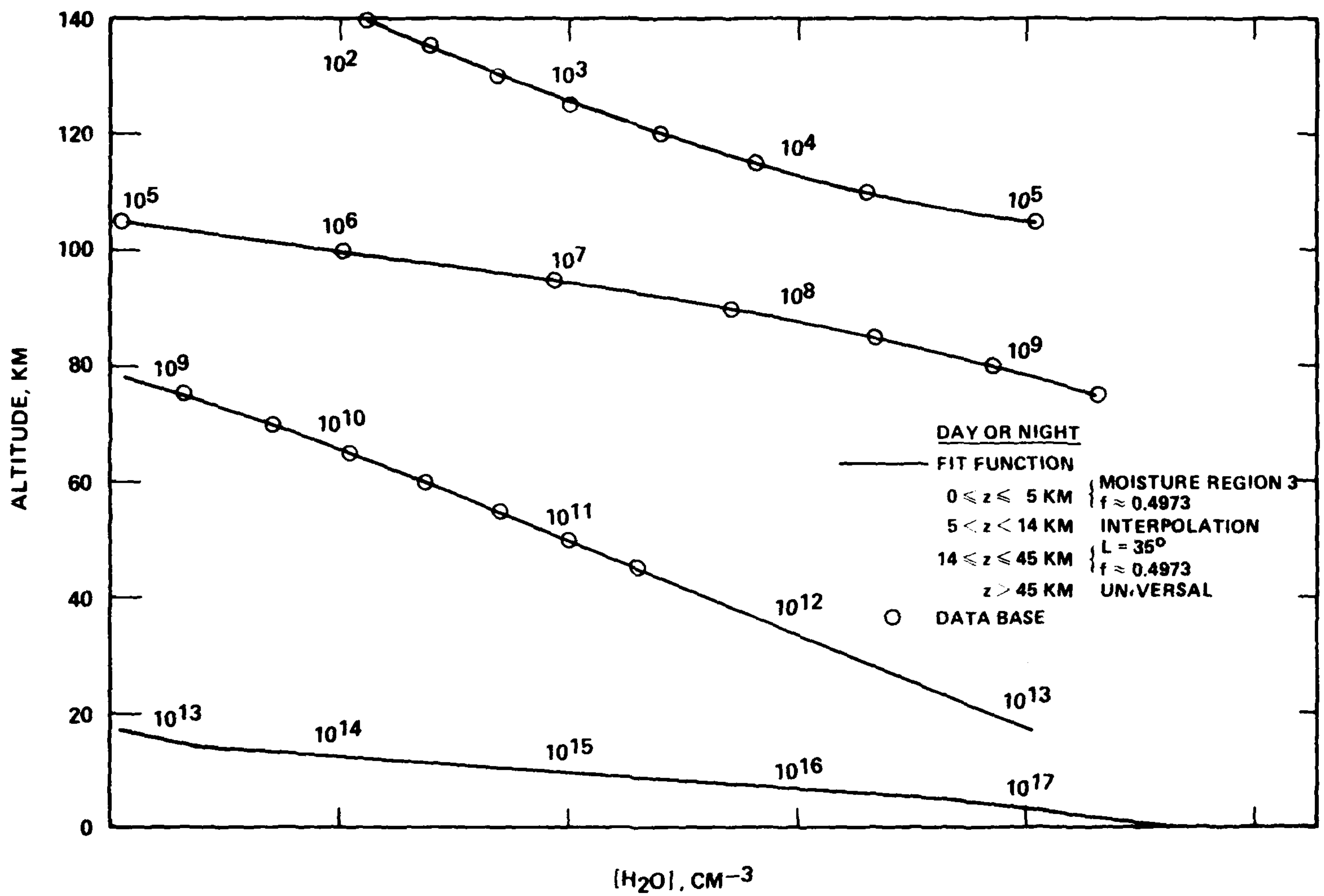

Figure 4-17. H_2O density profile.

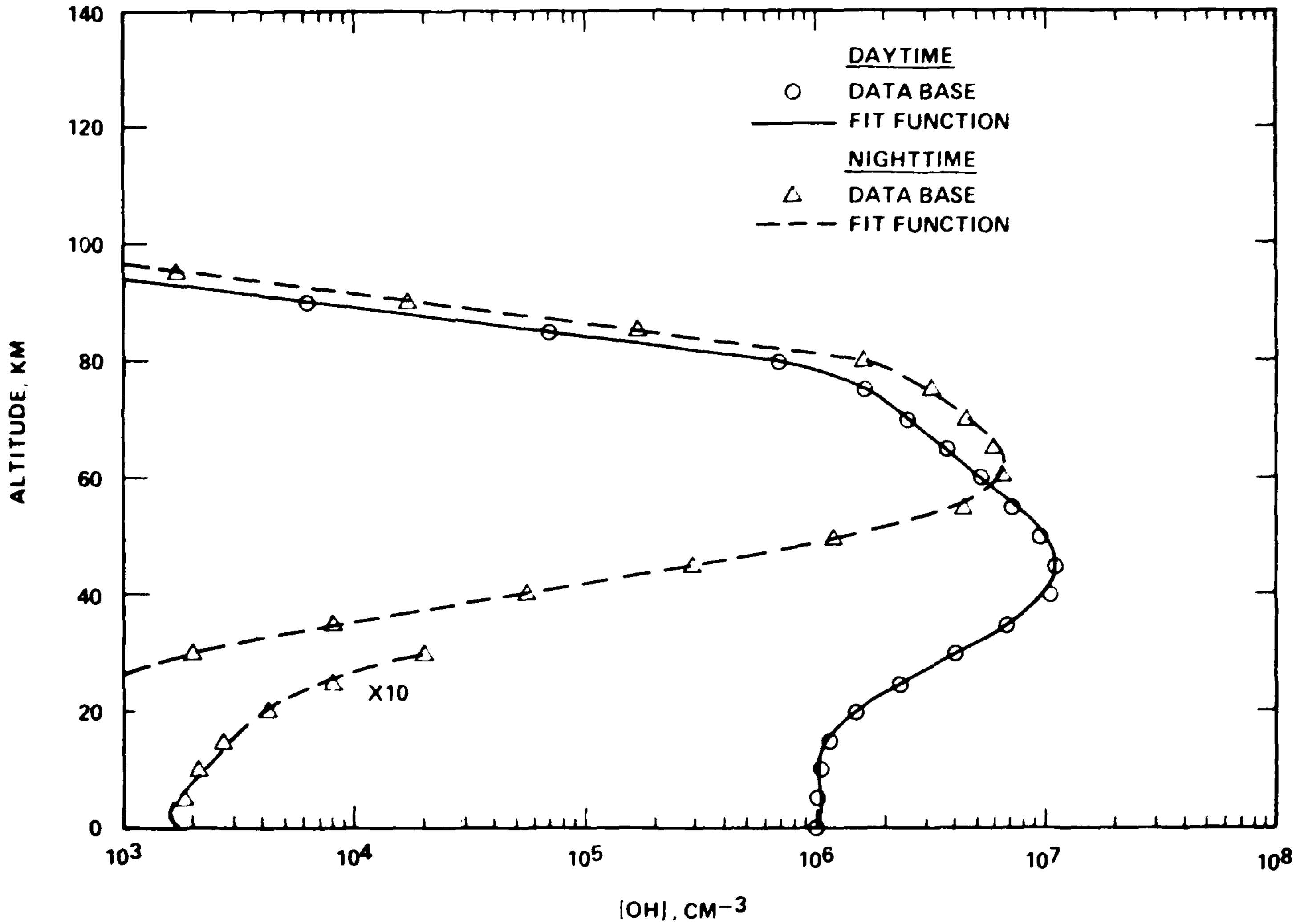

Figure 4-18. OH density profile.

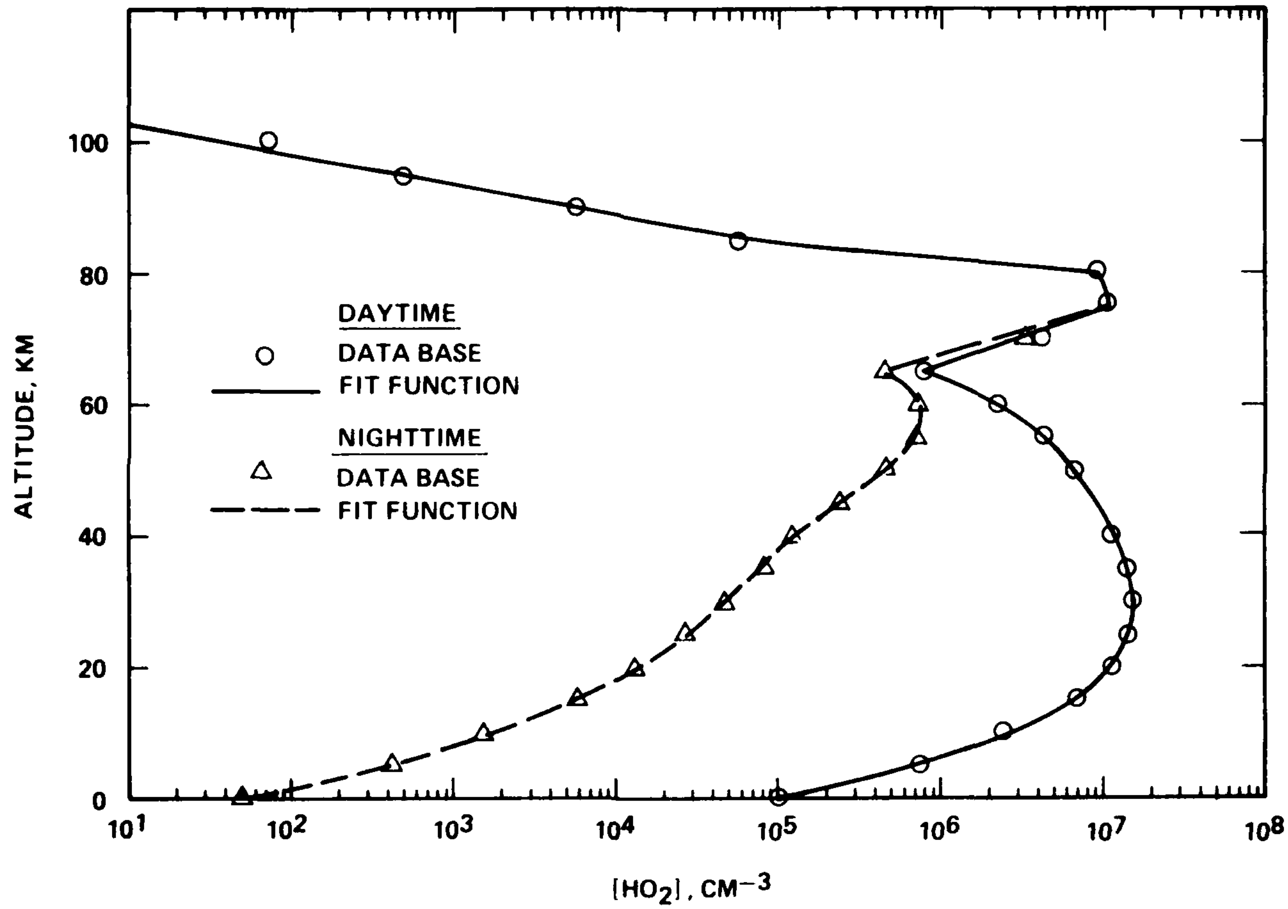

Figure 4-19. HO_2 density profile.

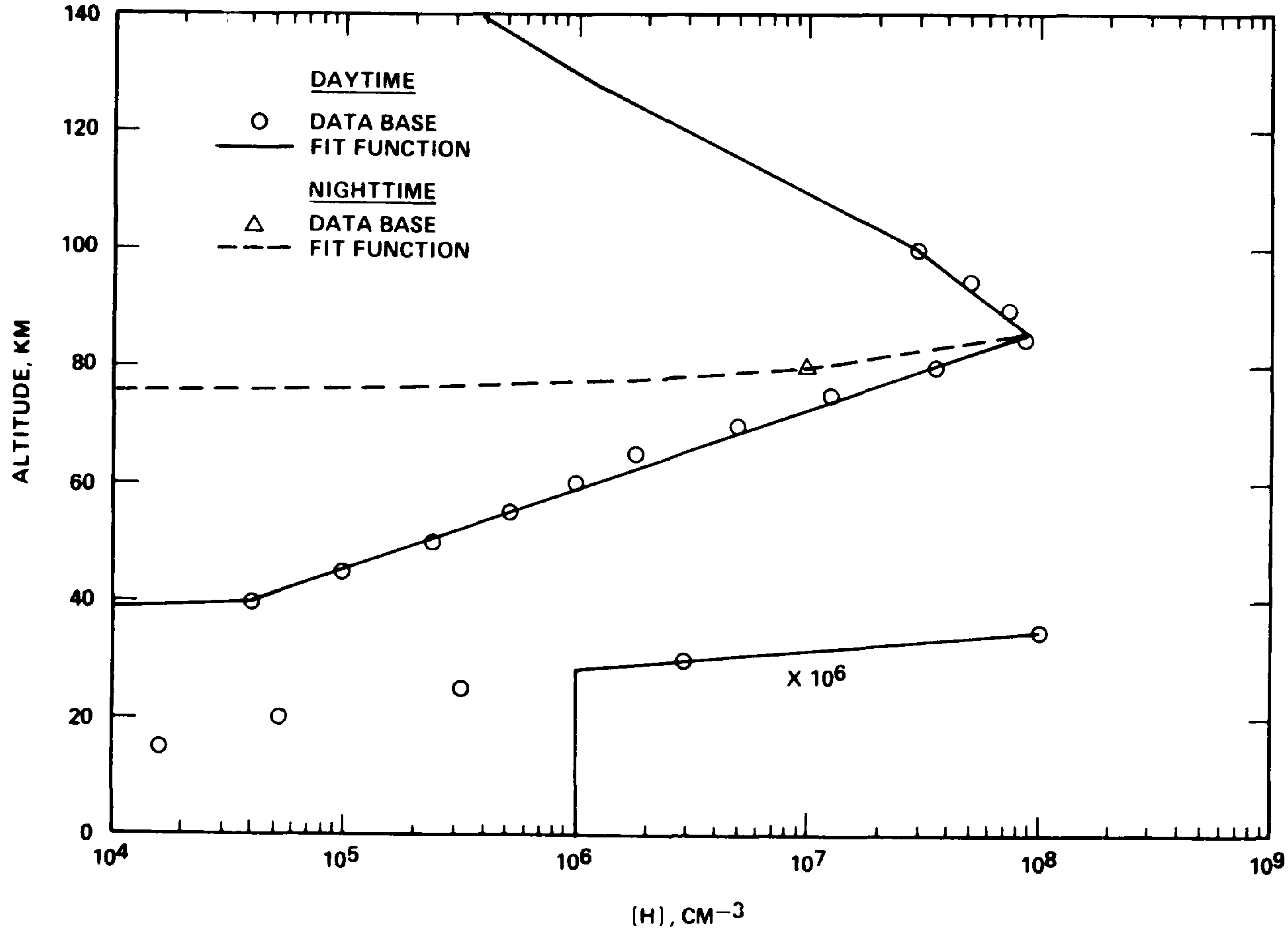

Figure 4-20. H density profile.

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ROSCOE MANUAL, VOLUME 14A-1 - AMBIENT ATMOSPHERE (MAJOR AND MIN--ETC(U)
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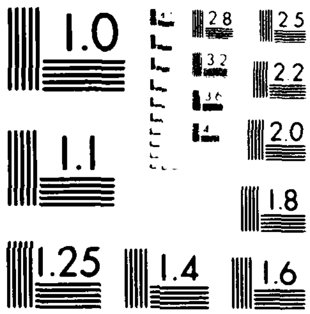

MICROCOPY RESOLUTION TEST CHART

SECTION 5

AMBIENT IONOSPHERE (SUBROUTINE IONOSU)

5-1 INTRODUCTION

Subroutine IONOSU provides the properties of the ambient ionosphere required by the chemistry modules. The quantities required for the E- and F-region ionospheric chemistry in ROSCOE-IR are obtained by a natural extension of the method used for ROSCOE-Radar (see Volume 14a, pages 67-74). The principal change is from the generic molecular ion M^+ to NO^+, N_2^+, and O_2^+. There is no change in the requirements of the D-region chemistry module for ionospheric properties.

See Table 5-1 for a summary of inputs and outputs for Subroutine IONOSU.

5-2 E- AND F-REGION IONOSPHERIC PROPERTIES

The E- and F-region chemistry module requires the following quantities:

a. q, the effective total ion-production rate that reproduces the ambient ionosphere when used with the chemistry model ($cm^{-3}\ sec^{-1}$)

b. O^+, the positive atomic-ion density (cm^{-3})

c. NO^+, the NO^+ molecular-ion density (cm^{-3})

d. N_2^+, the N_2^+ molecular-ion density (cm^{-3})

e. O_2^+, the O_2^+ molecular-ion density (cm^{-3})

f. T_x, the electron (and N_2 vibration) temperature (°K).

The E- and F-region ionospheric chemistry equations, which are a natural extension of the pair of equations used for ROSCOE-Radar (Volume 14a, Section 5, Equations (1) and (2)), are

Table 5-1. Input and output variables for Subroutine IONOSU.

INPUT VARIABLES

Argument List

JJ	-	Calculation flag If {JJ=1: calculate initialization parameters {JJ=2: calculate ionospheric properties
ZH	-	Altitude of interest (km)

ATMOUP Common

IDORN	-	Parameter for day or night. If COSCHI is the cosine of the zenith angle of the sun at point P, IDORN is 1 for daytime, i.e., IF(COSCHI.GE. 0.0), and is -1 for nighttime, i.e., IF(COSCHI.LT.0.0)
SNI(1)	-	N_2 concentration ($1/cm^3$)
SNI(2)	-	O_2 concentration ($1/cm^3$)
SNI(3)	-	O concentration ($1/cm^3$)
SNI(7)	-	N concentration ($1/cm^3$)
SNI(8)	-	NO concentration ($1/cm^3$)
TT	-	Heavy-particle temperature (°K)

ALTODN Common

ALTKM(47)	-	The array of altitudes at which minor species are specified as data in SPCMIN

RATCOF Function Routine

Reaction rate coefficients for chemical ractions

DATA

HEBOTD	-	Altitude below which the daytime electron density decreases exponentially and above which the logarithm of the daytime electron density increases parabolically (km)
EBOTD	-	Daytime electron density at altitude HEBOTD ($1/cm^3$)
HF2MXD	-	Altitude at which the maximum daytime electron density occurs (km)

(Continued)

Table 5-1. (Cont'd)

EF2MXD	-	Daytime electron density at altitude HF2MXD ($1/cm^3$)
EDDSCH	-	Scale height with which the daytime electron density decreases below altitude HEBOTD (km)
F2DSCH	-	Scale height with which the daytime electron density decreases above altitude HF2MXD
HEBOTN	-	Altitude below which the nighttime electron density decreases exponentially and above which the logarithm of the nighttime electron density increases sinusoidally (km)
EBOTN	-	Nighttime electron density at altitude HEBOTN ($1/cm^3$)
HF2MXN	-	Altitude at which the maximum nighttime electron density occurs (km)
EF2MXN	-	Nighttime electron density at altitude HF2MXN ($1/cm^3$)
EDNSCH	-	Scale height with which the nighttime electron density decreases below altitude HEBOTN (km)
F2NSCH	-	Scale height with which the nighttime electron density decreases above altitude HF2MXN
TXT120	-	The difference between the electron temperature and the gas temperature at 120-km altitude in the ambient daytime ionosphere (°K)
TXT200	-	The difference between the electron temperature and the gas temperature at 200-km altitude in the ambient daytime ionosphere (°K)
TXT800	-	The difference between the electron temperature and the gas temperature at 800-km altitude in the ambient daytime ionosphere (°K)
DQDAY(18)	-	The effective total ion-production rate at altitudes 0(5)85 km that reproduces the ambient daytime D-region ionosphere when used with the chemistry model (ion pairs/[cm^3 sec])
DQNIT(18)	-	The effective total ion-production rate at altitudes 0(5)85 km that reproduces the ambient nighttime D-region ionosphere when used with the chemistry model (ion pairs/[cm^3 sec])

(Continued)

Table 5-1. (Cont'd)

OUTPUT VARIABLES		
ATMOUP Common		
SNI(9)	-	Electron concentration for ZH $\geq$ 90 km ($1/cm^3$)
SNI(10)	-	O^+ concentration for ZH $\geq$ 90 km ($1/cm^3$)
SNI(11)	-	NO^+ concentration for ZH $\geq$ 90 km ($1/cm^3$)
SNI(12)	-	Electron (and N_2 vibration) temperature (°K)
SNI(28)	-	N_2^+ concentration for ZH $\geq$ 90 km ($1/cm^3$)
SNI(29)	-	O_2^+ concentration for ZH $\geq$ 90 km ($1/cm^3$)
IONOUP Common		
EFE	-	See SNI(9) above
EFOP	-	See SNI(10) above
EFNOP	-	See SNI(11) above
EFN2P	-	See SNI(28) above
EFO2P	-	See SNI(29) above
TX	-	See SNI(12) above
QDEF	-	The effective total ion-production rate that reproduces the ambient ionosphere when used with the chemistry model

$$[\dot{O}^+] = q_1 - \beta_{11}[O^+] - \alpha_1[O^+][e] \quad (1)$$

$$[N\dot{O}^+] = q_2 + \beta_{21}[O^+] + \beta_{23}[N_2^+] + \beta_{24}[O_2^+] - \alpha_2[NO^+][e] \quad (2)$$

$$[\dot{N}_2^+] = q_3 - \beta_{33}[N_2^+] - \alpha_3[N_2^+][e] \quad (3)$$

$$[O_2^+] = q_4 + \beta_{41}[O^+] - \beta_{44}[O_2^+] - \alpha_4[O_2^+][e] \quad (4)$$

$$[e] = [O^+] + [NO^+] + [N_2^+] + [O_2^+] \quad (5)$$

$$q_i = \gamma_i q \quad (6a)$$

$$\sum_{i=1}^{4} \gamma_i = 1 \quad (6b)$$

$$\gamma_i = A_i / \sum_{i=1}^{4} A_i \quad (7)$$

$$A_1 = [O] \quad (8a)$$

$$A_2 = 2[NO] \quad (8b)$$

$$A_3 = 2[N_2] \quad (8c)$$

$$A_4 = 2[O_2] \quad . \quad (8d)$$

The assumed reactions and rate coefficients are given in Table 5-2. The rate coefficients are supplied to Subroutine IONOSU by Function RATCOF.

In the above equations, the quantities are defined as follows:

$[O^+]$ = O^+ atomic-ion density (cm^{-3})

$[NO^+]$ = NO^+ molecular-ion density (cm^{-3})

$[N_2^+]$ = N_2^+ molecular-ion density (cm^{-3})

Table 5-2. E- and R-region ionospheric chemistry reactions and rate coefficients.

Reaction Number Here	Reaction Number SO-76	Reaction	Rate Coefficient[a,b]
10	--	$O^+ \rightarrow O + h\nu$	c
11	--	$O^+ + e + e \rightarrow O + e$	c
2a	R6	$NO^+ + e \rightarrow N(^4S) + O$	$3.5 \times 10^{-7}\ (T_e/380)^{-0.5}$
2b	R5	$NO^+ + e \rightarrow N(^2D) + O$	$3.5 \times 10^{-7}\ (T_e/380)^{-0.5}$
3	R3	$N_2^+ + e \rightarrow N(^4S) + N(^2D)$	$2.9 \times 10^{-7}\ (T_e/300)^{-0.33}$
4	R20	$O_2^+ + e \rightarrow O + (O^1D)$	$2.2 \times 10^{-7}\ (300/T_e)^{0.9}$
5	R2	$O^+ + N_2 \rightarrow NO^+ + N(^4S)$	6×10^{-13} $T_i \geq 600°K$; $6 \times 10^{-13}\ (600/T_i)$, $T_i < 600$
6	R21	$O^+ + O_2 \rightarrow O_2^+ + O$	$2.0 \times 10^{-11}\ (T_i/300)^{-0.4}$
7	R4	$N_2^+ + O \rightarrow NO^+ + N(^2D)$	$2.5 \times 10^{-10}\ (300/T_i)^{0.44}$
8	R8	$O_2^+ + N(^4S) \rightarrow NO^+ + O$	1.8×10^{-10}
9	R9	$O_2^+ + NO \rightarrow NO^+ + O_2$	6.3×10^{-10}

[a] In units of cm^3/sec for two-body reactions and cm^6/sec for three-body reactions.

[b] From SO-76 (Strobel et al.) except for our reaction numbers 10 and 11 taken from BLKCHM in ROSCOE-Radar.

[c] α_1 is given by: $\alpha_1 = C_{10} + C_{11}[e] + 1.5 \times 10^{-7}\ [e]^{1/2}/T_e^3$

C_{10} = radiative recombination rate coefficient for the reaction $O^+ + e \rightarrow O + h\nu$
$= 4.4 \times 10^{-12}\ (T_e/300)^{-0.75}$

C_{11} = collisional-radiative recombination rate coefficient for the reaction $O^+ + e + e \rightarrow O + e$
$= 1.2 \times 10^{-19}\ (T_e/300)^{-5.0}$

$[O_2^+]$ = O_2^+ molecular-ion density (cm^{-3})

q = total ion-production rate (cm^{-3} sec^{-1})

q_1 = O^+-ion production rate (cm^{-3} sec^{-1})

q_2, q_3, q_4 = NO^+-, N_2^+-, O_2^+-ion production rate (cm^{-3} sec^{-1})

β_{11} = $C_5[N_2] + C_6[O_2] = \beta_{21} + \beta_{41}$

β_{21} = $C_5[N_2]$

C_5 = ion-molecule interchange rate coefficient (cm^3/sec)

C_6 = ion-molecule charge-exchange rate coefficient (cm^3/sec)

β_{23} = $C_7[O]$

β_{24} = $C_8[N] + C_9[NO]$

β_{33} = $C_7[O] = \beta_{23}$

β_{41} = $C_6[O_2]$

β_{44} = $C_8[N] + C_9[NO] = \beta_{24}$

α_1 = C_1 (corresponds to α_r in ROSCOE-Radar)

= effective two-body collisional-radiative recombination rate coefficient for atomic ions (cm^3/sec) [KJ-74b]

α_2 = C_2

= dissociative recombination rate coefficient for the reaction $NO^+ + e \rightarrow$ products (cm^3/sec)

α_3 = C_3

= dissociative recombination rate coefficient for the reaction $N_2^+ + e \rightarrow N(^4S) + N(^2D)$ (cm^3/sec)

α_4 = C_4

= dissociative recombination rate coefficient for the reaction $O_2^+ + e \rightarrow O + O(^1D)$

Assume steady-state conditions. After putting Equation (6) into Equations (1) through (4), we have

$$\gamma_1 q - \beta_{11}[O^+] - \alpha_1[O^+][e] = 0 \tag{9}$$

$$\gamma_2 q + \beta_{21}[O^+] + \beta_{23}[N_2^+] + \beta_{24}[O_2^+] - \alpha_2[NO^+][e] = 0 \tag{10}$$

$$\gamma_3 q - \beta_{33}[N_2^+] - \alpha_3[N_2^+][e] = 0 \tag{11}$$

$$\gamma_4 q + \beta_{41}[O^+] - \beta_{44}[O_2^+] - \alpha_4[O_2^+][e] = 0 . \tag{12}$$

By regarding [e] as known, we have five equations ((5), (9), (10), (11) and (12)) in five unknowns (q, $[O^+]$, $[NO^+]$, $[N_2^+]$, and $[O_2^+]$). Rewrite Equations (9) through (12) for $[X^+][e]$ and add, followed by use of Equation (5):

$$[O^+][e] = \{\gamma_1 q - \beta_{11}[O^+]\}/\alpha_1$$

$$[NO^+][e] = \{\gamma_2 q + \beta_{21}[O^+] + \beta_{23}[N_2^+] + \beta_{24}[O_2^+]\}/\alpha_2$$

$$[N_2^+][e] = \{\gamma_3 q - \beta_{33}[N_2^+]\}/\alpha_3$$

$$[O_2^+][e] = \{\gamma_4 q + \beta_{41}[O^+] - \beta_{44}[O_2^+]\}/\alpha_4$$

$$[e]^2 = A'q + B'[O^+] + C'[N_2^+] + D'[O_2^+] \tag{13}$$

with

$$A' = \gamma_1/\alpha_1 + \gamma_2/\alpha_2 + \gamma_3/\alpha_3 + \gamma_4/\alpha_4 \tag{14a}$$

$$B' = -\beta_{11}/\alpha_1 + \beta_{21}/\alpha_2 + \beta_{41}/\alpha_4 = \beta_{21}\left(\frac{1}{\alpha_2} - \frac{1}{\alpha_1}\right) + \beta_{41}\left(\frac{1}{\alpha_4} - \frac{1}{\alpha_1}\right) \tag{14b}$$

$$C' = \beta_{23}/\alpha_2 - \beta_{33}/\alpha_3 = \beta_{23}\left(\frac{1}{\alpha_2} - \frac{1}{\alpha_3}\right) \tag{14c}$$

$$D' = \beta_{24}/\alpha_2 - \beta_{44}/\alpha_4 = \beta_{24}\left(\frac{1}{\alpha_2} - \frac{1}{\alpha_4}\right). \quad (14d)$$

Solve Equations (11) and (12) for $[N_2^+]$ and $[O_2^+]$ and put into Equation (13).

$$[N_2^+] = \gamma_3 q/\{\beta_{33} + \alpha_3[e]\} \quad (15)$$

$$[O_2^+] = \{\gamma_4 q + \beta_{41}[O^+]\}/\{\beta_{44} + \alpha_4[e]\} \quad (16)$$

$$[e]^2 = A'q + B'[O^+] + C'\gamma_3 q/\{\beta_{33} + \alpha_3[e]\}$$

$$+ D'\{\gamma_4 q + \beta_{41}[O^+]\}/\{\beta_{44} + \alpha_4[e]\}$$

$$= (A' + C'\gamma_3/\{\beta_{33} + \alpha_3[e]\} + D'\gamma_4/\{\beta_{44} + \alpha_4[e]\})q$$

$$+ (B' + D'\beta_{41}/\{\beta_{44} + \alpha_4[e]\})\ [O^+]. \quad (17)$$

Eliminate $[O^+]$ from Equation (17) by use of $[O^+]$ from Equation (9):

$$[O^+] = \gamma_1 q/\{\beta_{11} + \alpha_1[e]\} \quad (18)$$

$$[e]^2 = Aq + B[O^+]$$

$$= Aq + B\gamma_1 q/\{\beta_{11} + \alpha_1[e]\}$$

$$= (A + B\gamma_1/\{\beta_{11} + \alpha_1[e]\})q$$

or

$$q = \frac{[e]^2}{A + B\gamma_1/(\beta_{11} + \alpha_1[e])} \quad (19)$$

with

$$A = A' + C'\gamma_3/\{\beta_{33} + \alpha_3[e]\} + D'\gamma_4/\{\beta_{44} + \alpha_4[e]\} \tag{20}$$

$$B = B' + D'\beta_{41}/\{\beta_{44} + \alpha_4[e]\} \quad . \tag{21}$$

Solve Equation (10) for $[NO^+]$:

$$\boxed{[NO^+] = \frac{\gamma_2 q + \beta_{21}[O^+] + \beta_{23}[N_2^+] + \beta_{24}[O_2^+]}{\alpha_2[e]} \quad .} \tag{22}$$

Collate Equations (19), (18), (15), (16), and (22) in the order in which they must be evaluated. Also use

$$\beta_{23} = \beta_{33} \ , \qquad \beta_{24} = \beta_{44} \quad .$$

$$q = \frac{[e]^2}{A + B\gamma_1/FACTQ} \tag{23}$$

$$[O^+] = \frac{\gamma_1 q}{FACTQ} \tag{24}$$

$$[N_2^+] = \frac{\gamma_3 q}{A2DEN} \tag{25}$$

$$[O_2^+] = \frac{\gamma_4 q + \beta_{41}[O^+]}{A3DEN} \tag{26}$$

$$[NO^+] = \frac{\gamma_2 q + \beta_{21}[O^+] + \beta_{23}[N_2^+] + \beta_{24}[O_2^+]}{\alpha_2[e]} \tag{27}$$

where

$$FACTQ = \beta_{11} + \alpha_1[e]$$

$$A2DEN = \beta_{33} + \alpha_3[e]$$

$$A3DEN = \beta_{24} + \alpha_4[e]$$

$$FACTA3 = D'/A3DEN$$

$$A = A' + C'\gamma_3/A2DEN + \gamma_4 \ FACTA3$$

$$B = B' + \beta_{41} \ FACTA3 \ .$$

In Subroutine IONOSU we use Equations (19), (18), (22), (15), and (16) to compute q, $[O^+]$, $[NO^+]$, $[N_2^+]$, and $[O_2^+]$ after prescribing analytic fits to nominal profiles of E- and F-region electron density [Ri-73, Figure 1] and electron temperature [Ev-73].

The prescribed electron-density profiles in the E- and F-region for noon and midnight conditions are shown in Figures 5-1a and 5-1b. The fit functions used to obtain these profiles are described in Table 5-3.

The prescribed electron temperature profile and the heavy-particle temperature profile in the E- and F-region for noon and midnight conditions are shown in Figure 5-2. The fit function used to obtain the electron temperature profile is described in Table 5-4.

For approximately mean solar-flux conditions, SBAR $\equiv \bar{S} \gtrsim 149 \times 10^{-22}$ W m^{-2} Hz^{-1}, profiles of q are shown for noon and midnight conditions in Figure 5-3 and the corresponding values of $[O^+]$, $[NO^+]$, $[N_2^+]$, and $[O_2^+]$ are shown in Figures 5-1a and 5-1b.

5-3 D-REGION IONOSPHERIC PROPERTIES

The D-region chemistry requires the following quantity:

> q, the effective total ion-production rate that adequately reproduces the ambient ionosphere when used with the chemistry model.

The modeling of q in the D-region (and lower) is offered with reservations; it may need to be improved if experience shows that this topic is more important than it is presently assumed to be for radar.

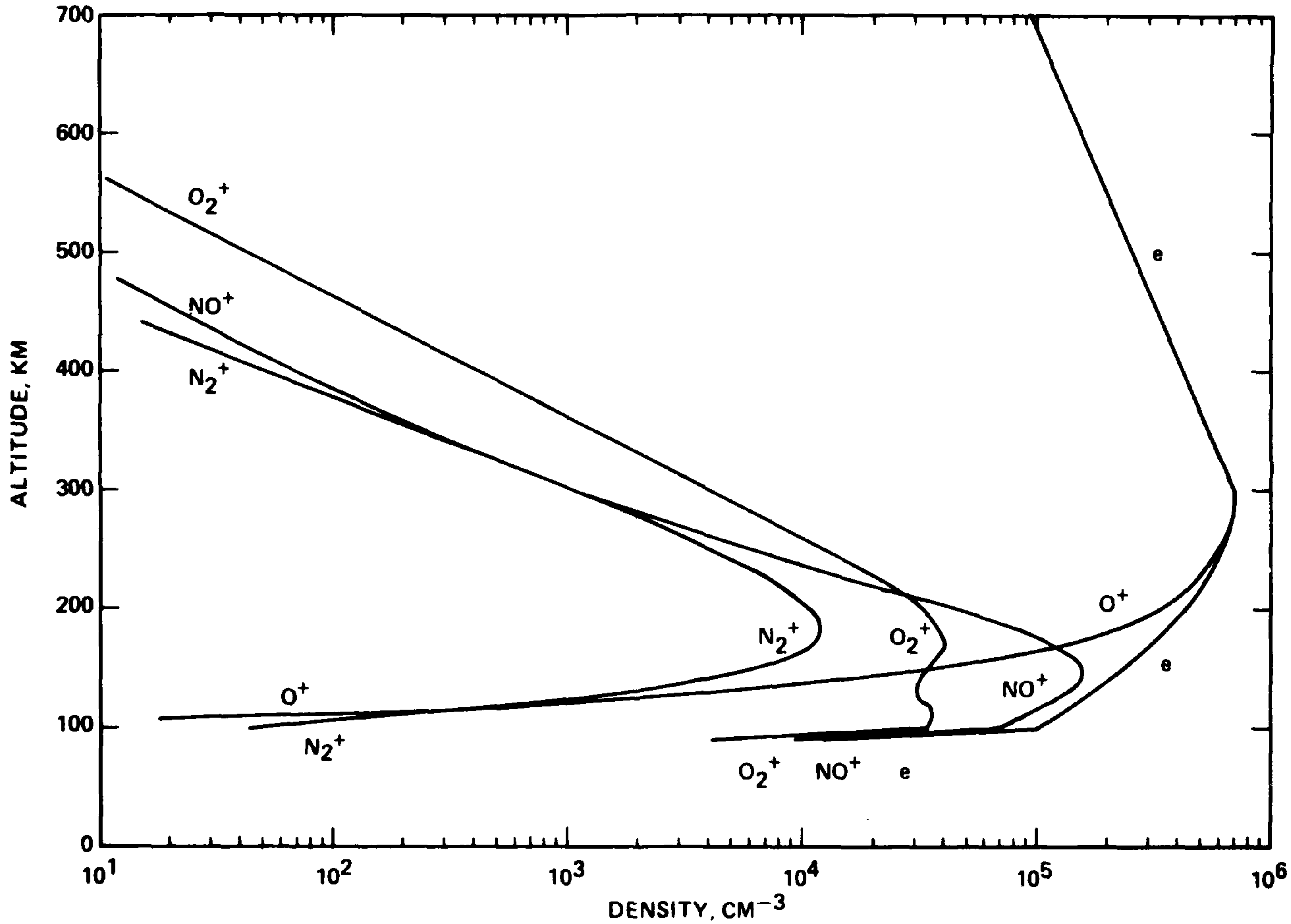

Figure 5-1a. E- and F-region ionospheric charged-species densities for noon conditions. The electron density profile is prescribed to be independent of solar-flux conditions. The atomic- (O^+) and molecular-ion (NO^+, N_2^+, O_2^+) densities are IONOSU-computed steady-state values for approximately average solar-flux conditions ($\overline{S} \approx 149 \cdot 10^{-22}$ W m^{-2} Hz^{-1}).

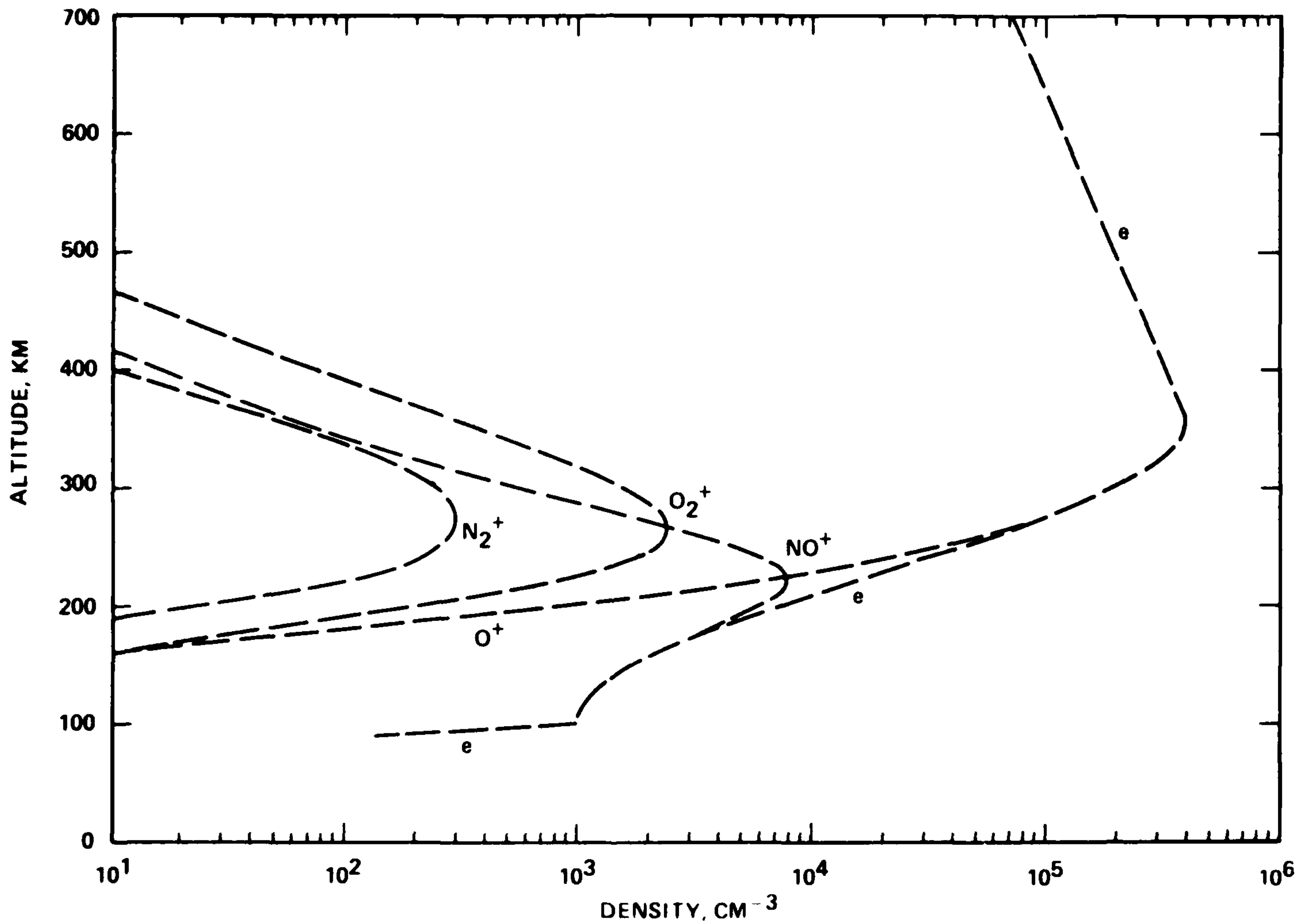

Figure 5-1b. E- and F-region ionospheric charged-species densities for midnight conditions. The electron density profile is prescribed to be independent of solar-flux conditions. The atomic- (O^+) and molecular-ion (NO^+, N_2^+, O_2^+) densities are IONOSU-computed steady-state values for approximately average solar-flux conditions ($\bar{S} \approx 149 \times 10^{-22}$ W m^{-2} Hz^{-1}).

Table 5-3. Fit functions for E- and F-region electron density profiles.[a]

Altitude Range, km	Description
Day	
90 - 100	Exponential, determined by data-point value (EBOTD) at 100-km altitude (HEBOTD) and scale height EDDSCH
100 - 300	Parabola, determined by data-point values EBOTD and EF2MXD at altitudes HEBOTD and HF2MXD and vertical slope at altitude HF2MXD
>300	Exponential, determined by data-point value (EF2MXD) at 300-km altitude (HF2MXD) and scale height F2DSCH
Night	
90 - 100	Exponential, determined by data-point value (EBOTN) at 100-km altitude (HEBOTN) and scale height EDNSCH
100 - 360	Sinusoid, determined by data-point values EBOTN and EF2MXN at altitudes HEBOTN and HF2MXN and vertical slope at the same altitudes
>360	Exponential, determined by data-point value (EF2MXN) at 360-km altitude (HF2MXN) and scale height F2NSCH

[a] Based on Figure 1 in Ri-73.

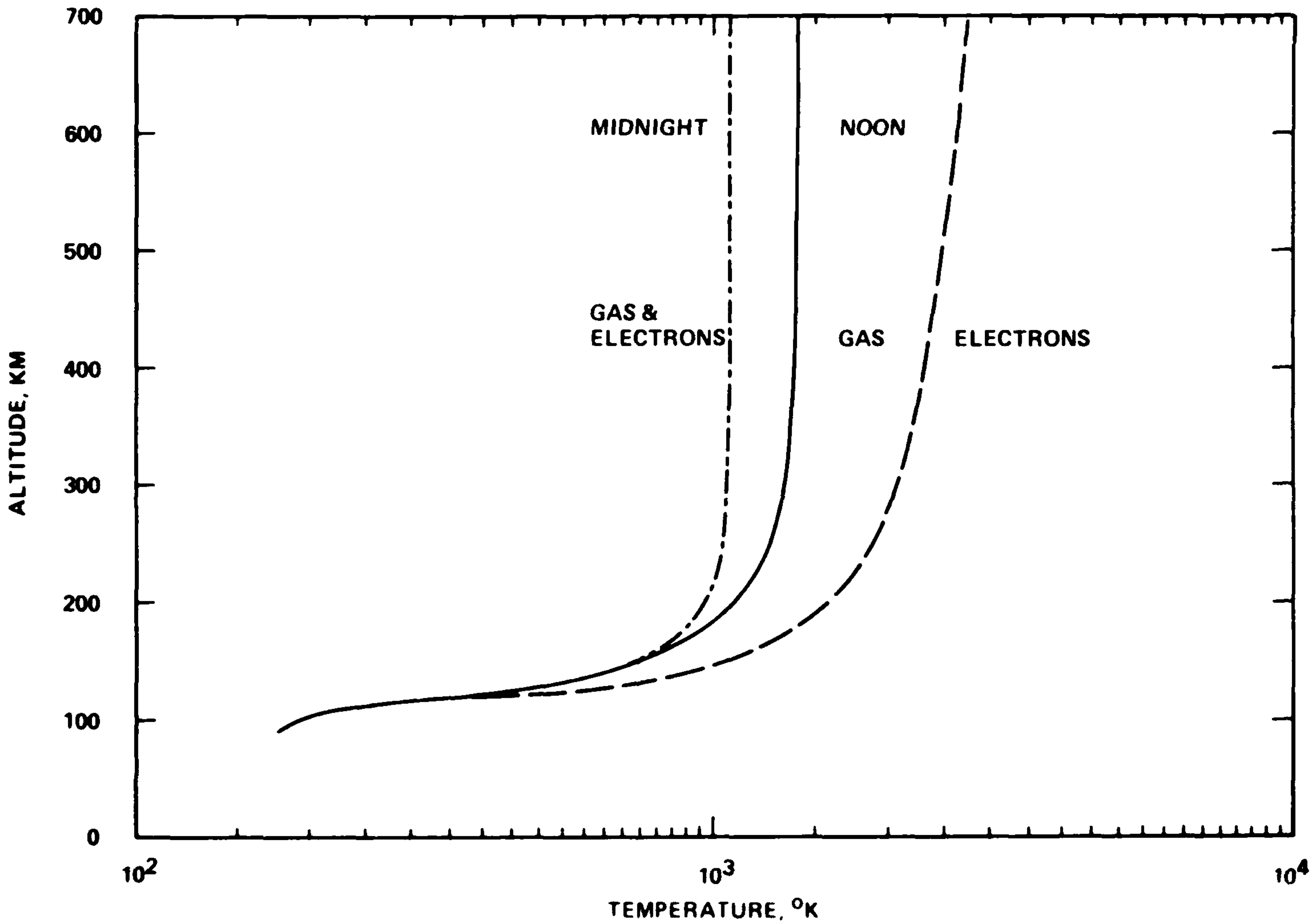

Figure 5-2. E- and F-region ionospheric temperatures. The difference between the electron and gas temperatures is prescribed to be independent of the solar-flux conditions. The absolute values shown are IONOSU-computed values for approximately average solar-flux conditions ($\bar{S} \approx 149 \times 10^{-22}$ W m-2 Hz-1).

Table 5-4. Fit function for electron temperature profile.

Altitude Range, km	Description
Day	
<120	Same as heavy-particle temperature
≥120	The difference between the electron temperature (T_x) and the gas temperature (T) is prescribed to be zero at 120-km altitude and 500°K at 200-km altitude. The parabola $T_x - T = 500[(ZH - 120)/80]^{1/2}$ is then used.
Night	
≥0	Same as heavy-particle temperature

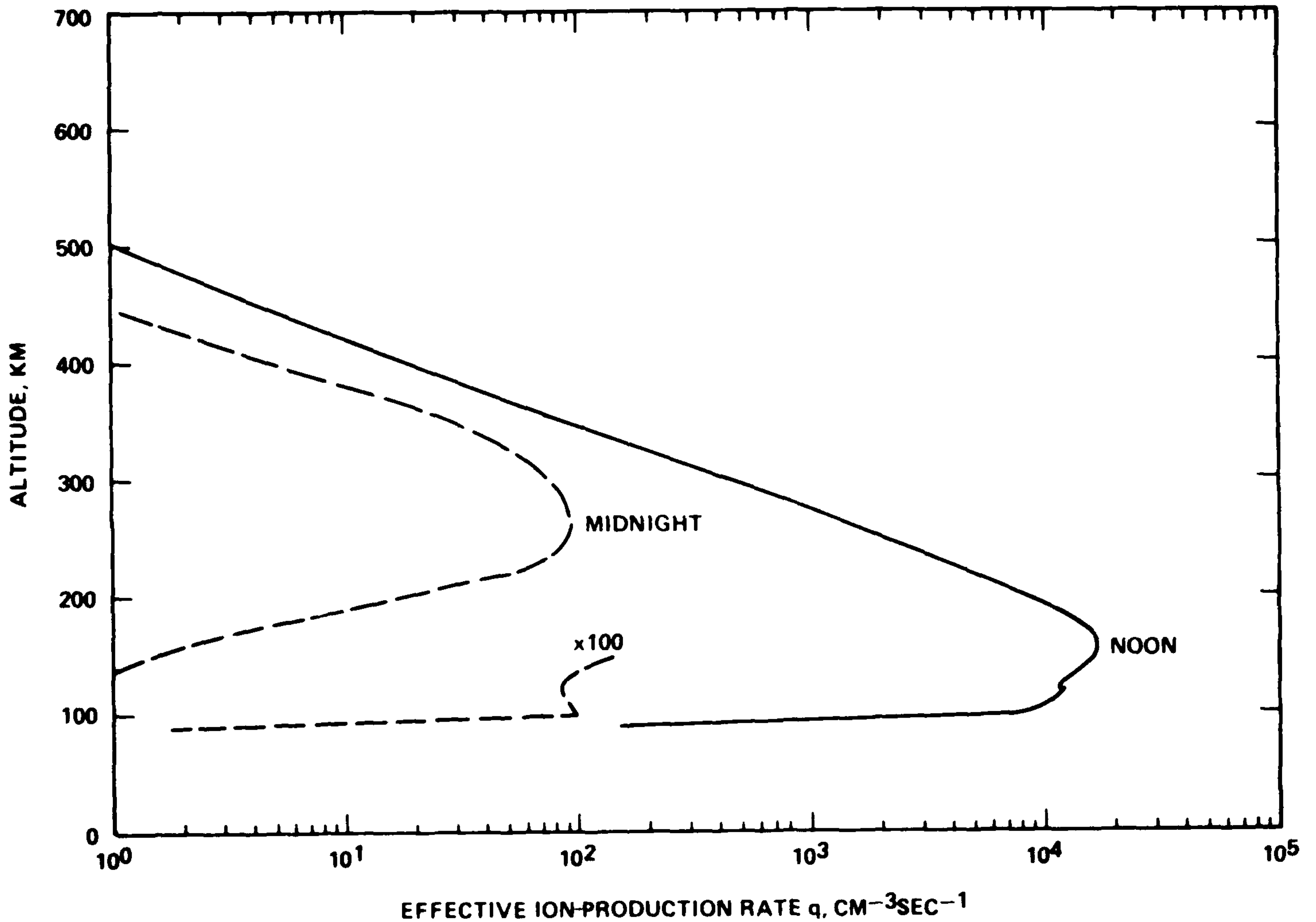

Figure 5-3. E- and F-region effective ion-production rates. The values shown are IONOSU-computed steady-state values for the prescribed electron density profiles in Figures 5-1a and 5-1b and for approximately average solar-flux conditions ($\bar{S} \approx 149 \cdot 10^{-22}$ W m^{-2} Hz^{-1}).

For the D region, q is determined by specifying data points at 30- and 60-km altitude and by requiring the fit function to be continuous with the value of q derived from the E- and F-region model at 90-km altitude. The fit function is extrapolated below 30-km altitude for modeling convenience and not on a physical basis.

The data adopted are based on the calculations of Webber [We-62] for the ion-production rate due to galactic cosmic rays. Webber [We-62, Figure 2] presents results in the altitude range from 30 to 90 km for two geomagnetic latitudes (50° and 70°) and for sunspot-minimum and sunspot-maximum conditions. For the geomagnetic latitude of 50°, Webber [We-62] finds q_{max} = 0.04 and q_{min} = 0.08 at 60-km altitude and q_{max} = 2.1 and q_{min} = 4.5 at 30-km altitude. We adopt solar-cycle mean values of 0.06 and 3.3 at 60- and 30-km altitude, respectively. The interested reader may also wish to consult Ra-72 (Figure 2-3) and Po-73a (Figures 2 and 3).

The profiles of q in the D and adjacent regions for noon and midnight conditions are shown in Figure 5-4. The fit functions used to obtain these profiles are described in Table 5-5.

Table 5-5. Fit functions for effective ion-production rate in D and lower regions.

Altitude Range, km	Description
	Day
0 - 60	Exponential, determined by data-point values at 30- and 60-km altitude
60 - 90	Exponential, determined by data-point values at 60-km altitude and daytime value of q from E- and F-region model at 90-km altitude
	Night
0 - 60	Same as daytime
60 - 90	Exponential, determined by data-point value at 60-altitude and nighttime value of q from E- and F-region model at 90-km altitude

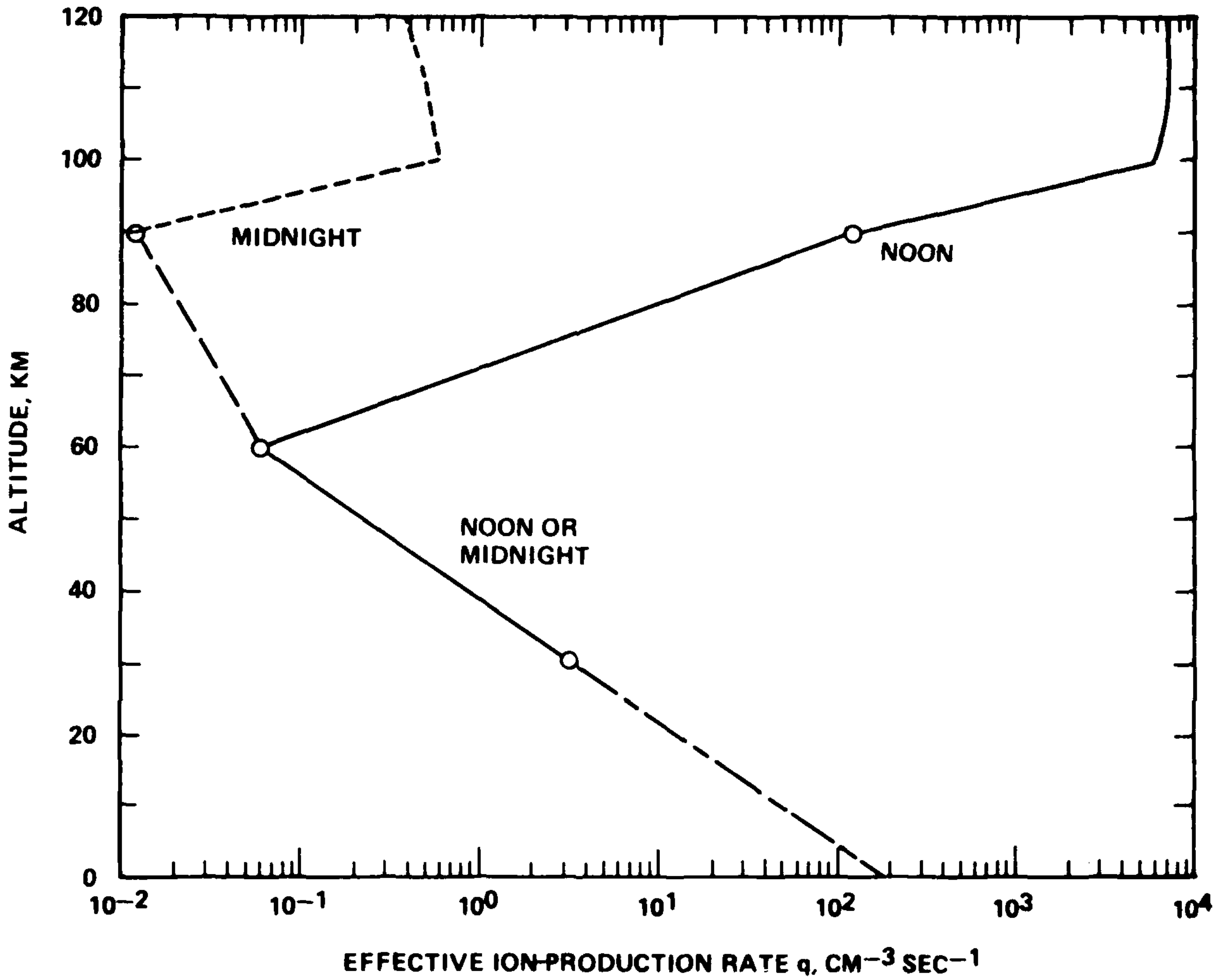

Figure 5-4. D-region effective ion-production rates. The values shown are IONOSU-computed fit functions required to pass through adopted data-base values at 30- and 60-km altitude and to join the IONOSU E- and F-region values at 90-km altitude. The extrapolation below 30-km altitude is purely for modeling convenience.

SECTION 6

PROGRAM DRVATM, LISTING OF COMPUTER PROGRAM, AND SAMPLE PROBLEM RESULTS

A driver routine (Program DRVATM) is provided to exercise the ATMOSU, SPCMIN, IONOSU, and associated routines. The required input consists of the year, month, day, zone time, geographic colatitude and longitude of the point of interest, three digital-flags relating to optional treatment of water vapor and temperature profiles, a set of test altitudes, and the number of such altitudes. Input quantities are more specifically described in Table 6-1. Program DRVATM, after reading and writing the input, first initializes the ATMOSU routine by the call ATMOSU (1,120.). The water vapor routine (WVOPT) is then initialized if WVFLAG $\neq$ 0.0. DRVATM next loops over the test-altitude array, exercises the ATMOSU, SPCMIN, IONOSU, and H2OSVP routines for each altitude, and prints the resultant atmospheric and ionospheric property values.

A listing of the driver, ATMOSU, SPCMIN, IONOSU, their associated subroutines, and outputs from two sample problems are provided.

The quantities in the output block at each altitude are labeled in the headings. The last four entries (E, O+, M+, and N+) in row-two of the output block at each altitude ($\geq$90 km) are computed by Subroutine CHEMQ and are included for comparison with the quantities E, O+, and NO+ in row-1 and N2+ and O2+ in row-4. Subroutine CHEMQ, prepared by Knapp and Jordano (see Volume 11) for use with the NRL Simple-Chemistry module developed for ROSCOE-Radar, computes steady-state ionization for the E- and F-region; it is not a part of the operational atmospheric and ionospheric module.

Table 6-1. Input quantities to Program DRVATM.

NALTS	- Number of test altitude values
ALTS(I)	- Test altitude values (km)
IYRS	- Number of the year in the 1900's at east longitude GLO (e.g., 1974 becomes 74)
IMONS	- Number of the month at east longitude GLO (e.g., February becomes 2)
IDAYS	- Day of the month at east longitude GLO
ZT	- Zone time for the 15-degree longitude interval containing east longitude GLO
GCO	- Geographic colatitude of grid origin or whatever reference point is desired (degrees)
GLO	- Geographic east longitude of grid origin or whatever reference point is desired (degrees)
WVFLAG	- Flag for optional treatment of water vapor = 0.0, normal treatment ≠ 0.0, optional treatment
METHOD	- Flag indicating one of four options for treatment of water vapor = 1 data values in parts per million by mass (ppmm) = 2 data values in absolute humidity (g/m^3) = 3 data values in relative humidity (percent; 10 percent is input as 10., not 0.10) = 4 data values in dew-point temperature (°K)
TPFLAG	- Flag for optional treatment of temperature profile = 0.0, normal treatment ≠ 0.0, optional treatment TPFLAG is transferred to Subroutine TEMPZH through ZHTEMP Common. A nonzero value of TPFLAG allows Subroutine TEMPZH to read the user-specified profile at altitudes ZZ = 0.0(4.0)120.0 km.

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      PROGRAM DRVATM (INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)            DRIVER       2
C                                                                       DRIVER       3
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * *           DRIVER       4
C     THIS ROUTINE IS PROVIDED TO DRIVE AND TEST ATMOSU AND THE         DRIVER       5
C     RELATED ROUTINES WHICH COMPUTE THE PROPERTIES OF THE              DRIVER       6
C     UNDISTURBED ATMOSPHERE AND IONOSPHERE.                            DRIVER       7
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * *           DRIVER       8
C                                                                       DRIVER       9
C     INPUT PARAMETERS                                                  DRIVER      10
C             NALTS - NUMBER OF TEST-ALTITUDE VALUES                    DRIVER      11
C           ALTS(I) - TEST-ALTITUDE VALUES, KM                          DRIVER      12
C              IYRS - NUMBER OF THE YEAR IN THE 1900 S AT EAST          DRIVER      13
C                     LONGITUDE GLO (E.G., 1974 BECOMES 74)             DRIVER      14
C             IMONS - NUMBER OF THE MONTH AT EAST LONGITUDE GLO         DRIVER      15
C                     (E.G., FEBRUARY BECOMES 2)                        DRIVER      16
C             IDAYS - DAY OF THE MONTH AT EAST LONGITUDE GLO            DRIVER      17
C                ZT - ZONE TIME FOR THE 15-DEGREE LONGITUDE INTERVAL    DRIVER      18
C                     CONTAINING EAST LONGITUDE GLO                     DRIVER      19
C               GCO - GEOGRAPHIC COLATITUDE OF GRID ORIGIN OR WHATEVER  DRIVER      20
C                     REFERENCE POINT IS DESIRED (DEGREES)              DRIVER      21
C               GLO - GEOGRAPHIC EAST LONGITUDE OF GRID ORIGIN OR       DRIVER      22
C                     WHATEVER REFERENCE POINT IS DESIRED (DEGREES)     DRIVER      23
C            WVFLAG - FLAG FOR OPTIONAL TREATMENT OF WATER VAPOR.       DRIVER      24
C                     .EQ. 0.0  NORMAL TREATMENT                        DRIVER      25
C                     .NE. 0.0  OPTIONAL TREATMENT                      DRIVER      26
C            METHOD - FLAG INDICATING ONE OF FOUR OPTIONS, FOR          DRIVER      27
C                     OPTIONAL TREATMENT OF WATER VAPOR.                DRIVER      28
C                     =1 DATA VALUES IN PARTS PER MILLION BY WEIGHT     DRIVER      29
C                     =2 DATA VALUES IN ABSOLUTE HUMIDITY,              DRIVER      30
C                             GRAMS/METERS**3                           DRIVER      31
C                     =3 DATA VALUES IN RELATIVE HUMIDITY, PERCENT      DRIVER      32
C                         (10 PERCENT IS INPUT AS 10. NOT 0.10)         DRIVER      33
C                     =4 DATA VALUES IN DEW-POINT TEMPERATURE, DEG K    DRIVER      34
C            TPFLAG - FLAG FOR OPTIONAL TREATMENT OF TEMPERATURE        DRIVER      35
C                     PROFILE.                                          DRIVER      36
C                     .EQ. 0.0  NORMAL TREATMENT                        DRIVER      37
C                     .NE. 0.0  OPTIONAL TREATMENT                      DRIVER      38
C                     TPFLAG IS TRANSFERRED TO SUBROUTINE TEMPZH        DRIVER      39
C                     THROUGH COMMON ZHTEMP.  A NONZERO VALUE OF TPFLAG DRIVER      40
C                     ALLOWS SUBROUTINE TEMPZH TO READ THE USER-        DRIVER      41
C                     -SPECIFIED PROFILE AT ALTITUDES ZZ=0.0(4.0)120. KM DRIVER     42
CCC                                                                     DRIVER      43
      COMMON/ATMOUP/ HL,SBAR,IDURN,PP,RHO,TT,SNI(30),HRHO,FEHSEQ        KOMM02       2
      COMMON/IONOUP/  EFE,EFOP,EFNOP,EFN2P,EFO2P,TI,WDEF                KOMM04       2
      COMMON  /SPECQ/ CN2,CO2,CNO,CN4S,CN2D,CO,CNP,COP,CENE,TV,TE,TG    KOMM06       2
      COMMON/TIME/ IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,CAT,FYR,FST,RHOSKM  KOMM07       2
     *        ,CHI                                                      KOMM07       3
      COMMON/WPC/  WVFLAG,METHOD,W20120                                 KOMM09       2
      COMMON/ZHTEMP/  NZHT,ZHTZ(3),ZHT(31),TZHZ(3),TZH(31),TPFLAG       KOMM10       2
CCC                                                                     DRIVER      50
      DIMENSION  ALTS(200)                                              DRIVER      51
      DATA  PI / 3.141592653590 /                                       DRIVER      52
C                                                                       DRIVER      53
      PIO2 = PI/2.                                                      DRIVER      54
      RADDEG = PI/180.                                                  DRIVER      55
C                                                                       DRIVER      56
C  * *  READ IN TEST ALTITUDES                                          DRIVER      57
```

```
C
      READ(5,1001)NALTS
 1001 FORMAT(I5)
      READ(5,1002)(ALTS(I),I=1,NALTS)
 1002 FORMAT(8F10.2)
C
C * * READ IN YEAR,MONTH,DAY,ZONE TIME, GEOGRAPHIC COLATITUDE AND
C * * LONGITUDE OF GRID ORIGIN.
C
 1010 READ(5,1003)  IYRS,IMONS,IDAYS,ZT,GCO,GLO,WVFLAG,METHOD,TPFLAG
 1003 FORMAT (3I5,4E10.4,I5,E10.4)
C           CONVERT GLO TO THE CORRESPONDING POSITIVE QUANTITY, IF GLO
C           IS READ IN AS A NEGATIVE QUANTITY.
      IF( GLO .LT. 0.0 )  GLO = GLO + 360.
C         A NEGATIVE VALUE OF IYRS IS USED TO TERMINATE EXAMPLES.
      IF( IYRS.LE.0 )  CALL EXIT
C
C  *  *  PRINT OUT INPUT VALUES
C
      WRITE(6,2001)NALTS
 2001 FORMAT(1H1,//,20H TEST VALUES READ IN,//,8H NALTS =,I5,//,10X,
     * 3H I ,2X,11H ALTS(I),KM,/)
      WRITE(6,2002)(I,ALTS(I),I=1,NALTS)
 2002 FORMAT (6(2X,I8,F10.2))
      WRITE(6,2004)  IYRS,IMONS,IDAYS,ZT,GCO,GLO
 2004 FORMAT (//,8H   IYRS =I5,10H   IMONS =I5,10H   IDAYS =I5/
     * 8H     ZT =E12.4,14H HRS     GCO =E12.4,14H DEG     GLO =E12.4,
     * 4H DEG)
      WRITE(6,2007)  WVFLAG,METHOD,TPFLAG
 2007 FORMAT (8H WVFLAG=,F8.2,10X,8H METHOD=,I5,10X,8H TPFLAG=,F8.2)
C         CONVERT GCO AND GLO FROM DEGREES TO RADIANS.
      GCO = GCO*RADDEG
      GLO = GLO*RADDEG
C         IDENTIFY THE GRID ORIGIN AS THE POINT P.
      PLAT = PID2-GCO
      PLON = GLO
C
C  *  *  INITIALIZE THE ATMOSU ROUTINE
C
      WRITE(6,8020)
 8020 FORMAT(//20H INITIALIZATION CALL,//)
C
      CALL ATMOSU(1,120.)
      IF( WVFLAG.EQ.0.0 )  GO TO 2008
C         INITIALIZE SUBROUTINE WVOPT BY INPUTTING USER'S OPTIONAL DATA
C         FOR WATER VAPOR CONTENT, PER ONE OF FOUR METHODS.
      CALL WVOPT(1,120.,H20120)
C         GET WATER VAPOR MIXING RATIO AT 120 KM FOR USE IN
C         EXTRAPOLATING TO HIGHER ALTITUDES IN SUBROUTINE SPCHIN.
      CALL WVOPT(2,120.,H20120)
 2008 CONTINUE
C
      WRITE(6,2006)  IYRS,IMONS,IDAYS,ZT,GCO,GLO
 2006 FORMAT (//,8H   IYRS =I5,10H   IMONS =I5,10H   IDAYS =I5/
     * 8H     ZT =E12.4,14H HRS     GCO =E12.4,14H RAD     GLO =E12.4,
     * 4H RAD)
      WRITE(6,2005)  IDURN,UT,GAT,PLAT,PLON
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 2005 FORMAT (//,8H IDORN =I5,10H      UT =E12.4,10H      GAT =E12.4,10H
     *    PLAT =E12.4,10H    PLON =E12.4)
      WRITE(6,2003)HL,SBAR
 2003 FORMAT (/* HL =*F6.2* HRS (LOCAL TIME AT GRID ORIGIN),  SOLAR FLUX
     $ SBAR =*F7.2* 1.E-22 W/(M SQ HZ),*/1X,*FROM PROGRAM DRVATM (FORMAT
     $ 2003)*)
C
C  *  *  LOOP OVER TEST ALTITUDES
C
      WRITE(6,8002)
 8002 FORMAT (1H0,129H      ALT         N2          O2            O
     * AR          HE          CO2           E           O+           NO+
     *        Q0EP     /10X,9(5X,4H1/CC,3X),2X,10H1/(CC SEC))
      WRITE(6,8003)
 8003 FORMAT (1H0,9X,120H         N            NO           NO2         O2(SDG)
     *        O3          H2O          E           O+           N+
     * N+      /10X,10(5X,4H1/CC,3X))
      WRITE(6,8004)
 8004 FORMAT(1H0,9X,120H     PRESSURE     FENSEQ      DENSITY     DEN SC HT
     *        TEMP      E TEMP        H            OH           HO2          C
     *O     /10X,72H DYNES/CM**2                  GRAMS/CC          KM
     * DEG K        DEG K   ,4(5X,4H1/CC,3X))
      WRITE(6,8006)
 8006 FORMAT (1H0,9X,72H        H2O          CH4         N (4S)       N (2D)
     *        N (2P)       O (1D)   ,2(3X,7HSAT. VP,2X),22H       N2+          O
     *2+ /10X,6(5X,4H1/CC,3X),5X,5HWATER,8X,3HICE,3X,2(5X,4H1/CC,3X))
      WRITE(6,8007)
 8007 FORMAT (1H0,81X,12H REL. HUMID./82X,12H  PERCENT    )
      DO 50 I=1,NALTS
      ZH = ALTS(I)
      CALL ATMOSU(2,ZH)
      CALL SPCMIN(2,ZH)
      CALL IONOSU(2,ZH)
      VPH2O = 0.0
      VPICE = 0.0
      IF( ( TT .GE. 173.15 ) .AND. ( TT .LE. 373.15 ) )
     *CALL H2OSVP(TT,VPH2O,VPICE)
      ENEQ = 0.0
      OPQ  = 0.0
      ENPQ = 0.0
      IF( ZH.LT.90. )  GO TO 45
      CN2 = SNI(1)
      CO2 = SNI(2)
      CO = SNI(3)
      CNO = SNI(8)
      CN4S = SNI(7)
      CN2D = 1.0
      CNP = 0.0
      COP = 0.0
      CENE = 0.0
      TV = TT
      TE = TT
      TG = TT
C     SUBROUTINE CHENQ, WHICH IS NOT AN OPERATIONAL PART OF THE ATMOSU
C         PACKAGE, WAS PREPARED BY KNAPP AND JORDANO (KJ-74,KJ-743) TO
C         COMPUTE THE STEADY-STATE IONIZATION FOR THE E- AND F-REGION.
C         ITS RESULTS FOR E,O+,N+, AND O+ IN ROW-TWO OF THE OUTPUT BLOCK
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C         ARE INCLUDED FOR COMPARISON WITH THE QUANTITIES E, O+, AND NO+
C         IN ROW-ONE AND N2+ AND O2+ IN ROW-FOUR COMPUTED BY IONOSU.
      CALL CHEMQ(QOEF,ENPQ,OPQ,ENEQ)
   45 ENPQ = ENEQ-OPQ-ENPQ
      WRITE(6,8005)  ZH,(SNI(J),J=1,6),(SNI(J),J=9,11),QOEF,SNI(7),
     *               SNI(8),SNI(15),SNI(13),SNI(14),SNI(16),ENEQ,OPQ,
     *               ENPQ,ENPQ,PP,PERSEQ,RHO,HRHO,TT,SNI(12)
     *              ,(SNI(J),J=17,24),SNI(27),SNI(26),VPH2O,VPICE
     *              ,SNI(28),SNI(29),SNI(25)
 8005 FORMAT (1X,0PF9.2,1P10E12.3,3(/10X,1P10E12.3)/82X,1PE12.3)
   50 CONTINUE
C
      WRITE(6,9050)
 9050 FORMAT(//,20H END OF TEST PROBLEM)
      GO TO 1010
      END
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      SUBROUTINE ATMOSU(JJ,ZH)                                          ATMOSU
C                                                                       ATMOSU
C         ATMOSU COMPUTES THE PROPERTIES OF THE UNDISTURBED ATMOSPHERE,  ATMOSU
C         GIVEN THE ALTITUDE ZH, AFTER ASSOCIATED SUBROUTINES COMPUTE   ATMOSU
C         THE LOCAL APPARENT TIME HL, SOLAR FLUX SBAR, AND DAY-OR-NIGHT  ATMOSU
C         PARAMETER IDORN.                                              ATMOSU
C         ATMOSU IS REVISION 13  (01/07/79) BY D. A. HAMLIN AND N. R.   ATMOSU
C         SCHOONOVER OF ATMOS DEVELOPED BY R. W. LOWEN (SEE, AN AMBIENT ATMOSU
C         ATMOSPHERE MODEL FOR ROSCOE, P. 187, VOL. 5 OF PROC. DNA 1973 ATMOSU
C         ATMOSPHERIC EFFECTS SYMPOSIUM, DNA 3131-5, 5 JUNE 1973.)      ATMOSU
C         REVISION 02 (06/07/74) PROVIDES                               ATMOSU
C            1. IN HIGH-ALTITUDE MODEL, FOR USE OF GAF(120.) INSTEAD OF ATMOSU
C               GAF(0.) = GE IN COMPUTING GAM AND ZZ.                   ATMOSU
C            2. DENSITY SCALE HEIGHT FOR BOTH LOW- AND HIGH-ALTITUDE    ATMOSU
C               MODELS, WITH AN AD HOC PARABOLIC TRANSITION FROM 110- TO ATMOSU
C               120-KM ALTITUDE TO PROVIDE A CONTINUOUS DENSITY SCALE   ATMOSU
C               HEIGHT ACROSS THE BOUNDARY BETWEEN THE TWO MODELS.      ATMOSU
C            3. ALTERED FORMULA FOR O DENSITY ON FIRST CALL AND AT LOW  ATMOSU
C               ALTITUDE SO AS TO USE SF-FUNCTION DIRECTLY.             ATMOSU
C            4. COMMENT CARDS.                                          ATMOSU
C         REVISION 03 (10/25/74) PROVIDES                               ATMOSU
C            5. PROVISION FOR DAY OR NIGHT VALUES OF ATOMIC OXYGEN      ATMOSU
C               (OBTAINED FROM THE MINOR SPECIES SUBROUTINE SPCMIN)     ATMOSU
C               FOR ALTITUDES BELOW 120 KM.                             ATMOSU
C            6. AUTOMATED PROCEDURE FOR EVALUATING CONSTANTS IN DENSITY ATMOSU
C               SCALE-HEIGHT FORMULA USED IN THE 110- TO 120-KM         ATMOSU
C               TRANSITION REGION.                                      ATMOSU
C            7. PROCEDURE FOR LETTING SOLAR FLUX SBAR, AN INPUT TO      ATMOSU
C               ATMOSU, BE DETERMINED BY THE AUXILIARY ROUTINE SOLCYC.  ATMOSU
C            8. PROCEDURE FOR LETTING THE LOCAL (APPARENT) TIME HL,     ATMOSU
C               AN INPUT TO ATMOSU, BE DETERMINED BY THE AUXILIARY      ATMOSU
C               SUBROUTINE SOLORB.                                      ATMOSU
C            9. PROCEDURE FOR LETTING THE DAY OR NIGHT PARAMETER IDORN  ATMOSU
C               BE DETERMINED BY THE AUXILIARY SUBROUTINE SOLZEN.       ATMOSU
C         REVISION 04 (12/08/74) PROVIDES                               ATMOSU
C           10. CARBON DIOXIDE AS THE SIXTH SPECIES IN ATMOSU, WITH     ATMOSU
C               PROFILE SPECIFIED BY B. F. MYERS ON 12/07/74.           ATMOSU
C           11. EVALUATION OF DEPARTURE FROM HYDROSTATIC EQUILIBRIUM.   ATMOSU
C           12. A FLAG, ZHFLAG, TO INSURE THAT SUBROUTINES IONOSU AND   ATMOSU
C               SPCMIN ARE CALLED AT THE SAME ALTITUDE AT WHICH ATMOSU  ATMOSU
C               WAS LAST CALLED.                                        ATMOSU
C           13. DAY AND NIGHT PROFILES OF ATOMIC OXYGEN SPECIFIED BY    ATMOSU
C               B. F. MYERS ON 11/09/74 AND 11/23/74, RESPECTIVELY.     ATMOSU
C           14. CORRECTED PROCEDURE FOR EVALUATING CONSTANTS IN DENSITY ATMOSU
C               SCALE-HEIGHT FORMULA USED IN THE 110- TO 120-KM         ATMOSU
C               TRANSITION REGION.                                      ATMOSU
C           15. CORRECTED CONSTANT IN LOW-ALTITUDE FORMULA FOR DENSITY  ATMOSU
C               SCALE HEIGHT.                                           ATMOSU
C         REVISION 05 (02/04/75) PROVIDES                               ATMOSU
C           16. INTERFACE WITH SPCMIN WHICH NOW COMPUTES DENSITIES OF   ATMOSU
C               H2O, N, NO, NO2, O2(SINGLET DELTA G), AND O3.           ATMOSU
C           17. INTERFACE WITH IONOSU WHICH NOW COMPUTES THE EFFECTIVE  ATMOSU
C               ION PRODUCTION RATE AT ALL ALTITUDES.                   ATMOSU
C         REVISION 06 (04/08/75) PROVIDES                               ATMOSU
C           18. REVISED NIGHT PROFILE OF ATOMIC OXYGEN SPECIFIED BY     ATMOSU
C               B.F. MYERS ON 02/22/75 (MINOR CHANGE BELOW 60 KM).      ATMOSU
C           19. REVISED DAY AND NIGHT PROFILES OF NITRIC OXIDE          ATMOSU
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C          SPECIFIED BY B.F. MYERS ON 04/05/75.                        ATMOSU
C       20. REVISED DAY AND NIGHT PROFILES OF ATOMIC NITROGEN          ATMOSU
C          SPECIFIED BY B.F. MYERS ON 04/11/75.                        ATMOSU
C     REVISION 07 (04/24/75) PROVIDES                                  ATMOSU
C       21. REVISED PROCEDURE FOR SPECIFYING AND USING DATE OF THE     ATMOSU
C          VERNAL EQUINOX (PER R.W. LOWEN (02/28/75)).                 ATMOSU
C     REVISION 08 (05/23/75) PROVIDES                                  ATMOSU
C       22. REVISED PROFILE OF WATER VAPOR SPECIFIED BY B.F. MYERS     ATMOSU
C          ON 05/10/75.                                                ATMOSU
C     REVISION 09 (06/02/75) PROVIDES                                  ATMOSU
C       23. CORRECTED FORMULA IN HIGH-ALTITUDE MODEL FOR EVALUATION    ATMOSU
C          OF DEPARTURE FROM HYDROSTATIC EQUILIBRIUM.                  ATMOSU
C     REVISION 10 (05/02/77) PROVIDES                                  ATMOSU
C       24. REPLACEMENT OF PREDETERMINED FIT COEFFICIENTS FOR G/TM     ATMOSU
C          PROFILE BY THOSE DERIVED DURING THE INITIALIZATION          ATMOSU
C          PHASE FROM SPECIFYING TEMPERATURE PROFILES AND A            ATMOSU
C          MOLECULAR-WEIGHT PROFILE.                                   ATMOSU
C       25. USE OF 0- TO 120-KM TEMPERATURE PROFILE FOR ANY LATITUDE   ATMOSU
C          AND SEASON, OBTAINED BY LINEAR INTERPOLATION OF A SET       ATMOSU
C          OF LATITUDE AND SEASON PROFILES BASED ON U.S. STANDARD      ATMOSU
C          ATMOSPHERE SUPPLEMENTS, 1966.                               ATMOSU
C       26. USE OF A SPECIFIED UNIVERSAL PROFILE OF THE MOLECULAR-     ATMOSU
C          WEIGHT FUNCTION, (MSTAR/M-1.) = SF = SFDAF, INDEPENDENT     ATMOSU
C          OF LATITUDE, SEASON, AND DIURNAL VARIATION. (THE NEW SF     ATMOSU
C          FUNCTION IS SPECIFIED BY THE DD-COEFFICIENT ARRAY FOR AN    ATMOSU
C          11TH-DEGREE POLYNOMIAL.) HOWEVER, NIGHTTIME ATOMIC          ATMOSU
C          OXYGEN PROFILE DIFFERS FROM DAYTIME PROFILE BELOW 90 KM     ATMOSU
C          AND IS COMPUTED FROM A SEPARATE FIT FUNCTION. DAYTIME       ATMOSU
C          ATOMIC OXYGEN PROFILE IS COMPUTED FROM SPECIFICATION OF     ATMOSU
C          TEMPERATURE AND MOLECULAR-WEIGHT PROFILE INSTEAD OF         ATMOSU
C          BEING SPECIFIED DIRECTLY AND ENTERED AS DATA IN             ATMOSU
C          SUBROUTINE SPCMIN.                                          ATMOSU
C       27. OPPORTUNITY FOR USER TO SPECIFY HIS TEMPERATURE PROFILE    ATMOSU
C          OF INTEREST (AT ALTITUDES Z = 0(4)120 KM) IF HE DOES        ATMOSU
C          NOT CHOOSE TO USE THE ONE SELECTED BY THE CODE AS A         ATMOSU
C          FUNCTION OF LATITUDE AND SEASON.                            ATMOSU
C       28. ELIMINATION OF A PRESSURE-CORRECTION FACTOR EMPLOYED IN    ATMOSU
C          THE ORIGINAL MODEL TO MATCH CIRA-1965 CONDITIONS AT         ATMOSU
C          120-KM ALTITUDE.                                            ATMOSU
C       29. SEASON-DEPENDENT CONDITIONS AT 120-KM ALTITUDE (THE BASE   ATMOSU
C          ALTITUDE FOR THE HIGH-ALTITUDE MODEL) INSTEAD OF            ATMOSU
C          CONSTANT CONDITIONS.                                        ATMOSU
C       30. INCREASE OF THE DIMENSION OF THE SNI ARRAY FROM 6 TO 30.   ATMOSU
C     REVISION 11 (03/01/78) PROVIDES                                  ATMOSU
C       31. INCLUSION OF N(2P) IN SUBROUTINE SPCMIN.                   ATMOSU
C       32. REPLACEMENT OF THE GENERIC MOLECULAR ION M+ IN             ATMOSU
C          SUBROUTINE IONOSU BY THE THREE MOLECULAR IONS NO+, N2+,     ATMOSU
C          AND O2+.  IONOUP COMMON IS ACCORDINGLY CHANGED.             ATMOSU
C     REVISION 12 (05/21/78) PROVIDES                                  ATMOSU
C       33. DELETION OF THE FIRST THREE VARIABLES IN THE ARGUMENT      ATMOSU
C          LIST IN THE CALL TO SUBROUTINE JULIAN SINCE THESE           ATMOSU
C          VARIABLES ARE SUPPLIED THROUGH TIME COMMON.                 ATMOSU
C       34. DELETION OF THE UNUSED ARRAY BB(3).                        ATMOSU
C     REVISION 13 (01/07/79) PROVIDES                                  ATMOSU
C       35. REVISED FORMAT 8001.                                       ATMOSU
C     REVISION 14 (06/15/79) PROVIDES                                  ATMOSU
C       36. CORRECTED SPECIFICATION OF MOLECULAR WEIGHT PROFILE        ATMOSU
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C             (I.E., PARAMETER FDAY) AT ALTITUDES ZH = 96(4)120 KM.      ATMOSU    116
C             THESE CHANGES ARE RELATIVELY SMALL (ABOUT 10 PERCENT).     ATMOSU    117
C        REVISION 15 (07/06/79) PROVIDES                                 ATMOSU    118
C          37. REVISED FIT FUNCTION FOR NIGHTTIME O DENSITY BETWEEN      ATMOSU    119
C             75 AND 90 KM.                                              ATMOSU    120
CC                                                                       ATMOSU    121
C        INPUT PARAMETERS                                                ATMOSU    122
C           ARGUMENT LIST                                                ATMOSU    123
C               JJ - CALCULATION FLAG                                    ATMOSU    124
C                    = 1, CALCULATE INITIALIZATION PARAMETERS            ATMOSU    125
C                    = 2, CALCULATE ATMOSPHERIC PROPERTIES               ATMOSU    126
C               ZH - ALTITUDE OF INTEREST (KM)                           ATMOSU    127
C           ATMOUP COMMON                                                ATMOSU    128
C                    HL, SBAR, IDORN                                     ATMOSU    129
C           TIME COMMON                                                  ATMOSU    130
C                  IYRS, IMONS, IDAYS, ZT, PLAT, PLON                    ATMOSU    131
C           ALTOON COMMON                                                ATMOSU    132
C                  ALTKM(47), ONITE(18), CO2(25)                         ATMOSU    133
C           ZHTEMP COMMON                                                ATMOSU    134
C                  NZHT, TZH(31), ZHT(31)                                ATMOSU    135
C        OUTPUT PARAMETERS                                               ATMOSU    136
C           ATMOUP COMMON                                                ATMOSU    137
C                  PP, RHO, TT, SNI(30), HRHO, FEHSEQ                    ATMOSU    138
C           ALTOON COMMON                                                ATMOSU    139
C                  S3Z0D                                                 ATMOSU    140
C           TIME COMMON                                                  ATMOSU    141
C                  RHO5KM                                                ATMOSU    142
C           ZHCHEK COMMON                                                ATMOSU    143
C                    ZHFLAG, SPIFLG                                      ATMOSU    144
C                                                                        ATMOSU    145
      COMMON/ALTOON/  ALTKM(47),ONITE(18),CO2(25),S3Z0D                  KOMM01      2
      COMMON/ATMOUP/ HL,SBAR,IDORN,PP,RHO,TT,SNI(30),HRHO,FEHSEQ         KOMM02      2
      COMMON/SOLARP/  SOLLAT,SOLLON,SOLIRR(10)                           KOMM05      2
      COMMON/TIME/ IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,GAT,FYR,FST,RHO5KM   KOMM07      2
     *            ,CHI                                                   KOMM07      3
      COMMON/ZHCHEK/  ZHFLAG,SPIFLG                                      KOMM09      2
      COMMON/ZHTEMP/  NZHT,ZHTZ(3),ZHT(31),TZHZ(3),TZH(31),TPFLAG        KOMM10      2
C                                                                        ATMOSU    152
C        VARIABLES IN ATMOUP                                             ATMOSU    153
C                HL = LOCAL TIME, HRS                                    ATMOSU    154
C              SBAR = AVER. 10.7-CM SOLAR FLUX, 1.E-22 W/(M**2 HZ)       ATMOSU    155
C             IDORN = INDEX FOR DAY OR NIGHT. FOR O BELOW 120 KM, USE    ATMOSU    156
C                     DAYTIME PROFILE IF(IDORN.GE.0) AND NIGHTTIME       ATMOSU    157
C                     PROFILE IF(IDORN.LT.0)                             ATMOSU    158
C                PP = PRESSURE, DYNES/CM**2                              ATMOSU    159
C               RHO = DENSITY, G/CM**3                                   ATMOSU    160
C                TT = TEMPERATURE, DEGREES KELVIN                        ATMOSU    161
C            SNI(1) = N2,  1/CM**3   (FROM ATMOSU)                       ATMOSU    162
C            SNI(2) = O2,  1/CM**3   (FROM ATMOSU)                       ATMOSU    163
C            SNI(3) = O,   1/CM**3   (FROM ATMOSU)                       ATMOSU    164
C            SNI(4) = AR,  1/CM**3   (FROM ATMOSU)                       ATMOSU    165
C            SNI(5) = HE,  1/CM**3   (FROM ATMOSU)                       ATMOSU    166
C            SNI(6) = CO2, 1/CM**3   (FROM ATMOSU)                       ATMOSU    167
C            SNI(7) = N,   1/CM**3   (FROM SPCMIN)                       ATMOSU    168
C            SNI(8) = NO,  1/CM**3   (FROM SPCMIN)                       ATMOSU    169
C            SNI(9) = E,   1/CM**3   (FROM IONOSU)                       ATMOSU    170
C           SNI(10) = O+,  1/CM**3   (FROM IONOSU)                       ATMOSU    171
```

```
C          SMI(11) = NO+, 1/CM**3  (FROM IONOSU)
C          SMI(12) = TX,  DEG K     (FROM IONOSU)
C          SMI(13) = O2(1DG), 1/CM**3  (FROM SPCMIN)
C          SMI(14) = O3,        1/CM**3  (FROM SPCMIN)
C          SMI(15) = NO2,       1/CM**3  (FROM SPCMIN)
C          SMI(16) = H2O,       1/CM**3  (FROM SPCMIN)
C          SMI(17) = H,         1/CM**3  (FROM SPCMIN)
C          SMI(18) = OH,        1/CM**3  (FROM SPCMIN)
C          SMI(19) = HO2,       1/CM**3  (FROM SPCMIN)
C          SMI(20) = CO,        1/CM**3  (FROM SPCMIN)
C          SMI(21) = N2O,       1/CM**3  (FROM SPCMIN)
C          SMI(22) = CH4,       1/CM**3  (FROM SPCMIN)
C          SMI(23) = N(4S),     1/CM**3  (FROM SPCMIN)
C          SMI(24) = N(2D),     1/CM**3  (FROM SPCMIN)
C          SMI(25) = REL. HUMIDITY,      (FROM SPCMIN)
C          SMI(26) = O(1D),     1/CM**3  (FROM SPCMIN)
C          SMI(27) = N(2P),     1/CM**3  (FROM SPCMIN)
C          SMI(28) = N2+,       1/CM**3  (FROM IONOSU)
C          SMI(29) = O2+,       1/CM**3  (FROM IONOSU)
C             HRHO = DENSITY SCALE HEIGHT, KM
C           FENSEQ = FRACTIONAL ERROR IN HYDROSTATIC EQUILIBRIUM.
C
      DIMENSION  A(6),B(5),C(6),S(5),AA(12),DD(13)
      DIMENSION  SMIZ(6), SMI(6), ALP(6)
      DIMENSION  D(20,21),XC(7),ZION(5),ONZI(5)
      DIMENSION  ZINIC(5),ZICO2(5),CO2ZI(5)
      DIMENSION  FOAY(31)
C
C         DEFINITIONS OF DATA QUANTITIES
C             BIGMS = SEA-LEVEL MEAN MOLECULAR WEIGHT, G/MOLE
C                PZ = SEA-LEVEL PRESSURE, DYNES/CM**2
C              BIGA = AVOGADRO NUMBER, PARTICLES/MOLE
C                RR = UNIVERSAL GAS CONSTANT, ERG/(MOLE DEG-K)
C                     (SET IN SUBROUTINE, RR=SK*BIGA)
C
      DATA  BIGMS,PZ,BIGA / 28.96,1.01325E+06,6.022169E+23 /
C
C                SK = BOLTZMANN CONSTANT, ERG/(DEG-K)
C              NDEG - DEGREE OF POLYNOMIAL TO BE FITTED FOR THE
C                     DAYTIME PROFILE OF SF.
C
C         CAUTION ----  NDEG MUST NOT EXCEED 12 WITHOUT MAKING
C                       APPROPRIATE CHANGES IN PROGRAM.
C
      DATA  PI,SK / 3.14159265359O,1.380622E-16 /, NDEG / 11 /
C
C                GZ = SEA-LEVEL GRAVITATIONAL ACCELERATION, CM/SEC**2
C                RE = MEAN RADIUS OF EARTH, KM  (ALLEN, ASTROPHYSICAL
C                      QUANTITIES, 1973)
C
      DATA  GZ, RE / 980.621, 6.37103E+03 /
C
C                IS = NUMBER OF MAJOR SPECIES
C            SMI(I) = MASS OF N2, O2, O, AR, HE, AND CO2,  GRAMS
C
      DATA  IS, (SMI(I),I=1,6) /  6, 4.6517E-23, 5.3135E-23, 2.6567E-23,
     *                          6.6335E-23, 6.6464E-24, 7.3080E-23/
```

```
C
C          ALP(I) = THERMAL DIFFUSION COEFFICIENT
C
      DATA  (ALP(I),I=1,6) /  4*0.0, -0.40, 0.0 /
C         3PM VALUES  05/04/77     FOR  FDAY
      DATA  (FDAY(I),I=1,31) / 1.14E-17,1.47E-16,5.95E-16,3.86E-15,
     *                         3.47E-14,2.71E-13,2.56E-12,2.15E-11,
     *        1.59E-10,1.12E-09,5.90E-09,2.61E-08,9.14E-08,2.76E-07,
     *        7.24E-07,1.89E-06,3.83E-06,6.33E-06,1.19E-05,3.20E-05,
     *        8.62E-05,2.44E-04,7.11E-04,2.38E-03,1.05E-02,2.40E-02,
     *        3.65E-02,4.78E-02,5.65E-02,6.82E-02,7.66E-02 /
CCC
C * * * ARITHMETIC STATEMENT FUNCTIONS TO CALCULATE
C * * * G/TM, INTEGRAL OF G/TM, AND G.
CCC
      GOTMAF( AQ ) = (((((((((( AA(12)*AQ + AA(11))*AQ + AA(10))*AQ
     *          + AA(9))*AQ + AA(8))*AQ + AA(7))*AQ + AA(6))*AQ
     *          + AA(5))*AQ + AA(4))*AQ + AA(3))*AQ + AA(2))*AQ + AA(1)
C
      GTMIAF( AQ ) = (((((((((((AA(12)/12.*AQ + AA(11)/11.)*AQ
     *          + AA(10)/10.)*AQ + AA(9)/9.)*AQ + AA(8)/8.)*AQ
     *          + AA(7)/7.)*AQ + AA(6)/6.)*AQ + AA(5)/5.)*AQ
     *          + AA(4)/4.)*AQ + AA(3)/3.)*AQ + AA(2)/2.)*AQ + AA(1))*AQ
C
      GAF( BQ ) = GZ/(1.0+BQ/RE)**2
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE N/NSTAR DAY.
CCC
      SFDAF( BQ ) = EXP( ((((((((((((DD(13)*BQ + DD(12))*BQ + DD(11))*BQ
     *               + DD(10))*BQ + DD(9))*BQ + DD(8))*BQ + DD(7))*BQ
     *               + DD(6))*BQ + DD(5))*BQ + DD(4))*BQ + DD(3))*BQ
     *               + DD(2))*BQ + DD(1) )
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE DENSITY SCALE
C * * * HEIGHT (KM).
CCC
      GKKZAF( AQ ) = ((((((((( AA(12)*11.*AQ + AA(11)*10.)*AQ
     *          + AA(10)*9.)*AQ + AA(9)*8.)*AQ + AA(8)*7.)*AQ
     *          + AA( 7)*6.)*AQ + AA(6)*5.)*AQ + AA(5)*4.)*AQ
     *          + AA( 4)*3.)*AQ + AA(3)*2.)*AQ + AA(2)
CCC
C        STATEMENTS 100 TO 200-1 ARE DONE JUST ONCE, ON A CALL TO
C        ATMOSU(1,120), TO SET UP NEEDED PARAMETERS AND TO EVALUATE
C        SOLAR-FLUX-DEPENDENT FOURIER COEFFICIENTS USED IN COMPUTING
C        THE TIME-DEPENDENT VALUES OF TAU, THE VARIABLE CONTROLLING THE
C        TEMPERATURE GRADIENT AT THE LOWER BOUNDARY, TIF, THE
C        EXOSPHERIC TEMPERATURE (SEE J. S. NISBET, RADIO SCIENCE VOL.
C        5, P. 437 (1971)), AND THE COEFFICIENTS IN THE PARABOLIC
C        TRANSITION FUNCTION FOR THE DENSITY SCALE-HEIGHT BETWEEN
C        THE LOW- AND HIGH-ALTITUDE MODELS.
C        SUBSEQUENT CALLS, TO ATMOSU(2,ZH),    GO TO STATEMENT 200
C        WHEREAFTER A LOW-ALTITUDE MODEL IS USED FOR ALTITUDES ZH
C        LESS THAN 120 KM AND A HIGH-ALTITUDE MODEL IS USED OTHERWISE.
CCC
CCC      INITIALIZATION
CCC
      GO TO (100,200), JJ
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  100 RR = SK*BIGA
      CC1 = 1.0E+05*BIGMS/RR
C         CALL THE 5 AUXILIARY ROUTINES.
      CALL ZTTOUT
      CALL JULIAN(YRFJ,VEQJ,DAYJ)
      CALL SOLCYC(DAYJ)
      CALL SOLORB(YRFJ,VEQJ,DAYJ,SOLLAT,SOLLON)
      CALL SOLZEN(SOLLAT,SOLLON)
C         CALCULATE FIT COEFFICIENTS DD(I) USED TO COMPUTE SF.
      CALL FITTER(NZHT,ZHT,FDAY,NDEG, 1 , 2 ,DD)
      DD(13) = 0.0
C         CALL ROUTINE TO GET SEASONAL TEMPERATURE PROFILE.
      CALL TEMPZH
      DO 104 N=1,NZHT
      SF = SFDAF( ZHT(N) )
C         RESET TZH(N) TO BE THE RATIO (GDTM) OF THE ACCELERATION DUE TO
C         GRAVITY TO THE MOLECULAR-SCALE TEMPERATURE AT ALTITUDE ZHT(N).
      TZH(N) = GAF( ZHT(N) )/((1.+SF)*TZH(N))
  104 CONTINUE
      CALL FITTER(NZHT,ZHT,TZH,11, 2 , 2 ,AA)
C         COMPUTE GRAV. ACCEL. G, G DIVIDED BY MOL. SCALE TEMP. TM, AND
C         INTEGRAL OF G/TM AT 120 KM.
      GG = GAF( ZH )
      GDTM = GDTMAF( ZH )
      GDTMI = GTMIAF( ZH )
C         COMPUTE PRESSURE, DENSITY, AND TEMPERATURE AT 120 KM
C         ACCORDING TO THE LOW-ALTITUDE MODEL.  THESE VALUES PROVIDE
C         THE BOUNDARY CONDITIONS AT 120 KM FOR THE HIGH-ALTITUDE MODEL.
      PP = PZ*EXP(-CC1*GDTMI)
      RHO = BIGMS*GDTM/RR*PP/GG
C         CALCULATE DENSITY AT 5 KM FOR USE IN SUBROUTINE WATER.
      PP5 = PZ*EXP(-CC1*GTMIAF( 5. ))
      RHO5KM = BIGMS*GDTMAF( 5. )/RR*PP5/GAF( 5. )
C         INITIALIZE SUBROUTINE SPCMIN
      CALL SPCMIN(1,ZH)
C         EVALUATE BMBMS AT 120. KM
      SF = SFDAF( ZH )
      BMBMS = 1.0/( 1. + SF )
      TZ    = BMBMS*GG/GDTM
C         COMPUTE THE SPECIES NUMBER DENSITIES AT 120 KM.
C         COMPUTE TOTAL NUMBER DENSITY,N(1/CM**3)
      SN = BIGA/BIGMS*RHO/BMBMS
C         COMPUTE TOTAL NUMBER DENSITY IF NO DISSOCIATION,NSTAR(1/CM**3)
      SNS = BIGA*RHO/BIGMS
C         COMPUTE DENSITIES (1/CM**3) OF N2, O2, O, AR, HE, AND CO2.
      SNIZ(1) = 0.78*SNS
      SNIZ(2) = 1.211*SNS - SN
      SNIZ(3) = 2.*SNS*SF
      SNIZ(4) = 0.009*SNS
      SNIZ(5) = 4.625E-05*SNS
      SNIZ(6) = CO2(25)
C
      RE120 = RE+120.
      GGSK = GG/SK
      CC = PI*HL/12.
      FF = SBAR
C         COMPUTE FOURIER COEFFICIENTS USED FOR TAU AT 120 KM.
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      A(1) = +2.210156E-02 - 1.973030E-05 * FF                          ATMOSU
      A(2) = +6.712358E-03 - 1.181137E-05 * FF                          ATMOSU
      A(3) = +2.748180E-04 + 3.390522E-07 * FF                          ATMOSU
      A(4) = -5.663477E-04 + 8.669016E-07 * FF                          ATMOSU
      A(5) = -4.652258E-05 + 2.322930E-07 * FF                          ATMOSU
      A(6) = +8.984354E-05 - 1.128157E-07 * FF                          ATMOSU
      B(1) = -3.407398E-03 + 1.900959E-05 * FF                          ATMOSU
      B(2) = -5.428597E-04 + 4.101313E-06 * FF                          ATMOSU
      B(3) = -2.518983E-04 - 5.341112E-07 * FF                          ATMOSU
      B(4) = -1.380845E-04 + 2.075324E-07 * FF                          ATMOSU
      B(5) = +1.358994E-04 + 3.931811E-07 * FF                          ATMOSU
C         COMPUTE FOURIER COEFFICIENTS USED FOR TIF.                    ATMOSU
      C(1) = +5.443538E+02 + 4.328837E+00 * FF                          ATMOSU
      C(2) = -1.179819E+02 - 6.495360E-01 * FF                          ATMOSU
      C(3) = +3.115091E+01 - 4.766818E-02 * FF                          ATMOSU
      C(4) = +4.069323E+00 + 4.154692E-02 * FF                          ATMOSU
      C(5) = -6.389061E+00 + 1.415760E-02 * FF                          ATMOSU
      C(6) = +1.045482E+00 - 1.995652E-02 * FF                          ATMOSU
      S(1) = -1.138663E+01 - 7.293749E-01 * FF                          ATMOSU
      S(2) = +1.359668E+01 + 2.815729E-03 * FF                          ATMOSU
      S(3) = +9.859158E-01 + 8.138831E-02 * FF                          ATMOSU
      S(4) = +7.061132E-01 - 1.151738E-02 * FF                          ATMOSU
      S(5) = -2.925315E-01 - 4.625236E-02 * FF                          ATMOSU
C         COMPUTE TAU (1/KM) AND TIF (DEGREES KELVIN)                   ATMOSU
      TAU = A(1)                                                        ATMOSU
      TIF = C(1)                                                        ATMOSU
      DO 110 I=1,5                                                      ATMOSU
      FI = I                                                            ATMOSU
      SFI = SIN(CC*FI)                                                  ATMOSU
      CFI = COS(CC*FI)                                                  ATMOSU
      TAU = TAU + CFI*A(I+1) + SFI*B(I)                                 ATMOSU
  110 TIF = TIF + CFI*C(I+1) + SFI*S(I)                                 ATMOSU
      WRITE(6,8001)TIF,TAU                                              ATMOSU
 8001 FORMAT (/* TIF = *F8.3* DEG K,  TAU = *1PE12.5* 1/KM, FROM SUBROUT ATMOSU
     1INE ATMOSU (FORMAT 8001)*)                                        ATMOSU
C                                                                       ATMOSU
C         TO PROVIDE A CONTINUOUS DENSITY SCALE HEIGHT ACROSS THE       ATMOSU
C         BOUNDARY BETWEEN THE LOW- AND HIGH-ALTITUDE MODELS, WE USE A  ATMOSU
C         PARABOLIC TRANSITION FUNCTION,                                ATMOSU
C             HRHO = FHR120 * ZHM110**2 + SB * ZHM110 + HRO110          ATMOSU
C         WHERE                                                         ATMOSU
C           HRO110 = DENSITY SCALE HEIGHT AT 110 KM                     ATMOSU
C           ZHM110 = ZH-110.                                            ATMOSU
C            SB    = APPROXIMATE DERIVATIVE OF DENSITY SCALE HEIGHT     ATMOSU
C                    AT 110-KM ALTITUDE                                 ATMOSU
C                  = HR1105-HR1095                                      ATMOSU
C           HR1105 = DENSITY SCALE HEIGHT AT 110.5 KM.                  ATMOSU
C           HR1095 = DENSITY SCALE HEIGHT AT 109.5 KM.                  ATMOSU
C           FHR120 = (HRO120 - 10.*SB - HRO110)/(120.-110.)**2          ATMOSU
C         IN THIS INITIALIZATION CALL WE NEED TO COMPUTE THE DENSITY    ATMOSU
C         SCALE HEIGHT AT 120 KM, HRO120, ACCORDING TO THE HIGH-ALTITUDE ATMOSU
C         MODEL, WHICH DEPENDS ON HL AND SBAR, AND ALSO THE DENSITY     ATMOSU
C         SCALE HEIGHTS ACCORDING TO THE LOW-ALTITUDE MODEL AT 110 KM,  ATMOSU
C         110.5 KM, AND 109.5 KM.                                       ATMOSU
C         COMPUTE SMALL A.                                              ATMOSU
      SA = (TIF - TZ)/TIF                                               ATMOSU
C         COMPUTE COEFFICIENT OF H-SUB-I IN GAMMA-SUB-I                 ATMOSU
```

```
      GAMT = 1.0E+05*GGSK/(TIF*TAU)
      RHO = 0.0
      DRODZN = 0.0
      DO 120 I=1,IS
      SNZSNI = SNIZ(I)*SNI(I)
      GAM = GAMT*SMI(I)
      ALGAMI = ALP(I) + GAM + 1.0
      RHO = RHO + SNZSNI
      DRODZN = DRODZN + SNZSNI*(GAM + ALGAMI*SA/(1.-SA))
  120 CONTINUE
      HRO120 = RHO/DRODZN/TAU
C         COMPUTE DENSITY SCALE HEIGHT AT 110 KM.
      GDTM = GDTMAF( 110. )
      HRO110 = 1.0/(CC1*GDTM
     *         - 2.0/(RE+110.0) - GKKZAF( 110.0 )/GDTM)
C         COMPUTE DENSITY SCALE HEIGHT AT 110.5 KM.
      GDTM = GDTMAF( 110.5 )
      HR1105 = 1.0/(CC1*GDTM
     *         - 2.0/(RE+110.5) - GKKZAF( 110.5 )/GDTM)
C         COMPUTE DENSITY SCALE HEIGHT AT 109.5 KM.
      GDTM = GDTMAF( 109.5 )
      HR1095 = 1.0/(CC1*GDTM
     *         - 2.0/(RE+109.5) - GKKZAF( 109.5 )/GDTM)
      SB = HR1105-HR1095
      FMR120 = 0.01*(HRO120 - 10.*SB - HRO110)
C
C         AT NIGHTTIME, O DIFFERS FROM DAYTIME O ONLY BELOW ALTITUDE
C         ZION(5) = 90 KM.  IF( ZH.LT.ZION(1)), WHERE ZION(1) = 60 KM,
C         SNI(3) = ONZI(1) = ONITE(13) = 1.1 .
C         IF(ZH.GE.ZION(1) .AND. ZH.LT.ZION(2)), WHERE ZION(2) = 75 KM,
C         SNI(3) = ONZI(2)*EXP(ZN2ON*ONSCHI)  WHERE
C              ONZI(2) = ONITE(16) = 4.90E+08
C                ZN2ON = ZH-ZION(2)
C               ONSCHI = ALOG(ONZI(2)/ONZI(1))/(ZION(2)-ZION(1))
C         IF(ZH.GT.ZION(2) .AND. ZH.LE.ZION(4))  WHERE ZION(4) = 85 KM,
C         SNI(3) = ONZI(4)*EXP(-(85.-ZH)/SZ)
C         WHERE SZ IS AN ALTITUDE-DEPENDENT SCALE HEIGHT SO DETERMINED
C         THAT THE FUNCTION PASSES THROUGH THE DATA POINTS AT 75, 80,
C         AND 85 KM,
C               SZ = S85 - (S85-S80)*(85.-ZH)/5.
C              S80 = 5./ALOG( ONITE(18)/ONITE(17) )
C              S85 = 2.*S80 - 10./ALOG( ONITE(18)/ONITE(16) )
C         IF(ZH.GT.ZION(4) .AND. ZH.LT.ZION(5))  WHERE ZION(5) = 90 KM,
C         SNI(3) = ONZI(4)*EXP(ZN4ON/ONSCH)  WHERE
C         ONZI(4) = ONITE(18) = 9.0E+10
C           ZN4ON = ZH - ZION(4)
C           ONSCH = (ZION(5) - ZION(4))/ALOG( ONZI(5)/ONZI(4) )
C         THE NIGHTTIME O CONSTANTS ARE NOW SET.
      ZION(1) = ALTKM(13)
      ONZI(1) = ONITE(13)
      DO 130 I=2,5
      ZION(I) = ALTKM(I+14)
      ONZI(I) = ONITE(I+14)
  130 CONTINUE
      ZN2 = ZION(5)
C         TO RESET ONZI(5) TO ITS PROPER VALUE WE NEED TO FIRST
C         CALCULATE ODAYZ5...
```

```
C
C         COMPUTE GRAV. ACCEL. G, G DIVIDED BY MOL. SCALE TEMP. TM,
C         AND INTEGRAL OF G/TM AT ALTITUDE ZH2.
C
      GG = GAF( ZH2 )
      GDTM = GDTMAF( ZH2 )
      GDTMI = GTMIAF( ZH2 )
C         COMPUTE PRESSURE AND DENSITY AT ALTITUDE ZH2
      PP = PZ*EXP(-CC1*GDTMI)
      RHO = BIGMS*GDTM/RR*PP/GG
C         COMPUTE N/NSTAR DAY AT ALTITUDE ZH2
      SF = SFDAF( ZH2 )
      BNBNS = 1.0/(1. + SF)
C         COMPUTE TOTAL NUMBER DENSITY, N(1/CM**3) AT ALTITUDE ZH2
      SN = BIGA/BIGMS*RHO/BNBNS
C         COMPUTE TOTAL NUMBER DENSITY IF NO DISSOCIATION,
C         NSTAR (1/CM**3)
      SNS = BIGA*RHO/BIGMS
      ODAYZ5 = 2.*SNS*SF
      ONZI(5) = ODAYZ5
      ONSCHI = ALOG(ONZI(2)/ONZI(1))/(ZION(2)-ZION(1))
      S80 = 5./ALOG( ONITE(18)/ONITE(17) )
      S85 = 2.*S80 - 10./ALOG( ONITE(18)/ONITE(16) )
      ONSCH = (ZION(5) - ZION(4))/ALOG( ONZI(5)/ONZI(4) )
C
C         TO PROVIDE A CONTINUOUS TRANSITION IN THE CO2 DENSITY BETWEEN
C         THE ALTITUDE OF 100 KM, BELOW WHICH A CONSTANT MIXING RATIO
C         IS ASSUMED, AND THE ALTITUDE OF 120 KM, AT WHICH THE ATMOSU
C         HIGH-ALTITUDE MODEL (BASED ON DIFFUSIVE EQUILIBRIUM) BEGINS,
C         WE USE THE POLYNOMIAL
C             LOG10(SNI(6)) = SUM( XC(I)*ZN1CO2**(I-1)), I=1,7
C         WHERE THE CONSTANTS XC(I),I=1,7 , ARE DETERMINED SO THAT THE
C         SLOPE OF ALOG10(SNI(6)) AT ZICO2(1) = 100 KM, DLCZ1Z, AND
C         AT ZICO2(5) = 120 KM, DLCZ5Z, IS CONTINUOUS AND ALOG10(SNI(6))
C         EQUALS THE VALUES FOR CO2 AT ZICO2(I) = 100,105,110,115, AND
C         120 KM FOR I=1,5 .
C         THE CO2 CONSTANTS ARE NOW SET...
      DO 160 I=1,5
      ZICO2(I) = ALTKM(I+20)
      CO2ZI(I) = CO2(I+20)
  160 CONTINUE
C         RESET CO2ZI(1) TO THE VALUE OBTAINED FROM THE LOW-ALTITUDE
C         MODEL AT ALTITUDE ZICO2(1) = 100 KM. TO DO THIS WE MUST FIRST
C         COMPUTE GRAV. ACCEL. G, G DIVIDED BY MOL. SCALE TEMP. TM, AND
C         INTEGRAL OF G/TM AT 100 KM.
C
C         COMPUTE GRAV. ACCEL. G, G DIVIDED BY MOL. SCALE TEMP. TM, AND
C         INTEGRAL OF G/TM AT 100 KM
      GG = GAF( 100. )
      GDTM = GDTMAF( 100. )
      GDTMI = GTMIAF( 100. )
C         COMPUTE PRESSURE AND DENSITY AT 100 KM
      PP = PZ*EXP(-CC1*GDTMI)
      RHO = BIGMS*GDTM/RR*PP/GG
C         COMPUTE TOTAL NUMBER DENSITY IF NO DISSOCIATION,
C         NSTAR, AT 100 KM.
      SNS = BIGA*RHO/BIGMS
```

```
      CO2ZI(1) = 3.20E-04 * SNS
      XC(7) = ALOG10(CO2ZI(1))
C         THE SLOPE OF ALOG10(SN1(6)) AT ALTITUDE ZICO2(1) = 100 KM,
C         DLCZ1Z, IS GIVEN BY DLCZ1Z = ALOG10(EXP(1.0))*((1./RHO)
C         *(D(RHO)/DZ)) = ALOG10(EXP(1.0))*(-1./HRHO).
C         COMPUTE DENSITY SCALE HEIGHT AT 100 KM.
      HRO100 = 1.0/(CC1*GDTM
     *        - 2.0/(RE+100.) - GKKZAF( 100. )/GDTM)
      DLCZ1Z = (-1.0/HRO100)*ALOG10( EXP(1.0) )
      XC(6) = DLCZ1Z
      DO 164 I=2,5
      ZIMIC(I) = ZICO2(I)-ZICO2(1)
  164 CONTINUE
      DO 165 I=1,4
      ZII2 = ZIMIC(I+1)
      D(I,5) = ZII2*ZII2
      DO 165 J=1,4
      D(I,5-J) = ZII2*D(I,6-J)
  165 CONTINUE
      ZII5 = ZIMIC(5)
      D(5,5) = 2.*ZII5
      DO 170 J=1,4
      FJ1 = J+1
      D(5,5-J) = ZII5*((FJ1+1.)/FJ1)*D(5,6-J)
  170 CONTINUE
      DO 175 I=1,4
      D(I,6) = ALOG10(CO2ZI(I+1)) - XC(6)*ZIMIC(I+1) - XC(7)
  175 CONTINUE
      DLCZ5Z = ALOG10( EXP(1.0) )*TAU*(SA+SNI(6)*GAMT)/(SA-1.0)
      D(5,6) = DLCZ5Z-XC(6)
      NO = 5
      CALL SOLVE(D,XC,NO)
C
C         COMPUTE O DENSITY AT 160 KM FOR USE IN O(1D) COMPUTATION IN
C         SUBROUTINE SPCHIN.
      ZZ = R1120*(ALTKM(33)-120.)/(RE+ALTKM(33))
      ETZ = EXP(-TAU*ZZ)
      TTDTZ = (TIF-(TIF-TZ)*ETZ)/TZ
      GAM = GAMT*SNI(3)
      ALGAM1 = ALP(3)+GAM+1.0
      O160D = SNIZ(3)*ETZ**GAM/TTDTZ**ALGAM1
C
C         EVALUATE ATMOSPHERIC PROPERTIES AT 90-KM ALTITUDE PRIOR
C         TO INITIALIZING IONOSU.
      ZHSAVE = ZH
      ZH = 90.
      JUMP = 0
      GO TO 210
  177 JUMP = 2
C         INITIALIZE IONOSU ROUTINE.
      CALL IONOSU(1,ZH)
      ZH = ZHSAVE
C         SET ZHFLAG AND SPIFLG  (ARBITRARY NEGATIVE VALUES)
      SPIFLG = -20.
      ZHFLAG = -20.
      RETURN
CC
```

```
CC                                                                       ATMOSU
  200 CONTINUE                                                           ATMOSU
      IF( ZH.EQ.ZHFLAG )  RETURN                                         ATMOSU
CCC                                                                      ATMOSU
C          AN ERRONEOUS CONDITION WILL OCCUR IF IONOSU OR SPCMIN IS      ATMOSU
C          CALLED WITH JJ=2 AND A GIVEN VALUE OF ZH IF ATMOSU HAS NOT    ATMOSU
C          BEEN CALLED FIRST WITH JJ=2 AND FOR THE SAME VALUE OF ZH.     ATMOSU
C          THE VARIABLE ZHFLAG IS USED TO DETECT THIS CONDITION AND      ATMOSU
C          TO MAKE THE REQUIRED CALL TO ATMOSU.                          ATMOSU
C          ZHFLAG IS INITIALIZED TO AN ARBITRARY NEGATIVE VALUE IN       ATMOSU
C          THE INITIALIZATION CALL TO ATMOSU.                            ATMOSU
CCC                                                                      ATMOSU
      ZHFLAG = ZH                                                        ATMOSU
  210 CONTINUE                                                           ATMOSU
      REZHI = 1.0/( RE+ZH )                                              ATMOSU
      IF( ZH .GE. 120. )  GO TO 250                                      ATMOSU
C                                                                        ATMOSU
CCCCCC     LOW-ALTITUDE MODEL (ZH .LT. 120.)                             ATMOSU
C                                                                        ATMOSU
C          COMPUTE GRAV. ACCEL. AT ALTITUDE ZH,   GG(CM/SEC**2).         ATMOSU
      GG = GAF( ZH )                                                     ATMOSU
C          COMPUTE GRAV. ACCEL. DIVIDED BY MOLECULAR-SCALE TEMPERATURE.  ATMOSU
      GDTM = GDTMAF( ZH )                                                ATMOSU
C          COMPUTE INTEGRAL OF G/TM.                                     ATMOSU
      GDTMI = GTMIAF( ZH )                                               ATMOSU
C           COMPUTE FUNCTION NEEDED FOR DENSITY SCALE HEIGHT             ATMOSU
      GKKZ = GKKZAF( ZH )                                                ATMOSU
C          COMPUTE PRESSURE (DYNES/CM**2)                                ATMOSU
      PP = PZ*EXP(-CC1*GDTMI)                                            ATMOSU
C          COMPUTE DENSITY (G/CM**3)                                     ATMOSU
      RHO = BIGMS*GDTM/RR*PP/GG                                          ATMOSU
C          COMPUTE DENSITY SCALE HEIGHT (KM).                            ATMOSU
      IF (ZH .GE. 110.) GO TO 230                                        ATMOSU
      HRHO = 1.0/(CC1*GDTM - 2.0*REZHI - GKKZ/GDTM)                      ATMOSU
      GO TO 235                                                          ATMOSU
  230 ZHM110 = ZH - 110.                                                 ATMOSU
      HRHO = (FHR120*ZHM110 + SB)*ZHM110 + HRO110                        ATMOSU
C          USE FIT FUNCTION TO UNIVERSAL PROFILE OF SF FUNCTION.         ATMOSU
  235 SF = SFDAF( ZH )                                                   ATMOSU
      BMBMS = 1.0/(1. + SF)                                              ATMOSU
C          COMPUTE TEMPERATURE (DEG K)                                   ATMOSU
      TT = BMBMS*GG/GDTM                                                 ATMOSU
C          COMPUTE NUMBER DENSITIES OF SPECIES.  WE PRESCRIBE THE        ATMOSU
C          DAY-NIGHT DEPENDENCE OF O AND USE THE LOW-ALTITUDE MODEL TO   ATMOSU
C          COMPUTE THE ASSOCIATED SLIGHT DAY-NIGHT DEPENDENCE OF O2 .    ATMOSU
      SNS = BIGA*RHO/BIGMS                                               ATMOSU
      SN = SNS/BMBMS                                                     ATMOSU
      SNI(1)  = 0.78*SNS                                                 ATMOSU
      SNI(2)  = 1.211*SNS - SN                                           ATMOSU
      SNI(3) = 2.*SNS*SF                                                 ATMOSU
      IF( IDORN.GE.0 )  GO TO 245                                        ATMOSU
C          COMPUTE NIGHTTIME VALUE OF O                                  ATMOSU
      IF( ZH .GE. 90.0 )  GO TO 245                                      ATMOSU
      IF( ZH - ZION(4) )  240,240,239                                    ATMOSU
C          FIT FOR 85.0 .LT. ZH .LT. 90.0                                ATMOSU
  239 ZM4ON = ZH - ZION(4)                                               ATMOSU
      SNI(3) = ONZI(4)*EXP(ZM4ON/ONSCH)                                  ATMOSU
```

```
      GO TO 245
  240 IF( ZH - ZION(2) )  242,242,241
C          FIT FOR 75.0 .LT. ZH .LE. 85.0
  241 SZ = S85 - (S85-S80)*(85.-ZH)/5.
      SNI(3) = ONITE(18)*EXP(-(85.-ZH)/SZ)
      GO TO 245
  242 IF( ZH-ZION(1) )  244,243,243
C          FIT FOR 60.0 .LE. ZH .LE. 75.0
  243 ZM2ON = ZH-ZION(2)
      SNI(3) = ONZI(2)*EXP(ZM2ON*ONSCHI)
      GO TO 245
C          FIT FOR ZH .LT. 60.0
  244 SNI(3) = ONZI(1)
C          FOR ZH .GE. 90.0, USE DAY SNI(3).  PROCEED WITH OTHER SPECIES.
  245 SNI(4)  = 0.009*SNS
      SNI(5)  = 4.625E-05*SNS
      IF( ZH.LE.100. )  GO TO 246
      ZM1CO2 = ZH-ZICO2(1)
      SNI(6) = 10.**((((((XC(1)*ZM1CO2 + XC(2))*ZM1CO2 + XC(3))*ZM1CO2
     *       + XC(4))*ZM1CO2 + XC(5))*ZM1CO2 + XC(6))*ZM1CO2 + XC(7))
      GO TO 247
  246 SNI(6) = 3.20E-04 * SNS
C          COMPUTE FRACTIONAL ERROR FROM HYDROSTATIC EQUILIBRIUM...
C          FEMSEQ = -1.0E-05*DPPDZH/(RHO*GG) - 1.0
C                 = -2.66709952E-12 * RR * ZH**1.833 / (BIGMS * GDTM)
C          WHERE   2.66709952E-12 = 1.0E-05 * 2.833 * 9.4144E-08
  247 FEMSEQ = -2.66709952E-12 * RR * ZH**1.833 / (BIGMS * GDTM)
      IF( JUMP.EQ.0 )  GO TO 177
      RETURN
C
CCCCCC    HIGH-ALTITUDE MODEL (ZH .GE. 120.)
C
C          COMPUTE THE GEOPOTENTIAL ALTITUDE ABOVE 120 KM, ZZ(KM).
  250 CONTINUE
      ZZ = RE120*(ZH-120.)*REZHI
C          COMPUTE THE TEMPERATURE AT THE GEOPOTENTIAL ALTITUDE,TT(DEG K)
      ETZ = EXP(-TAU*ZZ)
      TT = TIF - (TIF-TZ)*ETZ
C          COMPUTE RATIO OF TEMPERATURE TO TEMPERATURE AT 120 KM.
      TTOTZ = TT/TZ
      PP = 0.0
      RHO = 0.0
      DRODZH = 0.0
      DPPDZH = 0.0
      DO 260 I=1,IS
C          COMPUTE GAMMA-SUB-I.
      GAM = GAMT*SMI(I)
      ALGAMI = ALP(I) + GAM + 1.0
C          COMPUTE DENSITIES (1/CM**3) OF N2, O2, O, AR, HE, AND CO2.
      SNI(I) = SNIZ(I)*ETZ**GAM / TTOTZ**ALGAMI
C          COMPUTE TOTAL NUMBER DENSITY (1/CM**3).
      PP = PP + SNI(I)
C          COMPUTE TOTAL MASS DENSITY (G/CM**3).
      RHO = RHO + SNI(I)*SMI(I)
C          COMPUTE A PORTION OF THE SPATIAL DERIVATIVE OF THE DENSITY.
      SGAET = SNI(I)*(GAM + ALGAMI*ETZ*(TIF-TZ)/TT)
      DRODZH = DRODZH + SGAET*SMI(I)
C          COMPUTE A PORTION OF THE SPATIAL DERIVATIVE OF THE PRESSURE.
  260 DPPDZH = DPPDZH + SGAET
C          COMPUTE SPATIAL DERIVATIVE OF PRESSURE.
      DPPDZH = ( GAF( ZH )/GAMT ) *(SA*PP*ETZ - TT*DPPDZH/TIF)
C          COMPUTE FRACTIONAL ERROR FROM HYDROSTATIC EQUILIBRIUM.
      FEMSEQ = -(DPPDZH/(RHO*GAF( ZH )) + 1.0)
C          COMPUTE PRESSURE (DYNES/CM**2).
      PP = PP*TT*SK
C          COMPUTE DENSITY SCALE HEIGHT (KM).
      DRODZH = DRODZH*TAU*(RE120-ZZ)*REZHI
      HRHO = RHO/DRODZH
      RETURN
      END
```

```
      SUBROUTINE FITTER(NPTS,X,Y,NO,IKIND,ISIGN,Z)
CCC
C         SUBROUTINE FITTER USES THE METHOD OF LEAST SQUARES TO COMPUTE
C         THE COEFFICIENTS, Z(J),J=1,NO IN A POLYNOMIAL OF DEGREE NO
C         REPRESENTING THE DEPENDENT VARIABLE Y(I) (OR, OPTIONALLY, ITS
C         NATURAL LOGARITHM) SPECIFIED (AND GIVEN EQUAL WEIGHTS) AT
C         NPTS VALUES OF THE INDEPENDENT VARIABLE X(I).
CCC
CCC       NO REVISION REQUIRED IN GOING FROM ROSCOE-RADAR TO ROSCOE-IR.
CCC
C     INPUT PARAMETERS
C             NPTS - NUMBER OF DATA POINTS
C             X(I) - VALUES OF THE INDEPENDENT VARIABLE, E.G.,
C                    ALTITUDE, KM
C             Y(I) - VALUES OF THE DEPENDENT VARIABLE, E.G., SPECIES
C                    CONCENTRATION, 1./CM**3
C               NO - DEGREE OF POLYNOMIAL TO BE FITTED
C            IKIND - INDEX FOR KIND OF EQUATION TO BE FITTED
C                  = 1 IF EQUATION IS
C                      LN(Y) = A0 + A1*X + A2*X**2 + ... + AN*X**N
C                  = 2 IF EQUATION IS
C                        Y   = A0 + A1*X + A2*X**2 + ... + AN*X**N
C            ISIGN - INDEX FOR SIGN OF EXPONENTS
C                  = 1  FOR NEGATIVE EXPONENTS
C                  = 2  FOR POSITIVE EXPONENTS
CCC
C     OUTPUT PARAMETERS
C             Z(J) - THE LEAST-SQUARES FIT COEFFICIENTS.
C                    Z(1) CORRESPONDS TO A0, Z(2) TO A1, ETC.
CCC
      DIMENSION  A(20,21), X(100), Y(100), Z(20)
      NO1 = NO+1
      NO2 = NO+2
      DO 9 I=1,NO1
      DO 9 J=1,NO2
      A(I,J) = 0.0
    9 CONTINUE
      DO 20 I=1,NPTS
      R = Y(I)
      A(1,1) = A(1,1) + 1.0
      GO TO (10,12), IKIND
   10 R = ALOG(R)
   12 S = X(I)
      GO TO (14,16), ISIGN
   14 S = 1.0/S
   16 Q = 1.0
      A(1,NO2) = A(1,NO2) + R
      DO 13 J=2,NO1
      Q = Q*S
      A(1,J) = A(1,J) + Q
   13 A(J,NO2) = A(J,NO2) + Q*R
      DO 20 K=2,NO1
      Q = Q*S
   20 A(K,NO1) = A(K,NO1) + Q
      DO 30 I=2,NO1
      DO 30 J=1,NO
      A(I,J) = A(I-1,J+1)
   30 CONTINUE
      CALL SOLVE(A,Z,NO1)
      RETURN
      END
```

```
      SUBROUTINE H2OSVP(TEMP,EH2O,EICE)                                 H2OSVP
CCC                                                                     H2OSVP
C          SUBROUTINE H2OSVP COMPUTES THE SATURATION VAPOR PRESSURE OF  H2OSVP
C          WATER VAPOR OVER A PLANE SURFACE OF (1) WATER FOR THE        H2OSVP
C          TEMPERATURE RANGE FROM 173.15 TO 373.15 DEG K (-100 TO +100  H2OSVP
C          DEG C) AND (2) ICE FOR THE TEMPERATURE RANGE FROM 173.15 TO  H2OSVP
C          273.15 DEG K (-100 TO 0 DEG C).                              H2OSVP
C          VALUES OF ZERO ARE RETURNED FOR THE PARAMETERS OUTSIDE THE   H2OSVP
C          INDICATED TEMPERATURE RANGES AND A MESSAGE IS PRINTED IF THE H2OSVP
C          ROUTINE IS CALLED OUTSIDE THE INDICATED RANGE.               H2OSVP
CCC                                                                     H2OSVP
CCC        THIS IS A NEW ROUTINE FOR ROSCOE-IR.                         H2OSVP
CCC                                                                     H2OSVP
C          THE FORMULA USED FOR THE WATER REFERENCE IS A THIRD DEGREE   H2OSVP
C          POLYNOMIAL GIVEN BY WEXLER (WE-76, EQ(16B)) AS AN APPROXIMA- H2OSVP
C          TION TO HIS EQ(15) FOR THE NATURAL LOGARITHM OF THE VAPOR    H2OSVP
C          PRESSURE (IN PASCALS) OF WATER IN THE RANGE FROM 0 TO 100    H2OSVP
C          DEG C BUT USED HERE ALSO IN THE EXTRAPOLATED REGION FROM 0 TO H2OSVP
C          -100 DEG C. THE BASIC FORMULA FOR THE ICE REFERENCE IS THAT  H2OSVP
C          GIVEN BY GOFF (GO-63, EQ(5)). HOWEVER, TO SIMPLIFY THE COMPU- H2OSVP
C          TATION, WE HAVE FITTED A SIXTH DEGREE POLYNOMIAL (EWDEI) TO  H2OSVP
C          THE RATIO EH2O/EI, WHERE EI IS THE SATURATED VAPOR PRESSURE  H2OSVP
C          OVER ICE AS GIVEN BY GOFF (GO-63, EQ(5)), AND COMPUTE EICE   H2OSVP
C          FROM THE EXPRESSION EICE = EH2O/EWDEI.                       H2OSVP
CCC                                                                     H2OSVP
C          INPUT PARAMETER                                              H2OSVP
C                TEMP = TEMPERATURE (DEG K)                             H2OSVP
C          OUTPUT PARAMETERS                                            H2OSVP
C                EH2O = SATURATION VAPOR PRESSURE OVER WATER (MILLIBAR = H2OSVP
C                       1000 DYNE/CM**2 = 100 PASCAL)                   H2OSVP
C                EICE = SATURATION VAPOR PRESSURE OVER ICE (MILLIBAR)   H2OSVP
CCC                                                                     H2OSVP
      DIMENSION  AA(4),BB(7)                                            H2OSVP
CCC                                                                     H2OSVP
C          DEFINITIONS OF DATA QUANTITIES                               H2OSVP
C               AA(I) = COEFFICIENTS IN THIRD DEGREE POLYNOMIAL FOR     H2OSVP
C                       EH2O, GIVEN BY WEXLER (WE-76, EQ(16B))          H2OSVP
C               BB(I) = COEFFICIENTS IN SIXTH DEGREE POLYNOMIAL EWDEI   H2OSVP
C                       USED TO FIT THE RATIO EH2O/EI, IN THE RANGE FROM H2OSVP
C                       0 TO -100 DEG C.                                H2OSVP
CCC                                                                     H2OSVP
      DATA  (AA(I),I=1,4) / -0.63536311E+04,+0.34049260034E+02,         H2OSVP
     *                      -0.19509874E-01,+0.12811805E-04 /           H2OSVP
      DATA  (BB(I),I=1,7) / +1.0009968,-9.7223016E-03,+5.2165686E-05,   H2OSVP
     *                    -1.9329451E-07,-1.2522564E-09,-1.0981376E-11, H2OSVP
     *                    -1.3597429E-13 /                              H2OSVP
      EH2O = 0.0                                                        H2OSVP
      EICE = 0.0                                                        H2OSVP
      TTC = TEMP-273.15                                                 H2OSVP
      IF( (TTC.LT.-100.) .OR. (TTC.GT.+100.) )  GO TO 40                H2OSVP
      EH2O = (AA(4)*TEMP + AA(3))*TEMP + AA(2) + AA(1)/TEMP             H2OSVP
      EH2O = 0.01*EXP( EH2O )                                           H2OSVP
      EICE = 0.0                                                        H2OSVP
      IF( TTC.GT.0.0 )  GO TO 20                                        H2OSVP
      EWDEI = (((((BB(7)*TTC + BB(6))*TTC + BB(5))*TTC + BB(4))*TTC     H2OSVP
     *        + BB(3))*TTC + BB(2))*TTC + BB(1)                         H2OSVP
      EICE = EH2O/EWDEI                                                 H2OSVP
   20 RETURN                                                            H2OSVP
   40 CONTINUE                                                          H2OSVP
      PRINT 11,  TEMP                                                   H2OSVP
   11 FORMAT (1H0,67H  TEMP IS NOT IN THE RANGE  173.15 TO 373.15  DEG. H2OSVP
     *KELVIN,  TEMP = E14.6*, FROM SUBROUTINE H2OSVP (FORMAT 11)*)      H2OSVP
      CALL EXIT                                                         H2OSVP
      END                                                               H2OSVP
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```
      SUBROUTINE IONOSU(JJ,ZH)
CCC
C         SUBROUTINE IONOSU PROVIDES THE PROPERTIES OF THE AMBIENT
C         IONOSPHERE REQUIRED BY ALL THE CHEMISTRY MODULES.
CCC
C         REVISION 04  (03/01/78)  PROVIDES...
C            1. REPLACEMENT OF THE E- AND F-REGION GENERIC MOLECULAR
C               ION M+ BY NO+, N2+, AND O2+, FOR ROSCOE-IR.
C         NOTE- THIS VERSION OF IONOSU IS STILL LIMITED IN THAT THE
C               PROFILES OF IONOSPHERIC PROPERTIES ARE REPRESENTATIVE
C               BUT NOT NECESSARILY THE FINAL SELECTIONS.
C         REVISION 05  (06/27/79)  PROVIDES...
C            2. GAM(I) SPECIFICATION BY FORTRAN STATEMENT INSTEAD OF
C               DATA STATEMENTS, OWING TO A REVISED CONCEPTUAL
C               DEFINITION.  NOTE THAT GAM(I), WITH I=1,4, ARE NOW A
C               FUNCTION OF ALTITUDE.
CCC
C         THE E- AND F-REGION CHEMISTRY MODULE REQUIRES...
C         (1) Q(1/(CM**3 SEC)) = EFQ, THE EFFECTIVE TOTAL ION
C             PRODUCTION RATE THAT REPRODUCES THE AMBIENT IONOSPHERE
C             WHEN USED WITH THE CHEMISTRY MODEL.
C         (2) O+(1/CM**3) = EFOP, THE POSITIVE ATOMIC ION DENSITY.
C         (3) NO+(1/CM**3) = EFNOP, THE NO+ MOLECULAR ION DENSITY.
C         (4) N2+(1/CM**3) = EFN2P, THE N2+ MOLECULAR ION DENSITY.
C         (5) O2+(1/CM**3) = EFO2P, THE O2+ MOLECULAR ION DENSITY.
C         (6) TX(DEG K), THE ELECTRON AND N2 VIBRATIONAL TEMPERATURE.
CCC
C         THE D-REGION CHEMISTRY MODULE REQUIRES...
C         (1) Q(1/(CM**3 SEC)) = DQ, THE EFFECTIVE TOTAL ION PRODUCTION
C             RATE THAT REPRODUCES THE AMBIENT IONOSPHERE WHEN USED WITH
C             THE CHEMISTRY MODEL.
CCC
C         INPUT PARAMETERS
C            ARGUMENT LIST
C                 JJ - CALCULATION FLAG
C                      = 1, CALCULATE INITIALIZATION PARAMETERS
C                      = 2, CALCULATE ATMOSPHERIC PROPERTIES
C                 ZH - ALTITUDE OF INTEREST (KM)
C            ATMOUP COMMON
C                      IDORM, SNI(1), SNI(2), SNI(3), SNI(7), SNI(8), TT
C            ALTOON COMMON
C                      ALTKM(47)
C            RATCOF FUNCTION
C                      RATCOF
C            ZHCHEK COMMON
C                      ZHFLAG
C         OUTPUT PARAMETERS
C            ATMOUP COMMON
C                      SNI(9), SNI(10), SNI(11), SNI(12), SNI(28),
C                      SNI(29)
C            IONOUP COMMON
C                      EFE, EFOP, EFNOP, EFN2P, EFO2P, TX, QDEF
C            VARIABLES IN IONOUP
C                    EFE=SNI( 9) - ELECTRON DENSITY IN E- AND
C                                  F-REGION, 1/CM**3
C                   EFOP=SNI(10) - ATOMIC OXYGEN ION DENSITY IN E- AND
C                                  F-REGION, 1/CM**3
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C           EFNOP=SNI(11) - NO+ MOLECULAR ION DENSITY IN E- AND
C                           F-REGION, 1/CM**3
C           EFN2P=SNI(28) - N2+ MOLECULAR ION DENSITY IN E- AND
C                           F-REGION, 1/CM**3
C           EFO2P=SNI(29) - O2+ MOLECULAR ION DENSITY IN E- AND
C                           F-REGION, 1/CM**3
C              TX=SNI(12) - ELECTRON AND N2 VIBRATIONAL
C                           TEMPERATURE, DEG K
C                    QDEF - EFFECTIVE TOTAL ION PRODUCTION RATE,
C                           1/(CM**3 SEC)
C     ZHCHEK COMMON
C              ZHFLAG, SPIFLG
CCC
C        THE QUANTITIES REQUIRED FOR THE E- AND F-REGION IONOSPHERIC
C        CHEMISTRY IN ROSCOE-IR ARE OBTAINED BY A NATURAL EXTENSION OF
C        THE METHOD USED FOR ROSCOE-RADAR (SEE THE ROSCOE MANUAL,
C        DNA 3964F-14A, PAGES 67-74).  THE PRINCIPAL CHANGE IS A CHANGE
C        FROM THE GENERIC MOLECULAR-ION M+ TO NO+, N2+, AND O2+.
C        THE REQUIRED QUANTITIES ARE OBTAINED AS FOLLOWS...
C        (I) EFQ IS COMPUTED FROM
C            EFQ = EFE*EFE/(BIGA+BIGB*GAM(1)/FACTQ)
C            WHERE
C            EFE = ELECTRON DENSITY PROVIDED AS INPUT DATA TO
C                  IONOSU  (1/CM**3)
C           BIGA = AP+CP*GAM(3)/A2DEN+FACTA3*GAM(4)
C           BIGB = BP+FACTA3*BET41
C          FACTQ = BET11+ALP1*EFE
C             AP = GAM(1)/ALP2+GAM(2)/ALP2+GAM(3)/ALP3+GAM(4)/ALP4
C             BP = BET21*(1./ALP2-1./ALP1)+BET41*(1./ALP4-1./ALP1)
C             CP = BET23*(1./ALP2-1./ALP3)
C             DP = BET24*(1./ALP2-1./ALP4)
C          A2DEN = BET23+ALP3*EFE
C          A3DEN = BET24+ALP4*EFE
C         FACTA3 = DP/A3DEN
C           ALP1 = EFFECTIVE TWO-BODY COLLISIONAL-RADIATIVE
C                  RECOMBINATION RATE COEFFICIENT FOR ATOMIC IONS
C                = RATCOF(10,TX) + RATCOF(11,TX)*EFE + 1.5E-07*
C                  SQRT(EFE)/TX**3
C                  WHERE RATCOF(I,T) IS THE FUNCTION ROUTINE FOR
C                  E- AND F-REGION IONOSPHERIC RATE COEFFICIENTS
C           ALP2 = DISSOCIATIVE RECOMBINATION RATE COEFFICIENT FOR THE
C                  REACTION (NO+) + E = PRODUCTS,  CM**3/SEC
C                = RATCOF(2,TX)
C           ALP3 = DISSOCIATIVE RECOMBINATION RATE COEFFICIENT FOR THE
C                  REACTION (N2+) + E = PRODUCTS,  CM**3/SEC
C                = RATCOF(3,TX)
C           ALP4 = DISSOCIATIVE RECOMBINATION RATE COEFFICIENT FOR THE
C                  REACTION (O2+) + E = PRODUCTS,  CM**3/SEC
C                = RATCOF(4,TX)
C          BET21 = RATCOF(5,TT)*SNI(1)                        (1/SEC)
C          BET23 = RATCOF(7,TT)*SNI(3)                        (1/SEC)
C          BET24 = RATCOF(8,TT)*SNI(7) + RATCOF(9,TT)*SNI(8)  (1/SEC)
C          BET41 = RATCOF(5,TT)*SNI(2)                        (1/SEC)
C          BET11 = BET21 + BET41                              (1/SEC)
C         GAM(I) = RELATIVE EFFICIENCY PER PARTICLE (FOR O, NO, N2,
C                  AND O2 FOR I=1,2,3,4) IN DETERMINING THE E- AND
C                  F-REGION EFFECTIVE ION PRODUCTION RATE
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C          RATCOF(5,TT) = RATE COEFFICIENT FOR THE REACTION
C                         O+ + N2 = NO+ + N(4S)
C          RATCOF(6,TT) = RATE COEFFICIENT FOR THE REACTION
C                         O+ + O2 = O2+ + O
C          RATCOF(7,TT) = RATE COEFFICIENT FOR THE REACTION
C                         N2+ + O = NO+ + N(2D)
C          RATCOF(8,TT) = RATE COEFFICIENT FOR THE REACTION
C                         O2+ + N(4S) = NO+ + O
C          RATCOF(9,TT) = RATE COEFFICIENT FOR THE REACTION
C                         O2+ + NO = NO+ + O2
C           SNI(1) = N2 CONCENTRATION
C           SNI(2) = O2 CONCENTRATION
C           SNI(3) = O  CONCENTRATION
C           SNI(7) = N  CONCENTRATION
C           SNI(8) = NO CONCENTRATION
C          (2) EFOP IS COMPUTED FROM
C               EFOP = GAM(1)*EFQ/FACTQ
C          (3) EFN2P IS COMPUTED FROM
C              EFN2P = GAM(3)*EFQ/A2DEN
C          (4) EFO2P IS COMPUTED FROM
C              EFO2P = (GAM(4)*EFQ+BET41*EFOP)/A3DEN
C          (5) EFNOP IS COMPUTED FROM
C              EFNOP = (GAM(2)*EFQ+BET21*EFOP+BET23*EFN2P+BET24*EFO2P)/
C                     (ALP2*EFE)
C          (6) TE(DEG K) IS COMPUTED FROM AN INTERIM PRESCRIPTION.
CCC
C          ELECTRON DENSITY PROFILES FOR NOMINAL MIDLATITUDE DAYTIME AND
C          NIGHTTIME CONDITIONS IN THE E- AND F-REGIONS ARE PROVIDED AS
C          APPROXIMATE FITS TO CURVES IN FIG. 1 OF H. RISHBETH, PHYSICS
C          AND CHEMISTRY OF THE IONOSPHERE, CONTEMP. PHYSICS. VOL. 14,
C          P. 229(1973) (RI-73).
CCC
C          FOR DAYTIME ELECTRON DENSITY...
CCC
C          ASSUME PARABOLIC INCREASE IN LOG OF ELECTRON DENSITY FROM
C          ALOG10(EBOTD) = 5.0 AT ALTITUDE HEBOTD = 100.0 KM TO
C          ALOG10(EF2MXD) = ALOG10(7.5E+05) AT ALTITUDE HF2MXD = 300. KM,
C          FOLLOWED AT HIGHER ALTITUDE BY EXPONENTIAL DECREASE WITH
C          SCALE HEIGHT F2DSCH = 200. KM.  BELOW ALTITUDE HEBOTD, ASSUME
C          EXPONENTIAL DECREASE WITH SCALE HEIGHT EDDSCH = 5.0 KM.
C
C          IF(ZH.GT.HF2MXD)  EFE = EF2MXD*EXP((HF2MXD-ZH)/F2DSCH)
C          IF(ZH.GE.EBOTD .AND. ZH.LE.HF2MXD)
C          EFE = EF2MXD*10.**(EFEA*(HF2MXD-ZH)**2)
C          WHERE THE COEFFICIENT EFEA IS DETERMINED SO THAT EFE = EBOTD
C          AT ALTITUDE HEBOTD,
C          I.E., EFEA = ALOG10(EBOTD/EF2MXD)/(HF2MXD-HEBOTD)**2
C          WITH
C             HF2MXD = ALTITUDE OF F2MAX IN DAYTIME,  KM
C             EF2MXD = ELECTRON DENSITY AT F2MAX IN DAYTIME,  1/CM**3
C              EBOTD = ELECTRON DENSITY AT HEBOTD,  1/CM**3
C          IF(ZH.LT.HEBOTD)  EFE = EBOTD*EXP((ZH-HEBOTD)/EDDSCH)
CCC
C          FOR NIGHTTIME ELECTRON DENSITY...
CCC
C          ASSUME SINUSOID INCREASE IN LOG OF ELECTRON DENSITY FROM
C          ALOG10(EBOTN) = 3.0 AT ALTITUDE HEBOTN = 100. KM TO
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C         ALOG10(EF2MXN) = ALOG10(4.0E+05) AT ALTITUDE HF2MXN = 360. KM,
C         FOLLOWED AT HIGHER ALTITUDE BY EXPONENTIAL DECREASE WITH SCALE
C         HEIGHT F2NSCH = 200. KM.  BELOW HEBOTN, ASSUME EXPONENTIAL
C         DECREASE WITH SCALE HEIGHT EDNSCH = 5.0 KM.
C         IF(ZH.GT.HF2MXN)  EFE = EF2MXN*EXP((HF2MXN-ZH)/F2NSCH)
C         IF(ZH.GE.EBOTN .AND. ZH.LE.HF2MXN)
C         ALOG10(EFE) = ALOG10(EBOTN) + 0.50*ALOG10(EF2MXN/EBOTN)
C                       * (1.0+SIN(PIO2*(2.*ZH-HEBOTN-HF2MXN)/
C                       (HF2MXN-HEBOTN)))
C         IF(ZH.LT.HEBOTN)  EFE = EBOTN*EXP((ZH-HEBOTN)/EDNSCH)
CCC
C         ELECTRON TEMPERATURE PROFILES IN THE E- AND F-REGION ARE
C         OBTAINED, FOR (NOON) DAYTIME CONDITIONS, BY PRESCRIBING THE
C         DIFFERENCE BETWEEN THE ELECTRON TEMPERATURE TX AND THE GAS
C         TEMPERATURE TT AT  TWO  ALTITUDES AND USING A PARABOLIC FIT
C         TO THIS DIFFERENCE.  FOR NIGHTTIME CONDITIONS, WE ASSUME TX=TT
CCC
C         FOR DAYTIME ELECTRON TEMPERATURE...
C         ALTITUDE, KM       TX-TT, DEG K      TT(CIRA-65, MODEL-5, 8-HR)
C
C            120               0 = TXT120                 335
C            200             500 = TXT200                 933
CCC
C         THESE VALUES OF TX-TT ARE CONSISTENT WITH THE VALUES OF TX
C         REPORTED BY J.V. EVANS (MILLSTONE HILL THOMSON SCATTER RESULTS
C         FOR 1966 AND 1967, PLANET. SPACE SCI.  VOL. 21, PP. 763-792
C         (1973), (EV-73))  AND THE CIRA-1965 MODEL-5 8-HR ATMOSPHERE
C         (CI-65).
C
C         IF(ZH.LT.120.)  TX = TT
C         IF(ZH.GE.120.)  TXT = SQRT( ZHM120/A )
C         WHERE
C            ZHM120 = ZH-120.
C                 A = 80. / 500.**2
CCC
C         THE REQUIRED QUANTITY FOR THE D-REGION CHEMISTRY IS OBTAINED
C         AS FOLLOWS...
C         DQ IS FORCED TO EQUAL THE VALUE OF EFQ AT THE BOTTOM OF THE
C         GRID (90-KM) AND IS DETERMINED BY INPUT DATA AT LOWER
C         ALTITUDES.
C          NOTE ...  QDEF = DQ OR QDEF = EFQ DEPENDING ON THE
C                    ALTITUDE ZH.
CCC
C         FOR DAYTIME...
C
C         IF(ZH.LE.60.)
C                DQ = DQDAY(7) * QD1307**(ZHMZ07/Z13M07)
C           QD1307 = DQDAY(13)/DQDAY(7)
C           ZHMZ07 = ZH-ALTKM(7)
C           Z13M07 = ALTKM(13)-ALTKM(7)
C         IF(60..LT.ZH .AND. ZH.LT.90.)
C                DQ = DQDAY(13) * QD1913**(ZHMZ13/Z19M13)
C           QD1913 = EFQZ19/DQDAY(13)
C           ZHMZ13 = ZH-ALTKM(13)
C           Z19M13 = ALTKM(19)-ALTKM(13)
CCC
C         FOR NIGHTTIME...
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```
C
C         IF(ZH.LE.60.)
C              DQ = DQNIT(7) * QN1307**(ZHMZ07/Z13M07)
C           QN1307 = DQNIT(13)/DQNIT(7)
C
C         IF(60..LT.ZH .AND. ZH.LT.90.)
C              DQ = DQNIT(13) * QN1913**(ZHMZ13/Z19M13)
C           QN1913 = EFQZ19/DQNIT(13)
CCC
      DIMENSION  GAM(4)
      DIMENSION  DQDAY(18),DQNIT(18)
      COMMON/ALTODN/  ALTKM(47),ONITE(18),CO2(25),S3200
      COMMON/ATMOUP/ HL,SBAR,IDORN,PP,RHO,TT,SNI(33),HRHO,FEHSEQ
      COMMON/IONOUP/  EFE,EFOP,EFNOP,EFN2P,EFO2P,TX,QDEF
      COMMON/ZHCHEK/  ZHFLAG,SPIFLG
CCC
      DATA  EBOTD,HEBOTD,EF2MXD,HF2MXD,F2DSCH,EDDSCH /  1.0E+05,1.0E+02,
     *  7.0E+05,3.0E+02,2.0E+02,5.0 /
      DATA  EBOTN,HEBOTN,EF2MXN,HF2MXN,F2NSCH,EDNSCH /  1.0E+03,1.0E+02,
     *  4.0E+05,3.6E+02,2.0E+02,5.0 /
      DATA  TXT120,TXT200,TXT800 / 0.0,5.0E+02,1.8E+03 /
      DATA  PI / 3.14159265358 /
C         INTERIM VALUES 06/10/75
      DATA (DQDAY(I), I=1,18)/6*0.,3.3,5*0.,0.06,5*0./
C         INTERIM VALUES 06/10/75
      DATA (DQNIT(I), I=1,18)/6*0.,3.3,5*0.,0.06,5*0./
CCC
      GO TO (100,200), JJ
C         INITIALIZATION, CALLED FROM SUBROUTINE ATMOSU DURING ITS
C         INITIALIZATION.
  100 CONTINUE
      PID2 = PI/2.
      H2PBD2 = 0.50*(HF2MXN+HEBOTN)
      H2MBD2 = 0.50*(HF2MXN-HEBOTN)
      ALG2D1 = 0.50*ALOG10(EF2MXN/EBOTN)
      EFEA = ALOG10(EBOTD/EF2MXD)/(HF2MXD-HEBOTD)**2
      A = 80. / (500.*500.)
C         INITIALIZATION FOR D-REGION Q...
C         COMPUTE ELECTRON TEMPERATURE AT 90-KM ALTITUDE
      TX = TT
      IF(IDORN.LT.0) GO TO 150
C         COMPUTE DAYTIME ELECTRON DENSITY AT 90 KM
      EFE = EBOTD * EXP( (90.-HEBOTD)/EDDSCH)
      GO TO 180
C         COMPUTE NIGHTTIME ELECTRON DENSITY AT 90-KM ALTITUDE
  150 EFE = EBOTN * EXP((90. - HEBOTN)/EDNSCH)
  180 ALP1  = RATCOF(10,TX) + RATCOF(11,TX)*EFE
     $      + 1.5E-07*SQRT(EFE)/TX**3
      ALP2 = RATCOF( 2,TX)
      ALP3 = RATCOF( 3,TX)
      ALP4 = RATCOF( 4,TX)
CCC
C         SET SPIFLG=2.*ZH SO THAT A CALL TO SPCHIN WILL GET SNI(7)
C         AND SNI(8).  ALSO SET ZHFLAG=ZH SO THAT AN UNNECESSARY CALL
C         WILL NOT BE MADE TO ATMOSU.  THE CALL **CALL ATMOSU(2,90.)**
C         HAS EFFECTIVELY BEEN MADE DURING THE INITIALIZATION CALL
C         TO ATMOSU.
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CCC
      ZHFLAG = ZH
      SPIFLG = ZH+ZH
      CALL SPCMIN(2,ZH)
      BET21 = RATCOF( 5,TT)*SNI(1)
      BET23 = RATCOF( 7,TT)*SNI(3)
      BET24 = RATCOF( 8,TT)*SNI(7) + RATCOF( 9,TT)*SNI(8)
      BET41 = RATCOF( 6,TT)*SNI(2)
      BET11 = BET21 + BET41
      A1 = SNI(3)
      A2 = SNI(8)*2.
      A3 = SNI(1)*2.
      A4 = SNI(2)*2.
      SAI = A1 + A2 + A3 + A4
      GAM(1) = A1/SAI
      GAM(2) = A2/SAI
      GAM(3) = A3/SAI
      GAM(4) = A4/SAI
      AP     = GAM(1)/ALP1 + GAM(2)/ALP2 + GAM(3)/ALP3 + GAM(4)/ALP4
      BP     = BET21*(1.0/ALP2 - 1.0/ALP1) + BET41*(1.0/ALP4 - 1.0/ALP1)
      CP     = BET23*(1.0/ALP2 - 1.0/ALP3)
      DP     = BET24*(1.0/ALP2 - 1.0/ALP4)
      A2DEN = BET23 + ALP3*EFE
      A3DEN = BET24 + ALP4*EFE
      FACTA3 = DP/A3DEN
      BIGA = AP + CP*GAM(3)/A2DEN + FACTA3*GAM(4)
      BIGB = BP + FACTA3*BET41
      FACTQ = BET11 + ALP1*EFE
      EFQZ19 = EFE*EFE/(BIGA + BIGB*GAM(1)/FACTQ)
      IF(IDORN.LT.0) GO TO 190
      QD1913 = EFQZ19/DQDAY(13)
      QD1307 = DQDAY(13)/DQDAY(7)
      GO TO 195
  190 QN1913 = EFQZ19/DQNIT(13)
      QN1307 = DQNIT(13)/DQNIT(7)
  195 CONTINUE
      Z19M13 = ALTKM(19)-ALTKM(13)
      Z13M07 = ALTKM(13)-ALTKM(7)
      RETURN
CC
CC
  200 CONTINUE
      IF( ZH.NE.ZHFLAG )  CALL ATMOSU(2,ZH)
CCC
C         AN ERRONEOUS CONDITION WILL OCCUR IF IONOSU IS CALLED WITH
C         JJ=2 AND A GIVEN VALUE OF ZH IF ATMOSU HAS NOT BEEN CALLED
C         FIRST WITH JJ=2 AND FOR THE SAME VALUE OF ZH.
C         THE VARIABLE ZHFLAG IS USED TO DETECT THIS CONDITION AND
C         TO MAKE THE REQUIRED CALL TO ATMOSU.
C         ZHFLAG IS INITIALIZED TO AN ARBITRARY NEGATIVE VALUE IN
C         THE INITIALIZATION CALL TO ATMOSU.
CCC
      IF(ZH.GE.90.) GO TO 205
C         SET ELECTRON TEMPERATURE FOR ZH.LT.90.
      TE = TT
C         ZERO EFE, EFOP, AND EFMOLP FOR ZH.LT.90.
      EFE = EFOP = EFMOLP = 0.0
```

```
C          PROCEED WITH DQ CALCULATION FOR ZH.LT.90.
      IF(IDORN.LT.0) GO TO 350
C          COMPUTE DAYTIME DQ
      IF(ZH.LE.60.) GO TO 325
C          COMPUTE DAYTIME DQ FOR 60.LT.ZH.LT.90.
      ZHMZ13 = ZH-ALTKM(13)
      DQ = DQDAY(13) * QD1913**(ZHMZ13/Z19M13)
      GO TO 385
  325 CONTINUE
C          COMPUTE DAYTIME DQ FOR ZH.LE.60.
      ZHMZ07 = ZH-ALTKM(7)
      DQ = DQDAY(7) * QD1307**(ZHMZ07/Z13M07)
      GO TO 385
  350 CONTINUE
C          COMPUTE NIGHTTIME DQ
      IF(ZH.LE.60.) GO TO 375
C          COMPUTE NIGHTTIME DQ FOR 60.LT.ZH.LT.90.
      ZHMZ13 = ZH-ALTKM(13)
      DQ = DQNIT(13) * QN1913**(ZHMZ13/Z19M13)
      GO TO 385
  375 CONTINUE
C          COMPUTE NIGHTTIME DQ FOR ZH.LE.60.
      ZHMZ07 = ZH-ALTKM(7)
      DQ = DQNIT(7) * QN1307**(ZHMZ07/Z13M07)
  385 DDEF = DQ
      SNI( 9) = 0.0
      SNI(10) = 0.0
      SNI(11) = 0.0
      SNI(12) = TX
      SNI(28) = 0.0
      SNI(29) = 0.0
      RETURN
CCC
  205 IF( IDORN.LT.0 ) GO TO 250
CCC
C          COMPUTE DAYTIME ELECTRON DENSITY AND TEMPERATURE OF
C          E- AND F-REGIONS.
CCC
C          ELECTRON DENSITY
      IF( ZH-HEBOTD )  210,212,212
  210 EFE = EBOTD * EXP((ZH-HEBOTD)/EDDSCH)
      GO TO 220
  212 IF( ZH-HF2MXD )  214,214,216
  214 EFE = EF2MXD * 10.**(EFEA*(HF2MXD-ZH)**2)
      GO TO 220
  216 EFE = EF2MXD * EXP((HF2MXD-ZH)/F2DSCH)
C          ELECTRON TEMPERATURE
  220 IF( ZH-120. )  222,224,224
  222 TX = TT
      GO TO 280
  224 ZHM120 = ZH-120.
      TX = TT + SQRT( ZHM120/A )
      GO TO 280
CCC
C          COMPUTE NIGHTTIME ELECTRON DENSITY AND TEMPERATURE OF
C          E- AND F-REGIONS.
CCC
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```
C         ELECTRON DENSITY
  250 IF( ZH-HEBOTN )  260,262,262
  260 EFE = EBOTN * EXP((ZH-HEBOTN)/EDNSCH)
      GO TO 270
  262 IF( ZH-HF2MXN )  264,264,266
  264 EFE = EBOTN * 10.**( ALG2D1*(1.0+SIN(PID2*(ZH-H2PBD2)/H2MBD2)))
      GO TO 270
  266 EFE = EF2MXN * EXP((HF2MXN-ZH)/F2NSCH)
C         ELECTRON TEMPERATURE
  270 TX = TT
CCC
C         COMPUTE EFQ, EFOP, EFNOP, EFN2P, AND EFO2P
CCC
C         EFQ
  280 ALP1 = RATCOF(10,TX) + RATCOF(11,TX)*EFE
     $       + 1.5E-07*SQRT(EFE)/TX**3
      ALP2 = RATCOF( 2,TX)
      ALP3 = RATCOF( 3,TX)
      ALP4 = RATCOF( 4,TX)
      IF( ZH.NE.SPIFLG )  CALL SPCMIN(2,ZH)
CCC
C         AN ERRONEOUS CONDITION WILL OCCUR IF IONOSU IS CALLED WITH
C         JJ=2 AND A GIVEN VALUE OF ZH IF SPCMIN HAS NOT BEEN CALLED
C         FIRST WITH JJ=2 AND FOR THE SAME VALUE OF ZH.
C         THE VARIABLE SPIFLG IS USED TO DETECT THIS CONDITION AND
C         TO MAKE THE REQUIRED CALL TO SPCMIN.
CCC
C         THE OPTIMUM ORDER IS ""CALL ATMOSU(2,ZH)"" THEN
C         ""CALL SPCMIN(2,ZH)"" AND THEN ""CALL IONOSU(2,ZH)"".
C         ZHFLAG AND SPIFLG WILL DETECT CALLS MADE IN ANY OTHER ORDER.
CCC
C         SPIFLG IS INITIALIZED TO AN ARBITRARY NEGATIVE VALUE IN
C         THE INITIALIZATION CALL TO ATMOSU.
CCC
      BET21 = RATCOF( 5,TT)*SNI(1)
      BET23 = RATCOF( 7,TT)*SNI(3)
      BET24 = RATCOF( 8,TT)*SNI(7) + RATCOF( 9,TT)*SNI(8)
      BET41 = RATCOF( 6,TT)*SNI(2)
      BET11 = BET21 + BET41
      A1 = SNI(3)
      A2 = SNI(8)*2.
      A3 = SNI(1)*2.
      A4 = SNI(2)*2.
      SAI = A1 + A2 + A3 + A4
      GAM(1) = A1/SAI
      GAM(2) = A2/SAI
      GAM(3) = A3/SAI
      GAM(4) = A4/SAI
      AP     = GAM(1)/ALP1 + GAM(2)/ALP2 + GAM(3)/ALP3 + GAM(4)/ALP4
      BP     = BET21*(1.0/ALP2 - 1.0/ALP1) + BET41*(1.0/ALP4 - 1.0/ALP1)
      CP     = BET23*(1.0/ALP2 - 1.0/ALP3)
      DP     = BET24*(1.0/ALP2 - 1.0/ALP4)
      A2DEN = BET23 + ALP3*EFE
      A3DEN = BET24 + ALP4*EFE
      FACTA3 = DP/A3DEN
      BIGA = AP + CP*GAM(3)/A2DEN + FACTA3*GAM(4)
      BIGB = BP + FACTA3*BET41
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      FACTQ = BET11 + ALP1*EFE
      EFQ    = EFE*EFE/(BIGA + BIGB*GAM(1)/FACTQ)
      QDEF = EFQ
C         EFOP
      EFOP = GAM(1)*EFQ/FACTQ
C         EFN2P, EFO2P, AND EFNOP
      EFN2P = GAM(3)*EFQ/A2DEN
      EFO2P = (GAM(4)*EFQ + BET41*EFOP)/A3DEN
      EFNOP = (GAM(2)*EFQ + BET21*EFOP + BET23*EFN2P + BET24*EFO2P)
     $      / (ALP2*EFE)
      SNI(3) = EFE
      SNI(10) = EFOP
      SNI(11) = EFNOP
      SNI(12) = TE
      SNI(28) = EFN2P
      SNI(29) = EFO2P
      RETURN
      END
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      SUBROUTINE JULIAN(YRFJ,VEQJ,DAYJ)
CCC
C         JULIAN IS REVISION 03  (05/21/78) OF SUBROUTINE JULIAN
C         DEVELOPED FOR RESCUE-RADAR.
C         REVISION 01 (05/04/77) PROVIDES
C            1. CALCULATION OF (1) THE VARIABLE FYR, THE FRACTIONAL
C               SEASON-YEAR, NEEDED FOR THE NEW WATER VAPOR AND OZONE
C               MODELS AND (2) THE VARIABLE FST, THE FRACTIONAL SUMMER,
C               NEEDED FOR THE SEASONAL INTERPOLATION BETWEEN THE
C               SUMMER AND WINTER TEMPERATURE PROFILES INPUTTED AS
C               DATA FOR THE REVISED LOW-ALTITUDE MAJOR SPECIES MODEL.
C            2. REVERSAL OF SEASONS IN SOUTHERN HEMISPHERE.
C         REVISION 02 (10/15/77) PROVIDES
C            3. REVISED COMMENT CARDS.
C         REVISION 03 (05/21/78) PROVIDES
C            4. DELETION OF VARIABLES KYRS, KMONS, AND KDAYS FROM THE
C               ARGUMENT LIST SINCE THESE VARIABLES ARE NOW SUPPLED
C               THROUGH TIME COMMON WHERE THEY ARE KNOWN AS IYRS, IMONS,
C               AND IDAYS.
C            5. REVISED COMMENT CARDS.
CCC
C         SUBROUTINE JULIAN CONVERTS A GREGORIAN DATE AT GREENWICH TO
C         JULIAN DAY NUMBER DAYJ FOR SUBROUTINE SOLORB.
C         SUBROUTINE JULIAN IS VALID FOR YEARS 1901 TO 1999 INCLUSIVE.
CCC
C     INPUT PARAMETERS
C           TIME COMMON
C             IYRS - NUMBER OF THE YEAR IN THE 1900 S (E.G., 1974
C                    BECOMES 74), IN GREENWICH TIME ZONE.
C            IMONS - NUMBER OF THE MONTH (E.G., FEBRUARY BECOMES 2),
C                    IN GREENWICH TIME ZONE.
C            IDAYS - DAY OF THE MONTH, IN GREENWICH TIME ZONE.
C              PLAT - NORTH LATITUDE OF POINT P  (RADIANS)
CCC
C     OUTPUT PARAMETERS
C           ARGUMENT LIST
C             YRFJ - JULIAN DAY NUMBER (A HALF INTEGER) AT 0 HRS UT
C                    ON JANUARY 1 OF THE YEAR OF INTEREST.
C             VEQJ - JULIAN DATE FOR VERNAL EQUINOX.
C             DAYJ - JULIAN DAY NUMBER (A HALF INTEGER) AT 0 HRS UT
C                    ON THE DAY OF INTEREST.
C           TIME COMMON
C                FYR = FRACTIONAL SEASON-YEAR
C                      BEING 0 ON 1-JAN IN NORTHERN HEMISPHERE AND
C                      0 ON 1-JULY IN SOUTHERN HEMISPHERE.
C                FST = FRACTIONAL SUMMER
C                      BEING 1 ON 1-JULY AND 0 ON 1-JAN IN NORTHERN
C                      HEMISPHERE AND REVERSED IN SOUTHERN HEMISPHERE.
CCC
C     DEFINITION OF DATA
C          DAYM(I) - THE CUMULATIVE NUMBER OF DAYS FROM THE BEGINNING
C                    OF THE YEAR TO THE END OF THE (I-1)TH MONTH, IN
C                    A NON-LEAP YEAR.
CCC
      DIMENSION  DAYM(12)
      COMMON/TIME/ IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,GAT,FYR,FST,RHOSKM
     *        ,CHI
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      DATA  (DAYM(I),I=1,12) /  0.,31.,59.,90.,120.,151.,181.,212.,        JULIAN
     *                          243.,273.,304.,334. /                      JULIAN
      DAYS = IDAYS                                                         JULIAN
      YRS = IYRS                                                           JULIAN
CCC                                                                        JULIAN
C         THE FIRST TERM FOR DAYJ IS THE JULIAN DAY NUMBER AT 0 HRS UT    JULIAN
C         1900 JANUARY 1.  THE THIRD TERM FOR DAYJ IS THE NUMBER OF       JULIAN
C         EXTRA (LEAP-YEAR) DAYS SINCE 1900 TO THE START OF THE YEAR      JULIAN
C         OF INTEREST.                                                     JULIAN
CCC                                                                        JULIAN
      DAYJ = 2415020.5 + 365.*YRS + AINT( (YRS-1.)/4. )                   JULIAN
      YRFJ = DAYJ                                                          JULIAN
C         VERNAL EQUINOX OCCURS WITHIN ABOUT 7 SECONDS OF TIME AT         JULIAN
C         00 HOURS ON 21 MARCH 1974, AT WHICH TIME THE JULIAN DAY         JULIAN
C         NUMBER IS 2442127.5 . FOR NEARBY YEARS THE JULIAN DATE FOR      JULIAN
C         VERNAL EQUINOX WILL BE GIVEN BY VEQJ..                           JULIAN
      VEQJ = 2442127.5 + 365.25*(YRS-74.)                                  JULIAN
CCC                                                                        JULIAN
C         LEAP IS AN INDEX THAT EQUALS 0  FOR A LEAP YEAR AND OTHERWISE  JULIAN
C         EQUALS 1, 2, OR 3 .                                              JULIAN
CCC                                                                        JULIAN
      LEAP = MOD(IYRS,4)                                                   JULIAN
      IF( IMONS.LT.3 )  GO TO 1                                            JULIAN
      IF(  LEAP.EQ.0  )  DAYJ = DAYJ+1.0                                   JULIAN
    1 DAYJ = DAYJ + DAYM(IMONS) + (DAYS-1.0)                               JULIAN
      DAYYR = 365.                                                         JULIAN
      IF( LEAP.EQ.0 )  DAYYR = 366.                                        JULIAN
      FYR = (DAYJ-YRFJ)/DAYYR                                              JULIAN
      FST = 2.*FYR                                                         JULIAN
      IF( FYR.GT.0.5 )  FST = 2.-FST                                       JULIAN
      IF( PLAT.GE.0.0 )  GO TO 2                                           JULIAN
C         CORRECT FOR SOUTHERN HEMISPHERE                                  JULIAN
      FYR = FYR+0.50                                                       JULIAN
      IF( FYR.GT.1.0 )  FYR = FYR-1.0                                      JULIAN
      FST = 1.0-FST                                                        JULIAN
    2 RETURN                                                               JULIAN
      END                                                                  JULIAN
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```
      SUBROUTINE OZONE(KK,ZKM,OZ3)
CCC
C         SUBROUTINE OZONE COMPUTES THE LATITUDE AND SEASON DEPENDENCE
C         OF OZONE FOR ALTITUDES FROM 0- TO 55-KM. (FOR HIGHER ALTITUDES
C         SEE SUBROUTINE SPCMIN)
CCC
CCC       THIS IS A NEW ROUTINE FOR ROSCOM-IR.
CCC
C         INPUT PARAMETERS
C            ARGUMENT LIST
C                KK = CALCULATION FLAG
C                   = 1, CALCULATE INITIALIZATION PARAMETERS
C                   = 2, CALCULATE OZONE MIXING RATIO FOR 0- TO 55-KM
C               ZKM = ALTITUDE OF INTEREST, FROM 0- TO 55-KM
C            TIME COMMON
C              PLAT = NORTH LATITUDE OF POINT (RADIANS)
C               FYR = FRACTIONAL SEASON-YEAR, BEING 0 ON 1-JANUARY IN
C                     NORTHERN HEMISPHERE AND ON 1-JULY IN SOUTHERN
C                     HEMISPHERE
C         OUTPUT PARAMETER
C            ARGUMENT LIST
C              OZ3 = MIXING RATIO OF OZONE AT ALTITUDE ZKM, IN KG/KG
CCC
      COMMON/ATMOUP/ HL,SBAR,IDURN,PP,RHO,TT,SNI(30),HRHO,FEHSEQ
      COMMON/TIME/ IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,CAT,FYR,FST,RHOSKM
     *            ,CHI
      DATA  PI / 3.141592653590 /
CCC
      GO TO (100,200), KK
C         INITIALIZATION, CALLED FROM SUBROUTINE SPCMIN DURING ITS
C         INITIALIZATION.
  100 PI180 = PI/180.
      BLL = ABS(PLAT)/PI180
      AA = 2.56E-09*(105.-BLL)*EXP(-(105.-BLL)/47.)
      BB = 0.988 + 0.0136*BLL
      DD = (1.837 - 0.014*BLL)*1.0E-05
      EE = 0.50/(1.0+EXP(0.077*(BLL-44.))) + 6.0E-05*BLL*BLL - 0.014
      FF = (BLL-35./(1.0+EXP(-0.243*(BLL-80.))))**2
      Z1 = 12.54 - 0.093*BLL + 6.0/(1.0+EXP(-0.318*(BLL-85.5)))
      Z2 = 29.20 - 0.153*BLL - 6.0/(1.0+EXP(0.08*(BLL-10.)))
      ALPHT = 0.20 - 6.78E-04*BLL
      ZOT = (7.24E-04*BLL + 6.62E-03)*BLL + 46.9
      ALPHA = 0.235 + 0.295/(1.0+EXP(-0.0982*(BLL-37.)))
      BETA = 0.55 + 0.40/(1.0+EXP(0.094*(BLL-38.)))
      Z01C = 31.0 - 0.329*BLL + 11.6/(1.0+EXP(-0.112*(BLL-74.)))
      Z02C = 37.5 - 0.195*BLL + 9.49/(1.0+EXP(-0.135*(BLL-75.)))
      RETURN
  200 CONTINUE
      ZKRON = 0.0
      IF( (ZKM.GE.53.) .AND. (ZKM.LE.55.) )  ZKRON = 1.0
      BZZ = BB*(ZKM-Z1)
      IF( BZZ.GE.50.0 )  BZZ = 50.
      EFZ = FF/(ZKM**5 + 100.) - EE*(ZKM-Z2)
      IF( EFZ.GE.50.0 )  EFZ = 50.
      ATZ = ALPHT*(ZKM-ZOT)
      SMR = AA*(1.0+0.027*ZKM)/(1.0+EXP(BZZ)) + DD/(1.0+EXP(EFZ))
      SMR = SMR/(1.0+EXP(ATZ))
      AZZ = -ALPHA*(ZKM-Z01C)
      IF( AZZ.GE.50. )  AZZ = 50.
      CZZ = +BETA*(ZKM-Z02C)
      IF( CZZ.GE.50. )  CZZ = 50.
      CAPK = ( 1.05E-06/(1.0+EXP(AZZ)) ) / (1.0+EXP(CZZ))
      DZZ = 1.465*(ZKM-22.1)
      FZZ = 0.70*(ZKM-13.2)
      GAMMA = 60.12*(1.0/(1.0+EXP(DZZ)) + 0.655/(1.0+EXP(FZZ)))
      ANGLE = (360.*FYR-GAMMA)*PI180
      OZ3T = CAPK*SIN(ANGLE) + SMR
      DPSMR = 3.10E-06 - OZ3T
      OZ3 = OZ3T + DPSMR*ZKRON*(0.50+SIGN(0.50,DPSMR))
      RETURN
      END
```

```
      FUNCTION RATCOF(I,T)
CCC
C         FUNCTION RATCOF PROVIDES THE RATE COEFFICIENTS NEEDED FOR THE
C         E- AND F-REGION IONOSPHERE MODEL USED IN ROSCOE-IR.
C
C         THIS FUNCTION WAS PREPARED (03/01/78) FOR INTERIM USE
C         PENDING DEVELOPMENT BY G. E. TEMPO OF AN ADEQUATE EXTENSION
C         OF THE FUNCTION RATE USED IN ROSCOE-RADAR.
CCC
C         INPUT PARAMETERS
C            ARGUMENT LIST
C                I - REACTION INDEX (SEE BELOW)
C                T - TEMPERATURE (DEG K)
C                  = ELECTRON AND VIBRATIONAL TEMPERATURE FOR
C                    REACTIONS 2, 3, 4, 10, AND 11
C                  = HEAVY-PARTICLE KINETIC TEMPERATURE FOR
C                    OTHER REACTIONS
C         OUTPUT PARAMETER
C            FUNCTION RATCOF - REACTION RATE COEFFICIENT,
C                              CM**3/SEC FOR 2-BODY REACTIONS
C                              CM**6/SEC FOR 3-BODY REACTIONS
CCC
C         REACTIONS INCLUDED...
C
C        NO.          REACTION              RATE-COEFFICIENT REFERENCE
C        ************************************************************
C
C         2A NO+ +    E    = N(4S) +    O     HUANG ET AL.(1975)
C         2B NO+ +    E    = N(2D) +    O     HUANG ET AL.(1975)
C         3  N2+ +    E    = N(4S) + N(2D)    BIONDI (1969)
C         4  O2+ +    E    = O     + O(1D)    WALLS AND DUNN (1974)
C         5  O+  +   N2    = NO+   + N(4S)    DUNKIN ET AL.(1968)
C         6  O+  +   O2    = O2+   +   O      MCFARLAND ET AL.(1973)
C         7  N2+ +    O    = NO+   + N(2D)    MCFARLAND ET AL.(1973)
C         8  O2+ + N(4S)   = NO+   +   O      GOLDEN ET AL.(1966)
C         9  O2+ +   NO    = NO+   +  O2      FEHSENFELD ET AL.(1970)
C        10  O+  +    E    = O     +  HNU     BLOCK DATA BLKCHM, ROSCOE-RAD.
C        11  O+  + E + E   = O     +   E      BLOCK DATA BLKCHM, ROSCOE-RAD.
C
C        ************************************************************
C
C         FOR REACTIONS 2 THROUGH 9, RATE COEFFICIENTS ARE TAKEN
C         WITHOUT REVIEW AS PRESENTED IN SD-76 (STROBEL ET AL., JGR
C         VOL. 81, 3745(1976)).  FOR REACTIONS 10 AND 11, RATE
C         COEFFICIENTS ARE TAKEN FROM BLKCHM IN ROSCOE-RADAR.
CCC
      DIMENSION  RAT(11), POW(11)
      DATA  RAT / 0.0, 7.3E-07, 2.9E-07, 2.2E-07, 5.0E-13, 2.0E-11,
     $               2.5E-10, 1.8E-10, 6.3E-10, 4.4E-12, 1.2E-19 /
      DATA  POW / 0.0, 0.50, 0.33, 0.90, 0.0, 0.40, 0.44, 0.0, 0.0,
     $           0.75, 5.0 /
CCC
      RATCOF = RAT(I) * (300./T)**POW(I)
      IF( I.EQ.2 )  GO TO 2
      IF( I.EQ.5 )  GO TO 5
      RETURN
    2 RATCOF = RATCOF * (380./300.)**POW(2)
      RETURN
    5 IF( T.LT.600. )  RATCOF = RATCOF*(600./T)
      RETURN
      END
```

```
      SUBROUTINE SOLCYC(DAYJ)
CCC
C         SUBROUTINE SOLCYC COMPUTES THE SOLAR FLUX SBAR, AN INPUT TO
C         ATMOSU THROUGH COMMON ATMOUP, BASED ON AN ASSUMED SINUSOIDAL
C         11-YR (OR 4018-DAY) VARIATION, WITH THE MAXIMUM VALUE OF 250
C         FOR SBAR, ASSOCIATED WITH CIRA-65 MODEL 9, OCCURRING ON
C         1958 JUNE 1.  THE MINIMUM VALUE OF 65 FOR SBAR IS ASSOCIATED
C         WITH CIRA-65 MODEL 1.
CCC
C         REVISION 01  (03/01/78)  PROVIDES...
C            1. REVISED ATMOUP COMMON FOR ROSCOE-IR.
CCC
C     INPUT PARAMETER
C             DAYJ - JULIAN DAY NUMBER (A HALF INTEGER) AT 0 HRS UT
C                    ON THE DAY OF INTEREST.
CCC
C     OUTPUT PARAMETER
C             SBAR - AVERAGE 10.7-CM SOLAR FLUX, 1.0E-22 W/(M**2 HZ).
C                    SBAR IS AN INPUT TO ATMOSU THROUGH COMMON ATMOUP.
CCC
      COMMON/ATMOUP/ HL,SBAR,IDURN,PP,RHO,TT,SNI(30),HRHO,FEHSEQ
CCC
C     DEFINITION OF DATA
C            DJ5806 - JULIAN DAY NUMBER ON 1958 JUNE 1 =  2436355.5
      DATA  DJ5806 / 2436355.5 /
      DATA  PI / 3.141592653590 /
CCC
      PI2 = 2.*PI
      SBAR = 157.5 + 92.5*COS( (DAYJ-DJ5806)*PI2/4016. )
      RETURN
      END
```

```
      SUBROUTINE SOLORB(YRFJ,VEQJ,DAYJ,SOLLAT,SOLLON)
CCC
C        SUBROUTINE SOLORB COMPUTES THE NORTH LATITUDE SOLLAT AND
C        EAST LONGITUDE SOLLON OF THE APPARENT (ACTUAL MOTION)
C        SUBSOLAR POINT, GIVEN THE JULIAN DAY NUMBER AT 0 HRS UT ON
C        JANUARY 1 OF THE YEAR OF INTEREST (YRFJ), THE JULIAN DATE AT
C        WHICH VERNAL EQUINOX OCCURS (VEQJ), THE JULIAN DAY NUMBER AT
C        0 HRS ON THE DAY OF INTEREST (DAYJ), AND THE UNIVERSAL
C        TIME (UT).
C        REVISION  02(10/15/77)  PROVIDES...
C           1. DEFINITION OF A NEW VARIABLE, DELJUT, TO AVOID LOSS OF
C              SIGNIFICANCE IN COMPUTING SOLLON ON A SMALL-WORD MACHINE
C           2. REVISION OF THE ARGUMENT IN THE EQUATION-OF-TIME,
C              CONSISTENT WITH ITS DEFINITION.
C        REVISION 03  (03/01/78)  PROVIDES...
C           3. REVISED TIME COMMON FOR ROSCOE-IR.
CCC
C     INPUT PARAMETERS
C             YRFJ - JULIAN DAY NUMBER (A HALF INTEGER) AT 0 HRS UT ON
C                    JANUARY 1 OF THE YEAR OF INTEREST.
C             VEQJ - JULIAN DATE FOR VERNAL EQUINOX.
C             DAYJ - JULIAN DAY NUMBER (A HALF INTEGER) AT 0 HRS UT
C                    ON THE DAY OF INTEREST.
C               UT - UNIVERSAL TIME (DECIMAL HRS).
CCC
C     OUTPUT PARAMETERS
C              GAT - GREENWICH APPARENT TIME (DECIMAL HRS).
C                    GAT IS PLACED IN COMMON TIME.
C           SOLLAT - NORTH LATITUDE OF SUBSOLAR POINT (RADIANS).
C           SOLLON - EAST LONGITUDE OF SUBSOLAR POINT (RADIANS).
CCC
C     DEFINITIONS AND COMMENTS
C        UTD24 IS THE DECIMAL FRACTION OF DAY CORRESPONDING TO UT.
C        DAYJUT IS THE JULIAN (DECIMAL) DAY NUMBER AT UT HRS ON THE
C        DAY OF INTEREST.
C        DAYNO IS THE NUMBER OF ELAPSED (DECIMAL) DAYS SINCE THE
C        BEGINNING OF THE YEAR AT 0 HRS UT ON JANUARY 1.
C        THE QUANTITY (DAYJUT - AINT(DAYJUT)), THE WEST LONGITUDE OF
C        THE SUBSOLAR POINT EXPRESSED AS A DECIMAL FRACTION OF 2*PI
C        RADIANS, IS SUBTRACTED FROM 1 TO OBTAIN THE FRACTIONAL EAST
C        LONGITUDE.  THE FIRST TWO EXPRESSIONS FOR SOLLON ARE THE EAST
C        LONGITUDE OF THE SUBSOLAR POINT OF THE (FICTITIOUS) MEAN SUN.
C        IT IS POSSIBLE TO MAKE AN APPROXIMATE CORRECTION FOR THE
C        DIFFERENCE BETWEEN THE APPARENT (ACTUAL MOTION) SOLAR TIME
C        AND THE MEAN SOLAR TIME, KNOWN AS THE EQUATION-OF-TIME (SEE,
C        E.G., AMERICAN PRACTICAL NAVIGATOR (ORIGINALLY BY N.
C        BOWDITCH), U.S. NAVY H.O. PUB. NO. 9, P. 375, OF 1962
C        CORRECTED REPRINT EDITION, AVAILABLE FROM U.S. GOV. PRINTING
C        OFFICE).  IN THE U.S.A. (IN CONTRAST TO GREAT BRITAIN) THE
C        SIGN OF THE EQUATION-OF-TIME IS CONSIDERED POSITIVE IF THE
C        TIME OF THE MERIDIAN TRANSIT BY THE SUN IS EARLIER THAN 1200
C        HRS AND NEGATIVE IF LATER THAN 1200 HRS.  (NOTE THAT A
C        MERIDIAN TRANSIT BEFORE 1200 HRS CORRESPONDS TO THE EAST
C        LONGITUDE OF THE SUN BEING SMALLER THAN THE VALUE EXPECTED
C        BASED ON A MEAN SUN.)  ANNUAL EDITIONS OF THE NAUTICAL
C        ALMANAC PRIOR TO 1962 TABULATED VALUES OF THE EQUATION-OF-TIME
C        AT 12-HR INTERVALS.  THESE TABULATED VALUES OF THE EQUATION-OF
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C        -TIME COULD BE ADDED TO THE GREENWICH MEAN TIME (OR UNIVERSAL
C        TIME) TO OBTAIN THE GREENWICH APPARENT (OR ACTUAL MOTION)
C        TIME.  NEWER ANNUAL EDITIONS OF THE AMERICAN EPHEMERIS AND
C        NAUTICAL ALMANAC OR THE ASTRONOMICAL EPHEMERIS DO NOT EVEN
C        EXPLICITLY REFER TO THE TERM EQUATION-OF-TIME.  INSTEAD, FOR
C        MERIDIAN TRANSITS AND OTHER PHENOMENA THAT DEPEND ON HOUR
C        ANGLES AND GEOGRAPHIC LOCATION, THE NEWER EDITIONS REFER NOT
C        TO THE GREENWICH MERIDIAN AND TO UNIVERSAL TIME BUT TO A
C        MERIDIAN 1.002738*(DELTA T) EAST OF THE GEOGRAPHIC MERIDIAN
C        OF GREENWICH (KNOWN AS THE EPHEMERIS MERIDIAN) AND TO
C        EPHEMERIS TIME.  THE SOLAR EPHEMERIS TRANSIT, WHICH IS THE
C        EPHEMERIS TIME AT THE INSTANT OF SOLAR TRANSIT ACROSS THE
C        EPHEMERIS MERIDIAN, IS TABULATED AT 1-DAY INTERVALS IN THE
C        NEWER EDITIONS.  WE HAVE ADOPTED THE DEPARTURE OF THE VALUE OF
C        THE SOLAR EPHEMERIS TRANSIT FROM 12 HR 00 MIN 00 SEC AS A
C        CONVENIENT APPROXIMATION TO THE NEGATIVE VALUE OF THE
C        EQUATION-OF-TIME.  IN PARTICULAR, WE HAVE USED VALUES OF THE
C        SOLAR EPHEMERIS TRANSIT FOR 1974 TABULATED IN THE 1974 EDITION
C        OF EITHER THE ASTRONOMICAL EPHEMERIS OR THE AMERICAN EPHEMERIS
C        AND NAUTICAL ALMANAC, AND FITTED OUR ADOPTED VALUES OF THE
C        EQUATION-OF-TIME BY A FOUR-TERM FOURIER SERIES.  WE IGNORE THE
C        WEAK DEPENDENCE OF THE EQUATION-OF-TIME ON THE YEAR OF
C        INTEREST.  OUR FITTED EXPRESSION FOR THE EQUATION-OF-TIME IS
C        GIVEN BY
C
C        EQT = 0.385175*COS(F) - 3.146125*COS(F2)
C            - 7.392635*SIN(F) - 9.536825*SIN(F2) ,  MIN
C
C        WHERE
C                    F = RADDAY*(DAYJ-YRFJ)
C                   F2 = 2.*F
C               RADDAY = 2.*PI/365.25 RADIANS PER DAY
C                      = 0.0172024238 .
C        TO CONVERT FROM MINUTES OF TIME TO RADIANS OF LONGITUDE WE
C        MUST MULTIPLY EQT BY
C               RADMIN = 2.*PI/1440 RADIANS PER MINUTE
C                      = 0.00436332313 .
C        THUS, THE EAST LONGITUDE (RADIANS) OF THE APPARENT SUN IS
C           SOLLON = SOLLON-RADMIN*EQT
C        THE NORTH LATITUDE (RADIANS) OF THE APPARENT SUN IS
C           SOLLAT = SLATMX*SIN( (DAYJUT-VEQJ)*RADDAY )
C        WHERE THE MAXIMUM VALUE OF THE SOLAR LATITUDE IS
C           SLATMX = 0.409123 RADIANS .
CCC
      COMMON/TIME/ IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,CAT,FYR,FST,RHOSKM
     *            ,CHI
CCC
C     DEFINITIONS OF DATA AND CONSTANTS
C              PI = 3.14159265359O
C             PI2 = 2.*PI
C          RADDAY = PI2/365.25 RADIANS PER DAY IN A JULIAN YEAR
C                 = 0.0172024238
C          RADMIN = PI2/1440 RADIANS PER MINUTE IN A DAY
C                 = 0.00436332313
C          SLATMX = MAXIMUM VALUE OF SOLAR LATITUDE
C                 = 0.409123 RADIANS
CCC
```

```
      DATA  PI,SLATMX / 3.141592653590, 0.409123 /
CCC
      PI2 = 2.*PI
      RADDAY = PI2/365.25
      RADMIN = PI2/1440.
      UTD24 = UT/24.
      DAYJUT = DAYJ + UTD24
C        TO AVOID LOSS OF SIGNIFICANCE ON A SMALL-WORD MACHINE,
C        INTRODUCE A NEW VARIABLE, DELJUT.
      DELJUT = 0.50 + UTD24
      DAYNO = DAYJUT - YRFJ
CC    SOLLON = PI2*(1.0-DAYJUT+AINT( DAYJUT ))
      SOLLON = PI2*(1.0-DELJUT)
      IF( SOLLON.LT.0.0 )  SOLLON = SOLLON+PI2
      F = RADDAY*(DAYJ-YRFJ)
      F2 = 2.*F
      EQT = 0.385175*COS(F) - 3.146125*COS(F2)
     *    - 7.392635*SIN(F) - 9.536825*SIN(F2)
      SAT = UT + EQT/60.
      SOLLON = SOLLON - RADMIN*EQT
      SOLLAT = SLATMX*SIN( (DAYJUT-VEQJ)*RADDAY )
      RETURN
      END
```

```
      SUBROUTINE SOLVE (A, X, NO)
CCC
C         SUBROUTINE SOLVE, CALLED FROM SUBROUTINE FITTER, SOLVES A SET
C         OF NO SIMULTANEOUS LINEAR ALGEBRAIC EQUATIONS BY USING
C         GAUSS-JORDAN METHOD WITH MAXIMUM PIVOT FEATURE. (SEE, FORTRAN
C         IV PROGRAMMING AND COMPUTING BY JAMES T. GOLDEN,
C         PRENTICE-HALL, INC., 1965, PAGES 88-99)
CCC
CCC       NO REVISION REQUIRED IN GOING FROM ROSCOE-RADAR TO ROSCOE-IR.
CCC
C     INPUT PARAMETERS
C           A(I,J) - MATRIX OF CONSTANT COEFFICIENTS IN SET CONTAINING
C                    THE NUMBER NO SIMULTANEOUS LINEAR ALGEBRAIC
C                    EQUATIONS
C              NO - THE NUMBER OF EQUATIONS
CCC
C     OUTPUT PARAMETERS
C             X(K) - THE LEAST-SQUARES FIT COEFFICIENTS
CCC
      DIMENSION  A(20,21), B(20,21), X(20), LOC(20), ROW(20)
      KNO = NO+1
      DO 150 I=1,NO
      DO 150 J=1,KNO
      B(I,J) = A(I,J)
  150 CONTINUE
      DO 10 M=1,NO
      LOC(M) = 0
   10 ROW(M) = 0.0
      NP = NO+1
      DO 100 I=1,NO
      IP = I+1
C-----FIND MAX ELEMENT IN I-TH COL.
      AMAX = 0.0
      DO 2 K=1,NO
      IF(AMAX - ABS( A(K,I))) 3,2,2
C-----IS NEW MAX IN ROW PREVIOUSLY USED AS PIVOT.
    3 IF(ROW(K)) 4,4,2
    4 LOC(I) = K
      AMAX = ABS( A(K,I))
    2 CONTINUE
      IF(AMAX) 99,99,98
C-----MAX ELEMENT IN I-TH COL IS A(L,I)
   98 L = LOC(I)
      ROW(L) = 1.0
C-----PERFORM ELIMINATION, L IS PIVOT ROW, A(L,I) IS PIVOT ELEMENT.
      DO 50 J=1,NO
      IF(L-J) 6,50,6
    6 QF = -A(J,I)/A(L,I)
      DO 40 K=IP,NP
      A(J,K) = A(J,K) + QF*A(L,K)
   40 CONTINUE
   50 CONTINUE
  100 CONTINUE
      DO 200 I=1,NO
      L = LOC(I)
  200 X(I) = A(L,NO+1)/A(L,I)
C     WRITE(6,103)  (J, X(J),J=1,NO)
C 103 FORMAT (4(I8,2X,E15.8))
      RETURN
   99 WRITE(6,104)
  104 FORMAT (5X,27H NO UNIQUE SOLUTION EXISTS.)
      RETURN
      END
```

```
      SUBROUTINE SOLZEN(SOLLAT,SOLLON)
CCC
C         SUBROUTINE SOLZEN COMPUTES COSCHI, THE COSINE OF THE ZENITH
C         ANGLE OF THE SUN AT A POINT P, GIVEN THE GEOGRAPHIC NORTH
C         LATITUDE PLAT AND EAST LONGITUDE PLON OF THE POINT P AND THE
C         NORTH LATITUDE SOLLAT AND EAST LONGITUDE SOLLON OF THE
C         SUBSOLAR POINT.  THE DAY-OR-NIGHT PARAMETER IDORN IS 1 FOR
C         DAYTIME, I.E., IF(COSCHI.GE.0.0),  AND IS -1 FOR NIGHTTIME,
C         I.E., IF(COSCHI.LT.0.0).  THE LOCAL APPARENT TIME HL
C         IS ALSO COMPUTED FROM THE GREENWICH APPARENT TIME GAT AND THE
C         LONGITUDE PLON.
C         REVISION  01  (06/07/77)  PROVIDES
C            1. SOLAR ZENITH ANGLE, CHI (RADIANS)
C         REVISION 02  (03/01/78)  PROVIDES...
C            2. REVISED ATMOUP AND TIME COMMONS FOR ROSCOE-IR.
CCC
C     INPUT PARAMETERS
C              PLAT - NORTH LATITUDE OF POINT P (RADIANS)
C              PLON - EAST LONGITUDE OF POINT P (RADIANS)
C            SOLLAT - NORTH LATITUDE OF SUBSOLAR POINT (RADIANS)
C            SOLLON - EAST LONGITUDE OF SUBSOLAR POINT (RADIANS)
CCC
C     OUTPUT PARAMETERS
C               CHI - ZENITH ANGLE OF THE SUN AT POINT P (RADIANS)
C             IDORN - PARAMETER FOR DAY OR NIGHT.  IF COSCHI IS
C                     THE COSINE OF THE ZENITH ANGLE OF THE SUN AT
C                     POINT P, IDORN IS 1 FOR DAYTIME, I.E.,
C                     IF(COSCHI.GE.0.0), AND IS -1 FOR NIGHTTIME,
C                     I.E., IF(COSCHI.LT.0.0) .  IDORN IS AN INPUT TO
C                     ATMOSU THROUGH COMMON ATMOUP.
C                HL - LOCAL APPARENT TIME (DECIMAL HRS, E.G. 2230 HRS
C                     BECOMES 22.50 HRS).  HL IS AN INPUT TO ATMOSU
C                     THROUGH COMMON ATMOUP.
CCC
      COMMON/ATMOUP/ HL,SBAR,IDORN,PP,RHO,TT,SNI(30),RRHO,PENSEQ
      COMMON/TIME/ IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,GAT,FYR,FST,RHOSKM
     *       ,CHI
      DATA  PI / 3.1415926535890 /
CCC
C         THE FOLLOWING FORMULA IS BASED ON EQ. (1.41) OF IONOSPHERIC
C         RADIO PROPAGATION BY K. DAVIES, NBS MONOGRAPH 80, 1965
C         APRIL 1.  IT MAY ALSO BE DERIVED BY APPLYING THE LAW OF
C         COSINES FOR AN OBLIQUE SPHERICAL TRIANGLE.
CCC
      COSCHI = SIN(PLAT) * SIN(SOLLAT)
     *       + COS(PLAT) * COS(SOLLAT) * COS(PLON-SOLLON)
      CHI = ACOS( COSCHI )
      IDORN = 1
      IF( COSCHI.LT.0.0 )  IDORN = -IDORN
      PI2 = 2.*PI
      RADHR = PI/12.
      HL = GAT - (PI2-PLON)/RADHR
      IF( HL.LT.0.0 )  HL = HL+24.
      RETURN
      END
```

```
      SUBROUTINE SPCMIN(KK,ZH)                                          SPCMIN
CCC                                                                     SPCMIN
C         FOR ROSCOE-RADAR (MAY 1975),                                  SPCMIN
C         THE HIGH-ALTITUDE CHEMISTRY MODULE REQUIRES THE MINOR NEUTRAL SPCMIN
C         SPECIES O, CO2, N, AND NO.  PROFILES FOR DAY AND NIGHT AT ALL SPCMIN
C         ALTITUDES ARE PROVIDED FOR O AND CO2 IN ATMOSU.  HERE IN      SPCMIN
C         SPCMIN WE PROVIDE PROFILES OF N AND NO.                       SPCMIN
C         THE LOW-ALTITUDE CHEMISTRY MODULE REQUIRES, IN ADDITION TO O, SPCMIN
C         CO2, N, AND NO, THE MINOR NEUTRAL SPECIES H2O, O2(SINGLET     SPCMIN
C         DELTA G), O3, AND NO2, ALSO PROVIDED BY SPCMIN.               SPCMIN
CCC                                                                     SPCMIN
C         FOR ROSCOE-IR (MARCH 1978),                                   SPCMIN
C         THE CHEMISTRY-MODEL REQUIRES NEUTRAL SPECIES IN ADDITION TO   SPCMIN
C         THOSE INDICATED ABOVE FOR ROSCOE-RADAR.  THUS, SUBROUTINE     SPCMIN
C         SPCMIN ADDITIONALLY PROVIDES ALTITUDE PROFILES OF CO, N2O,    SPCMIN
C         CH4, H, OH, HO2, N(2D), N(2P), AND O(1D), AS WELL AS REVISED  SPCMIN
C         PROFILES OF O3, H2O, N, N(4S), AND NO.                        SPCMIN
C                                                                       SPCMIN
C     REVISION 01 (05/08/78) PROVIDES                                   SPCMIN
C       1. SETTING OF TWO CONSTANTS IN THE NIGHTTIME O3 PROFILE.        SPCMIN
C     REVISION 02 (05/21/78) PROVIDES                                   SPCMIN
C       2. DELETION OF UNUSED ARRAYS ANONZI(8), Z(9), ZIN2NO(8), AND    SPCMIN
C          ZINON(8).                                                    SPCMIN
C     REVISION 03 (06/24/79) PROVIDES                                   SPCMIN
C       3. REMOVAL OF SMALL DISCONTINUITY IN HO2 PROFILE AT 100 KM.     SPCMIN
C       4. CORRECTION OF KEYPUNCH ERROR IN DATA FOR NIGHTTIME H DENSITY SPCMIN
C          AT 80 KM (FROM 1.0E+08 TO 1.0E+07).                          SPCMIN
C       5. CORRECTION OF COMMENT-CARD UNITS FOR O3 MASS-MIXING-RATIO    SPCMIN
C          DATA.                                                        SPCMIN
C       6. LOWER LIMIT OF 1.0 FOR H DENSITY AT NIGHT BETWEEN 74 AND     SPCMIN
C          75 KM.                                                       SPCMIN
C       7. CORRECTED CONVERSION OF N2O VOLUME-MIXING RATIO (PPBV) TO    SPCMIN
C          N2O NUMBER DENSITY (1/CM**3).                                SPCMIN
C       8. ABSOLUTE VALUE OF LATITUDE IN COMPUTING LATITUDE FACTOR      SPCMIN
C          FOR N2O.                                                     SPCMIN
C     REVISION 04 (07/06/79) PROVIDES                                   SPCMIN
C       9. CORRECTED FIT FUNCTION FOR NO2 FOR 75.0 .LT. ZH .LT. 85.0 KM SPCMIN
C                                                                       SPCMIN
C     INPUT PARAMETERS                                                  SPCMIN
C         ARGUMENT LIST                                                 SPCMIN
C                KK - CALCULATION FLAG                                  SPCMIN
C                     = 1, CALCULATE INITIALIZATION PARAMETERS          SPCMIN
C                     = 2, CALCULATE ATMOSPHERIC PROPERTIES             SPCMIN
C                ZH - ALTITUDE OF INTEREST (KM)                         SPCMIN
C         ATMOUP COMMON                                                 SPCMIN
C             IDORN - INDEX FOR DAY OR NIGHT                            SPCMIN
C                     = +1, DAY                                         SPCMIN
C                     = -1, NIGHT                                       SPCMIN
C            SNI(I) - SPECIES DENSITIES FROM SUBROUTINE ATMOSU          SPCMIN
C                     ATMOSPHERIC MODEL.                                SPCMIN
C                     I = 1,6 FOR N2, O2, O, AR, HE, CO2                SPCMIN
C         TIME COMMON                                                   SPCMIN
C              PLAT - NORTH LATITUDE OF POINT (RADIANS)                 SPCMIN
C         ZHCHEK COMMON                                                 SPCMIN
C           ZHFLAG, - FLAGS USED TO DETECT AND CORRECT AN ERRONEOUS     SPCMIN
C           SPIFLG    SEQUENCE OF CALLS TO SUBROUTINES ATMOSU, SPCMIN,  SPCMIN
C                     AND IONOSU IN THE OPERATIONAL PHASE.  APPROPRIATE SPCMIN
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C                   EXCEPTIONS ARE ALLOWED IN THE INITIALIZATION
C                   PHASE.
C     OUTPUT PARAMETERS
C        ATMOUP COMMON
C          SNI( 7) - N       DENSITY, 1/CM**3
C          SNI( 8) - NO      DENSITY, 1/CM**3
C          SNI(13) - O2(SDG) DENSITY, 1/CM**3
C          SNI(14) - O3      DENSITY, 1/CM**3
C          SNI(15) - NO2     DENSITY, 1/CM**3
C          SNI(16) - H2O     DENSITY, 1/CM**3
C          SNI(17) - H       DENSITY, 1/CM**3
C          SNI(18) - OH      DENSITY, 1/CM**3
C          SNI(19) - HO2     DENSITY, 1/CM**3
C          SNI(20) - CO      DENSITY, 1/CM**3
C          SNI(21) - N2O     DENSITY, 1/CM**3
C          SNI(22) - CH4     DENSITY, 1/CM**3
C          SNI(23) - N(4S)   DENSITY, 1/CM**3
C          SNI(24) - N(2D)   DENSITY, 1/CM**3
C          SNI(25) - RELATIVE HUMIDITY, PERCENT
C          SNI(26) - O(1D)   DENSITY, 1/CM**3
C          SNI(27) - N(2P)   DENSITY, 1/CM**3
C        ALTOON COMMON
C        ALTKM(47) - THE ALTITUDES AT WHICH MINOR SPECIES ARE
C                    SPECIFIED AS DATA
C        ONITE(18) - THE NIGHTTIME O-VALUES SPECIFIED AS DATA
C          CO2(25) - THE CO2-VALUES SPECIFIED AS DATA
C        ZNCHEK COMMON
C          SPIFLG
CCC
      DIMENSION  AA(13),BB( 7),CC( 6),ANONIT(21),AN4SDN(33),AN2DDN(41)
      DIMENSION  O2SDGD(47),O2SDGN(47),O3DAY(26),O3NIT(27),DD(11)
      DIMENSION  Y(6),Z(6),TO3(6),UO3(6),VO3(6),WO3(6)
      DIMENSION  H2ODN(21),ANODAY(21),GG(13),FF(12),EE(14)
      DIMENSION  DOHDAY(21),DOHNIT(21),HO2DAY(21),HO2NIT(21),CCON(8),
     *           CHO2(8),DATCO(31),SMETH(25)
      DIMENSION  DAHDAY(21),DAHNIT(21),O1DDAY(33),DN2O(12),CN2O(9)
      DIMENSION  A(20,21)
      DIMENSION  SNO2D(33),SNO2N(33),HH(13)
      COMMON/ALTOON/  ALTKM(47),ONITE(18),CO2(25),S3200
      COMMON/ATMOUP/ HL,SBAR,IOORN,PP,RHO,TT,SNI(33),HRHO,FENSEQ
      COMMON/TIME/ IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,GAT,FYR,FST,RHOSKM
     *       ,CHI
      COMMON/VPC/  WVFLAG,METHOD,H2O120
      COMMON/ZNCHEK/  ZNFLAG,SPIFLG
CCC
      DATA  NDEGNO / 12 /, NDEG2D,NDEG4S / 6,5 /
      DATA  NALTNO / 21 /, NALT2D,NALT4S / 16,13 /
      DATA  NDGO2D,NALTO2 / 10,11 /
      DATA  NOGH2O,NKMH2O / 12,21 /, H2OPCC / 3.3426093E+16 /
      DATA  NDGMTH,NALTMH / 11,25 /, CH4PCC / 3.753690UE+16 /
      DATA  O23PCC / 1.2545327E+22 /, COMPCC / 2.1499203E+16 /
      DATA  PI / 3.141592653590 /
      DATA  NDGNO2,NKMNO2 / 12,33 /
      DATA  (ALTKM(I),I=1,47) /  0.,5.,10.,15.,20.,25.,30.,35.,40.,45.,
     *                   50.,55.,60.,65.,70.,75.,80.,85.,90.,95.,
     *  100.,105.,110.,115.,120.,125.,130.,135.,140.,145.,150.,155.,
     *  160.,165.,170.,175.,180.,185.,190.,195.,200.,205.,210.,215.,
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     * 220.,225.,230. /
C         BFM VALUES  02/22/75     FOR  O    NIGHT
      DATA  (ONITE(I),I=1,18) /  13*1.1, 2*0.0, 4.00E+08,
     *                           3.00E+10, 9.00E+10 /
C         BFM VALUES  12/07/74     FOR CO2
      DATA  (CO2(I),I=1,25) / 21*0.0, 1.30E+09,4.83E+08,1.70E+08,
     *                                 5.65E+07 /
C         THE CO2 VALUES AT ALTITUDES FROM 0.0 TO 100. KM ARE RESET
C         IN SUBROUTINE ATMOSU BY USING A CONSTANT MIXING-RATIO OF
C         3.20E-04
C         BFM VALUES  10/01/77     FOR  NO  DAY
      DATA  (ANODAY(I),I=1,21) / 1.30E+10,3.40E+09,1.30E+09,5.80E+08,
     *                           7.00E+08,1.75E+09,2.10E+09,1.75E+09,
     * 1.25E+09,8.50E+08,5.10E+08,3.00E+08,1.40E+08,6.40E+07,2.70E+07,
     * 1.30E+07,6.20E+06,4.30E+06,8.20E+06,1.90E+07,3.40E+07 /
C         BFM VALUES  10/01/77     FOR  NO  NIGHT
      DATA  (ANONIT(I),I=1,21) /  11*1.00E+00,1.00E+04,1.10E+05,
     *                            2.30E+05,4.80E+05,1.00E+06,2.00E+06,
     * 4.30E+06,8.20E+06,1.90E+07,3.40E+07 /
C         BFM VALUES  11/05/77     FOR  N     DAY AND NIGHT   N(TOTAL)
      DATA  (AN4SON(I),I=1,33) / 20*0.0,1.33E+06,2.90E+06,5.20E+06,
     *                         8.60E+06,1.26E+07,1.74E+07,2.26E+07,
     *      2.82E+07,3.14E+07,3.30E+07,3.35E+07,3.31E+07,3.20E+07 /
C         BFM VALUES  11/26/77     FOR  N     DAY AND NIGHT   N(2D)
      DATA  (AN2DDN(I),I=1,41) / 25*0.0,1.30E+04,3.00E+04,6.30E+04,
     *                         1.20E+05,2.00E+05,3.10E+05,4.60E+05,
     *      5.50E+05,6.00E+05,6.40E+05,6.50E+05,6.50E+05,6.40E+05,
     *      6.30E+05,6.10E+05,5.70E+05 /
C         BFM VALUES  01/04/75     FOR  O2(SDG)  DAY
      DATA  (O2SDGD(I),I=1,47) / 2.60E+06,4.40E+06,2.70E+07,1.25E+08,
     *                           4.90E+08,1.25E+09,2.70E+09,9.00E+09,
     * 1.80E+10,2.70E+10,3.50E+10,2.10E+10,1.50E+10,1.00E+10,6.10E+09,
     * 3.10E+09,2.05E+09,3.60E+09,1.30E+09,3.00E+08,5.60E+07,4.30E+06,
     * 6.20E+05,1.00E+05,1.40E+04,3.30E+03,7.10E+02,2.60E+02,1.00E+02,
     * 4.70E+01,2.30E+01,1.20E+01,15*6.10 /
C         BFM VALUES  01/04/75     FOR  O2(SDG)  NIGHT
      DATA  (O2SDGN(I),I=1,47) / 15*3.40,5.80E+02,1.00E+05,8.60E+07,
     *                           2.00E+08,1.40E+08,5.60E+07,4.30E+06,
     * 6.20E+05,1.00E+05,1.40E+04,3.30E+03,7.10E+02,2.60E+02,1.00E+02,
     * 4.70E+01,2.30E+01,1.20E+01,15*6.10 /
C         BFM VALUES  05/04/77     FOR O3  OZONE     DAY         (KG/KG)
      DATA  (O3DAY(I),I=1,26) / 11*0.0,3.1E-06,1.9E-06,1.0E-06,5.3E-07,
     *                         2.6E-07,2.9E-07,1.2E-06,7.0E-07,1.4E-07,
     * 3.6E-08,1.2E-08,3.0E-09,7.1E-10,1.5E-10,4.5E-11 /
C         BFM VALUES  05/04/77     FOR O3  OZONE     NIGHT       (KG/KG)
      DATA  (O3NIT(I),I=1,27) / 11*0.0,3.1E-06,3.3E-06,5.9E-06,4.3E-06,
     *                         1.5E-06,2.6E-07,5.6E-06,4.0E-06,1.5E-06,
     * 3.8E-07,9.9E-08,3.3E-08,6.5E-09,6.8E-10,1.5E-10,2.7E-11 /
C         BFM VALUES  05/04/77     FOR CO  CARBON MONOXIDE      (PPMM)
      DATA  (DATCO(I),I=1,31) / 0.12,0.12,0.11,0.072,0.054,0.048,0.048,
     *                          0.048,0.048,0.056,0.070,0.127,0.254,
     *  0.442,0.967,2.210,10.2,18.5,24.3,26.6,29.2,30.9,32.0,32.6,33.6,
     *  34.4,34.8,34.8,34.8,34.5,34.1 /
C         BFM VALUES  05/04/77     FOR CH4 METHANE              (PPMM)
      DATA  (SMETH(I),I=1,25) / 3*0.77,0.66,0.61,0.53,0.50,0.38,0.31,
     *                           0.24,0.11,4.76E-2,2.12E-2,1.34E-2,
     *       8.36E-3,4.80E-3,2.69E-3,1.84E-3,1.02E-3,8.77E-4,7.03E-4,
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     *      5.70E-4,4.40E-4,2.55E-4,1.06E-4 /
C          BFM VALUES  05/04/77    FOR H2O WATER              (PPMM)
      DATA  (H2ODN(I),I=1,21) / 2.20,2.39,2.50,2.67,2.74,2.71,2.60,
     * 2.36,2.10,1.80,1.51,1.25,0.98,0.76,0.46,0.21,0.066,0.018,
     * 0.0075,0.0053,0.0040 /
C          BFM VALUES  07/02/77  FOR  H  ATOMIC HYDROGEN    DAY
      DATA  (DAHDAY(I),I=1,21) / 7.0E-03,7.6E-03,1.0E-02,1.6E-02,
     *                           5.2E-02,3.2E-01,2.9E+00,1.0E+02,
     *   4.0E+04,1.0E+05,2.4E+05,5.1E+05,1.0E+06,1.8E+06,4.9E+06,
     *  1.25E+07,3.5E+07,8.6E+07,7.4E+07,5.0E+07,3.0E+07 /
C          BFM VALUES  07/02/77  FOR  H  ATOMIC HYDROGEN  NIGHT
      DATA  (DAHNIT(I),I=1,21) / 15*0.0,5.0E+02,1.0E+07,8.6E+07,
     *                           7.4E+07,5.0E+07,3.0E+07 /
C          BFM VALUES (05/02/77) FOR HYDROXYL RADICAL  OH    DAY
      DATA  (DOHDAY(I),I=1,21) / 1.0E+06,1.0E+06,1.05E+06,1.15E+06,
     *                           1.5E+06,2.3E+06,4.0E+06,6.8E+06,
     *  1.05E+07,1.1E+07,9.5E+06,7.2E+06,5.3E+06,3.7E+06,2.5E+06,
     *   1.6E+06,7.0E+05,7.0E+04,6.3E+03,5.7E+02,6.7E+01 /
C          BFM VALUES (05/02/77) FOR HYDROXYL RADICAL  OH  NIGHT
      DATA  (DOHNIT(I),I=1,21) / 1.7E+02,1.8E+02,2.1E+02,2.7E+02,
     *                           4.2E+02,8.1E+02,2.0E+03,8.0E+03,
     *   5.7E+04,2.9E+05,1.2E+06,4.4E+06,6.5E+06,5.9E+06,4.5E+06,
     *   3.2E+06,1.6E+06,1.7E+05,1.7E+04,1.7E+03,2.2E+02 /
C          BFM VALUES (05/02/77) FOR HYDROPEROXYL RADICAL  HO2   DAY
      DATA  (HO2DAY(I),I=1,21) / 1.0E+05,7.5E+05,2.4E+06,6.9E+06,
     *                           1.15E+07,1.5E+07,1.6E+07,1.5E+07,
     *   1.2E+07,9.1E+06,6.6E+06,4.2E+06,2.2E+06,7.9E+05,4.2E+06,
     *   1.2E+07,9.2E+06,5.7E+04,5.7E+03,4.9E+02,7.4E+01 /
C          BFM VALUES (05/02/77) FOR HYDROPEROXYL RADICAL  HO2  NIGHT
      DATA  (HO2NIT(I),I=1,21) / 4.9E+01,4.2E+02,1.6E+03,5.9E+03,
     *                           1.4E+04,2.7E+04,4.7E+04,8.3E+04,
     *   1.3E+05,2.4E+05,4.6E+05,6.9E+05,7.3E+05,4.6E+05,3.5E+06,
     *   1.2E+07,9.2E+06,5.7E+04,5.7E+03,4.9E+02,7.4E+01 /
C          BFM VALUES  07/02/77  FOR  O(1D)  ATOMIC OXYGEN.
      DATA  (O1DDAY(I),I=1,33) / 3*1.0E-02,3.8E-01,2.4E+00,1.1E+01,
     *                           3.9E+01,1.4E+02,3.5E+02,6.0E+02,
     *   6.0E+02,5.0E+02,4.2E+02,2.7E+02,4.6E+01,1.7E+01,1.0E+01,
     *   5.2E+01,5.8E+01,2.2E+02,8.0E+02,2.0E+03,3.9E+03,5.2E+03,
     *   6.4E+03,6.4E+03,6.1E+03,5.8E+03,5.5E+03,5.5E+03,5.3E+03,
     *   5.2E+03,5.0E+03 /
C          BFM VALUES  07/30/77  FOR  N2O    (PPBV)
      DATA  (DN2O(I),I=1,12) / 310.,260.,280.,290.,210.,120.,60.,25.,
     *                         9.4,2.9,0.78,0.13 /
C          BFM VALUES  02/14/75    FOR  NO2  DAY
      DATA  (SNO2D(I),I=1,33) /  2.50E+10,8.30E+09,1.40E+09,1.40E+09,
     *                           1.40E+09,2.40E+09,2.50E+09,1.25E+09,
     * 3.40E+08,7.10E+07,7.80E+06,2.30E+06,7.00E+05,2.60E+05,1.00E+05,
     * 5.00E+04,2.40E+04,1.20E+04,6.40E+03,3.40E+03,1.80E+03,1.10E+03,
     * 6.70E+02,4.30E+02,2.30E+02,1.90E+02,1.40E+02,1.15E+02,9.50E+01,
     * 8.00E+01,7.00E+01,6.00E+01,4.60E+01 /
C          BFM VALUES  02/14/75    FOR  NO2  NIGHT
      DATA  (SNO2N(I),I=1,33) /  3.50E+10,1.20E+10,2.70E+09,2.00E+09,
     *                           2.50E+09,4.15E+09,4.55E+09,3.00E+09,
     * 1.60E+09,9.20E+08,5.20E+08,3.00E+08,1.40E+09,5.50E+07,1.20E+07,
     * 1.00E+06,3.00E+04,1.20E+04,6.40E+03,3.40E+03,1.80E+03,1.10E+03,
     * 6.70E+02,4.30E+02,2.30E+02,1.90E+02,1.40E+02,1.15E+02,9.50E+01,
     * 8.00E+01,7.00E+01,5.00E+01,4.60E+01 /
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CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE NITRIC OXIDE IN
C * * * DAYTIME FOR ALTITUDES BELOW 100.0 KM
CCC
      ANODAF( BQ ) = EXP((((((((((((( AA(13)*BQ + AA(12))*BQ + AA(11))*BQ
     *               + AA(10))*BQ + AA(9))*BQ + AA(8))*BQ + AA(7))*BQ
     *               + AA(6))*BQ + AA(5))*BQ + AA(4))*BQ + AA(3))*BQ
     *               + AA(2))*BQ + AA(1))
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE ATOMIC NITROGEN
C * * * ( N(TOTAL) ) BETWEEN 100.0 AND 160.0 KM FOR BOTH DAY AND NIGHT.
CCC
      ANN4S( BQ ) = EXP(((((CC(6)*BQ + CC(5))*BQ + CC(4))*BQ
     *              + CC(3))*BQ + CC(2))*BQ + CC(1))
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE ATOMIC NITROGEN
C * * * ( N(2D) ) BETWEEN 125. AND 200. KM FOR BOTH DAY AND NIGHT.
CCC
      ANN2D( BQ ) = EXP((((((BB(7)*BQ + BB(6))*BQ + BB(5))*BQ
     *              + BB(4))*BQ + BB(3))*BQ + BB(2))*BQ + BB(1))
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE O2(1 DELTA)
C * * * IN DAYTIME FOR ALTITUDES BELOW 50.  KM.
CCC
      AO2SDF( BQ ) = EXP((((((((((( DD(11)*BQ + DD(10))*BQ + DD(9))*BQ
     *               + DD(8))*BQ + DD(7))*BQ + DD(6))*BQ + DD(5))*BQ
     *               + DD(4))*BQ + DD(3))*BQ + DD(2))*BQ + DD(1))
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE CO FOR
C * * * ALTITUDES BELOW 150 KM.
CCC
      AFCOAF( BQ ) = EXP(((((((((((((( EE(14)*BQ + EE(13))*BQ
     *               + EE(12))*BQ + EE(11))*BQ + EE(10))*BQ + EE(9))*BQ
     *               + EE(8))*BQ + EE(7))*BQ + EE(6))*BQ + EE(5))*BQ
     *               + EE(4))*BQ + EE(3))*BQ + EE(2))*BQ + EE(1))
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE METHANE FOR
C * * * ALTITUDES FROM 10. KM TO 120. KM.
CCC
      ACH4FF( BQ ) = EXP(((((((((((FF(12)*BQ + FF(11))*BQ + FF(10))*BQ
     *               + FF(9))*BQ + FF(8))*BQ + FF(7))*BQ + FF(6))*BQ
     *               + FF(5))*BQ + FF(4))*BQ + FF(3))*BQ + FF(2))*BQ
     *               + FF(1))
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE WATER FOR
C * * * 45.0 .LE. ALTITUDES (KM) .LE. 120.0 KM.
CCC
      AH2OFF( BQ ) = EXP(((((((((((( GG(13)*BQ + GG(12))*BQ + GG(11))*BQ
     *               + GG(10))*BQ + GG(9))*BQ + GG(8))*BQ + GG(7))*BQ
     *               + GG(6))*BQ + GG(5))*BQ + GG(4))*BQ + GG(3))*BQ
     *               + GG(2))*BQ + GG(1))
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE NO2 FOR
C * * * DAYTIME AT ALTITUDES BELOW 160. KM.
CCC
      ANO2FF( BQ ) = EXP((((((((((((( HH(13)*BQ + HH(12))*BQ + HH(11))*BQ
     *               + HH(10))*BQ + HH(9))*BQ + HH(8))*BQ + HH(7))*BQ
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     *              + HH(6))*BQ + HH(5))*BQ + HH(4))*BQ + HH(3))*BQ
     *              + HH(2))*BQ + HH(1))
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE OH FOR
C * * * DAYTIME OR NIGHTTIME FOR ALTITUDES BELOW 80. KM.
CCC
      ANOHDNF( BQ ) = EXP(((((((CCOH(8)*BQ + CCOH(7))*BQ + CCOH(6))*BQ
     *              + CCOH(5))*BQ + CCOH(4))*BQ + CCOH(3))*BQ
     *              + CCOH(2))*BQ + CCOH(1))
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE HO2 FOR
C * * * DAYTIME OR NIGHTTIME FOR ALTITUDES BELOW 65. KM.
CCC
      ANHO2FF( BQ ) = EXP(((((((CHO2(8)*BQ + CHO2(7))*BQ + CHO2(6))*BQ
     *              + CHO2(5))*BQ + CHO2(4))*BQ + CHO2(3))*BQ
     *              + CHO2(2))*BQ + CHO2(1))
CCC
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE N2O AT
C * * * ALTITUDES BELOW 55. KM.
CCC
      ANN2OFF( BQ ) = EXP((((((((CN2O(9)*BQ + CN2O(8))*BQ + CN2O(7))*BQ
     *              + CN2O(6))*BQ + CN2O(5))*BQ + CN2O(4))*BQ
     *              + CN2O(3))*BQ + CN2O(2))*BQ + CN2O(1))
CCC
      GO TO (100,200), KK
C       INITIALIZATION, CALLED FROM SUBROUTINE ATMOSU DURING ITS
C       INITIALIZATION.
  100 CONTINUE
      ALOGTE = ALOG10( EXP(1.0) )
      PIPLAT = 180./PI*ABS( PLAT )
C
C          ATOMIC NITROGEN PROFILE PARAMETERS.
C * * * TOTAL ATOMIC NITROGEN, BUT CALLED N(4S) IN CODING * * * * * * N
      H4S100 = ALTKM(21)
      H4S160 = ALTKM(33)
      CALL FITTER(NALT4S,ALTKM(21),ANN4SDN(21),NDEG4S, 1 , 2 ,CC)
      A4S100 = ANN4S( H4S100 )
      A4S160 = ANN4S( H4S160 )
      T3N4S = 0.693*SIN( (2.*FYR-0.50)*PI )
      TSN4S = SIN( (15.*HL-141.)*PI/180. )
      T24EXP = 1.0 + EXP(0.07*(PIPLAT-24.))
      T2N4S = SQRT( 0.60 + (0.56 + 0.44*TSN4S)*2.87/T24EXP )
      T75EXP = 1.0 + EXP(0.146*(PIPLAT-75.))
      T4N4S = 1.42*TSN4S/T75EXP
      T5N4S = 1.0 + 3.0/( 1.0 + EXP(-0.10*(SBAR-132.)) )
C
C * * * ATOMIC NITROGEN N(2D) * * * * * * * * * * * * * * * * * * * N(2D)
      H2D125 = ALTKM(26)
      H2D200 = ALTKM(41)
      CALL FITTER(NALT2D,ALTKM(26),ANN2DN(26),NDEG2D, 1 , 2 ,BB)
      A2D125 = ANN2D( H2D125 )
      A2D200 = ANN2D( H2D200 )
      TBN2DZ = (1.0+EXP(-2.197*(HL-6.)))*(1.0+EXP(+2.197*(HL-18.)))
      TBN2DZ = 1.0 / TBN2DZ
  115 CONTINUE
C
C * * * NITRIC OXIDE PROFILE PARAMETERS  * * * * * * * * * * * * * * * NO
```

```
C       FOR DAYTIME NO..
      CALL FITTER(NALTNO,ALTKM,ANODAY,NDEGNO, 1 , 2 , AA)
      HNO100 = ALTKM(21)
      ANO100 = ALOG( ANODAF( HNO100 ) )
      CNO100 = 1.0/(1.0+EXP(-0.22*(HNO100-72.)))
      ALOGGL = ALOG( 0.375 + 0.0125*PIPLAT )
      ZNO100 = ANO100 - (1.0-CNO100)*ALOGGL
      PNOSIN = SIN( PI*(15.*HL-105.)/180. )
C       SET THE CUBE OF THE 10.7-CM SOLAR FLUX SBAR, SBAR3.
      SBAR3 = SBAR**3
      A215F = 9.68 + 6.08*SBAR3/(SBAR3+5.0E+05)
      A215FL = (A215F-CNO100)/115.
      HNO050 = ALTKM(11)
      HNO055 = ALTKM(12)
      HNO060 = ALTKM(13)
      HNO085 = ALTKM(18)
      ANO050 = ANONIT(11)
      ANO055 = ANONIT(12)
      ANO060 = ANONIT(13)
      ANO085 = ANODAF( HNO085 )
      SNO685 = 25.0/ALOG( ANO085/ANO060 )
      SNO055 = 5.0/ALOG( ANO060/ANO055 )
      SNO060 = 2.*(SNO055 - 5.0/ALOG( ANO060/ANO050 ))
C
C * * * MOLECULAR OXYGEN (SINGLET DELTA G) PROFILE PARAMETERS * O2(SDG)
      ZO2090 = ALTKM(19)
      ZO2100 = ALTKM(21)
      AO2090 = O2SDGD(19)
      BO2090 = -ALOG( O2SDGD(22)/AO2090 )/(ALTKM(22)-ZO2090)
      IF( IDORN )  142,150,150
  142 ZO2070 = ALTKM(15)
      ZO2080 = ALTKM(17)
      AO2070 = O2SDGN(15)
      AO2080 = O2SDGN(17)
      BO2070 = -ALOG( AO2080/AO2070 )/(ZO2080-ZO2070)
      Z(6) = ALOG10( AO2080 )
      DO 144 I=1,4
      ZI12 = ALTKM(I+17)-ZO2080
      A(I,5) = ZI12
      DO 144 J=1,4
      A(I,5-J) = ZI12*A(I,6-J)
  144 CONTINUE
      ZI18 = ZO2100-ZO2080
      A(5,5) = 1.0
      A(5,5) = -BO2090*ALOGTE
      DO 146 J=1,4
      FJ = J
      A(5,5-J) = ZI18*((FJ+1.)/FJ)*A(5,6-J)
  146 CONTINUE
      DO 148 I=1,3
      A(I,5) = ALOG10( O2SDGN(I+17) ) - Z(6)
  148 CONTINUE
      A(4,6) = ALOG10( AO2090*EXP(-BO2090*(ZO2100-ZO2090)) ) - Z(6)
      NO = 5
      CALL SOLVE(A,Z,NO)
      GO TO 156
  150 ZO2050 = ALTKM(11)
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```
      ZO2075 = ALTKM(16)
      AO2050 = O2SOGD(11)
      AO2075 = O2SOGD(16)
      BO2050 = -ALOG( AO2075/AO2050 )/(ZO2075-ZO2050)
      CALL FITTER(NALTO2,ALTKM,O2SOGD,NDGO2D, 1 , 2 ,DD)
      Y(6) = ALOG10( AO2075 )
      Y(5) = -BO2050*ALOGTE
      DO 152 I=1,3
      ZI12 = ALTKM(I+16)-ZO2075
      A(I,4) = ZI12*ZI12
      A(I,5) = ALOG10( O2SOGD(I+16) ) - ZI12*Y(5) - Y(6)
      DO 152 J=1,3
      A(I,4-J) = ZI12*A(I,5-J)
  152 CONTINUE
      ZI18 = ZO2090-ZO2075
      A(4,4) = 2.*ZI18
      A(4,5) = -BO2090*ALOGTE - Y(5)
      DO 154 J=1,3
      FJ = J+1
      A(4,4-J) = ZI18*((FJ+1.)/FJ)*A(4,5-J)
  154 CONTINUE
      ND = 4
      CALL SOLVE(A,Y,ND)
  156 CONTINUE
C
C * * * CO (CARBON MONOXIDE) PARAMETERS * * * * * * * * * * * * * * * CO
      CALL FITTER(31,ALTKM,DATCO,13, 1 , 2 ,EE)
      COZ150 = AFCOAF( 150. )
C
C * * * CH4 (METHANE) PARAMETERS * * * * * * * * * * * * * * * * * * CH4
      NMTH = NALTMH-2
      CALL FITTER(NMTH,ALTKM(3),SMETH(3),NDGMTH, 1 , 2 ,FF)
      CH4TEN = ACH4FF( 10. )
      CH4120 = ACH4FF( 120. )
C
C * * * O3 (OZONE) PARAMETERS * * * * * * * * * * * * * * * * * * * * O3
C           FOR DAY OR NIGHT, INITIALIZE SUBROUTINE OZONE FOR ZH .LT. 55.0
      CALL OZONE(1,ZH,OZ3)
      IF( IO3NN )  162,172,172
C           START NIGHTTIME INITIALIZATION FOR ZH .GE. 55.0 KM.
  162 ZO3N55 = ALTKM(12)
      ZO3D55 = ZO3N55
C           DETERMINE PARAMETERS FOR NIGHT EXPONENTIAL FOR
C           70.0 .LT. ZH .LE. 75.0 KM.
      ZO3N70 = ALTKM(15)
      ZO3N75 = ALTKM(16)
      AO3N70 = O3NIT(15)
      BO3N70 = -ALOG( O3NIT(16)/AO3N70 )/(ZO3N75-ZO3N70)
C           DETERMINE COEFFICIENTS (YO3(I) I=1,6) SO THAT 5TH-DEGREE
C           POLYNOMIAL EQUALS DATA POINTS AT 55(5)70 KM, THE (ZERO)
C           DERIVATIVE AT 55 KM OF THE FIT FUNCTION BELOW 55 KM, AND THE
C           (NONVANISHING) DERIVATIVE AT 70 KM OF THE 70- TO 75-KM FIT
C           FUNCTION.
      YO3(6) = ALOG10(O3NIT(12))
      YO3(5) = 0.0
      DO 164 I=1,3
      ZI12 = ALTKM(I+12) - ZO3N55
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      A(I,4) = ZII2*ZII2
      A(I,5) = ALOG10( O3NIT(I+12) ) - ZII2*VO3(5) - VO3(6)
      DO 164 J=1,3
      A(I,4-J) = ZII2*A(I,5-J)
  164 CONTINUE
      ZII8 = ZO3N70-ZO3N55
      A(4,4) = 2.*ZII8
      A(4,5) = -BO3N70*ALOGTE - VO3(5)
      DO 166 J=1,3
      FJ = J+1
      A(4,4-J) = ZII8*((FJ+1.)/FJ)*A(4,5-J)
  166 CONTINUE
      NO = 4
      CALL SOLVE(A,VO3,NO)
C         DETERMINE PARAMETERS FOR NIGHT EXPONENTIAL FOR ZH .GE. 90.0 KM
      ZO3N90 = ALTKM(19)
      AO3N90 = O3NIT(19)
      BO3N90 = -ALOG( O3NIT(22)/AO3N90 )/(ALTKM(22)-ZO3N90)
C         DETERMINE 5TH-DEGREE POLYNOMIAL (COEFFICIENTS WO3(I) I=1,6) TO
C         MATCH DATA POINTS AT 75(5)90 KM AND DERIVATIVES OF 70-TO-75-KM
C         FIT-FUNCTION AT 75 KM AND .GE.-90.0-KM FIT FUNCTION AT 90.0 KM
      WO3(6) = ALOG10( O3NIT(16) )
      WO3(5) = -BO3N70*ALOGTE
      DO 168 I=1,3
      ZII2 = ALTKM(I+16) - ZO3N75
      A(I,4) = ZII2*ZII2
      A(I,5) = ALOG10( O3NIT(I+16) ) - ZII2*WO3(5) - WO3(6)
      DO 168 J=1,3
      A(I,4-J) = ZII2*A(I,5-J)
  168 CONTINUE
      ZII8 = ZO3N90-ZO3N75
      A(4,4) = 2.*ZII8
      A(4,5) = -BO3N90*ALOGTE - WO3(5)
      DO 170 J=1,3
      FJ = J+1
      A(4,4-J) = ZII8*((FJ+1.)/FJ)*A(4,5-J)
  170 CONTINUE
      NO = 4
      CALL SOLVE(A,WO3,NO)
      GO TO 178
C         START DAYTIME INITIALIZATION.
C         DETERMINE PARAMETERS FOR DAY EXPONENTIAL FOR ZH .GE. 90.0 KM.
  172 ZO3D90 = ALTKM(19)
      AO3D90 = O3DAY(19)
      BO3D90 = -ALOG( O3DAY(22)/AO3D90 )/(ALTKM(22)-ZO3D90)
C         DETERMINE 5TH-DEGREE POLYNOMIAL (COEFFICIENTS TO3(I) I=1,6) TO
C         MATCH DATA POINTS AT 55(5)75 KM AND THE (ZERO) DERIVATIVE OF
C         THE 0-TO-55-KM FIT FUNCTION AT 55 KM.
      ZO3D55 = ALTKM(12)
      ZO3N55 = ZO3D55
      ZO3D75 = ALTKM(16)
      TO3(6) = ALOG10(O3DAY(12))
      TO3(5) = 0.0
      DO 180 I=1,4
      ZII2 = ALTKM(I+12) - ZO3D55
      A(I,4) = ZII2*ZII2
      A(I,5) = ALOG10(O3DAY(I+12)) - ZII2*TO3(5) - TO3(6)
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      DO 180 J=1,3
      A(I,4-J) = Z112*A(I,5-J)
  180 CONTINUE
      ND = 4
      CALL SOLVE(A,TO3,ND)
C        DETERMINE 5TH-DEGREE POLYNOMIAL (COEFFICIENTS UO3(I) I=1,6) TO
C        DATA POINTS AT 75(5)90 KM AND DERIVATIVES OF 55-TO-75-KM FIT-
C        FUNCTION AT 75 KM AND .GE.-90.0-KM FIT-FUNCTION AT 90.0 KM.
      UO3(6) = ALOG10( O3DAY(16) )
      Z118 = ZO3075-ZO3055
      UO3(5) = (((5.*TO3(1)*Z118 + 4.*TO3(2))*Z118 + 3.*TO3(3))*Z118
     *         + 2.*TO3(4))*Z118 + TO3(5)
      DO 174 I=1,3
      Z112 = ALTKM(I+16) - ZO3D75
      A(I,4) = Z112*Z112
      A(I,5) = ALOG10( O3DAY(I+16) ) - Z112*UO3(5) - UO3(6)
      DO 174 J=1,3
      A(I,4-J) = Z112*A(I,5-J)
  174 CONTINUE
      Z118 = ZO3D90-ZO3D75
      A(4,4) = 2.*Z118
      A(4,5) = -BO3090*ALOGTE - UO3(5)
      DO 176 J=1,3
      FJ = J+1
      A(4,4-J) = Z118*((FJ+1.)/FJ)*A(4,5-J)
  176 CONTINUE
      ND = 4
      CALL SOLVE(A,UO3,ND)
  178 CONTINUE
C
C * * * FIT COEFFICIENTS FOR NO2 (DAY AND NIGHT)  * * * * * * * * * NO2
      CALL FITTER(NKMNO2,ALTKM,SNO2D,NOGNO2, 1 , 2 ,HH)
      HNO21D = ALTKM(29)
      HNO22D = ALTKM(33)
      ANO2FD = ANO2FF( HNO22D )
      HNO2DD = HNO21D-HNO22D
      RNO212 = ANO2FF( HNO21D ) / ANO2FD
      FNO255 = ANO2FF( 55. ) + ANODAF( 55. ) - ANO255
      ANO265 = SNO2N(14)
      HNO255 = ALTKM(12)
      HNO265 = ALTKM(14)
      HNO2DN = HNO255-HNO265
      RNO2FA = FNO255/ANO265
      ANO282 = ANO2FF( 82. )
      HNO282 = 82.
      HNO2DB = HNO265-HNO282
      RNO282 = ANO265/ANO282
C
C * * * FIT COEFFICIENTS FOR WATER  * * * * * * * * * * * * * * * * * * H2O
C        IF WVFLAG .NE. 0.0, USER MUST SUPPLY TABULAR WATER-VAPOR
C        PROFILE (FROM 0.0- TO 120.0-KM ALTITUDE) WHICH IS READ BY
C        SUBROUTINE WVOPT.  IN OPERATIONAL PHASE, SUBROUTINE WVOPT
C        PERFORMS A LOGARITHMIC INTERPOLATION TO RETURN THE H2O MASS-
C        MIXING RATIO.
      IF( WVFLAG.NE.0.0 )  GO TO 179
C        THIS INITIALIZATION CALL TO SUBROUTINE WATER EVALUATES THE
C        INDEX IX FOR THE QUASI-HOMOGENEOUS MOISTURE REGION AND
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C         EVALUATES THE LOGARITHM OF THE H2O MIXING RATIO AT 5- AND 14-
C         KM ALTITUDES.  THIS INITIALIZATION ALLOWS SUBROUTINE WATER IN
C         THE OPERATIONAL PHASE TO OUTPUT THE H2O MIXING RATIO (PPMM)
C         FOR ZH.LT.45 KM.
      CALL WATER(1,ZH,CH2O)
C         NOW DETERMINE THE H2O MASS-MIXING-RATIO FIT-COEFFICIENTS GG
C         FOR THE ALTITUDE RANGE FROM 20 TO 120 KM, EVEN THOUGH THE FIT
C         FUNCTION WILL BE USED IN THE OPERATIONAL PHASE ONLY FOR
C         45.LE.ZH.LT.120 KM.
      CALL FITTER(NKMH2O,ALTKM(5),H2ODM(1),NDGH2O, 1 , 2 ,GG)
C         THE VALUE OF THE MASS-MIXING RATIO AT 120 KM IS NEEDED FOR THE
C         OPERATIONAL PHASE.
      H2O120 = AH2OFF( 120. )
  179 CONTINUE
C
C * * * FIT COEFFICIENTS FOR ATOMIC HYDROGEN  * * * * * * * * * * * * * H
      H86 = 9.0E+07
      H100 = 3.77E+12*EXP(-0.1174*100.) + 4.07E+06*100.**(-0.7169)
      S86100 = 14./ALOG(H86/H100)
      IF( IDORN )  1071,1072,1072
 1071 S80 = 6.0/ALOG(H86/DAHNIT(17))
      S85 = 2.20*(S80 - 6.0/ALOG(H86/DAHNIT(16)))
      GO TO 1073
 1072 H30 = DAHDAY(7)
      H35 = DAHDAY(8)
      H40 = DAHDAY(9)
      S3035 = 5.0/ALOG(H35/H30)
      S3540 = 5.0/ALOG(H40/H35)
      S4086 = 46./ALOG(H86/H40)
 1073 CONTINUE
C
C * * * FIT COEFFICIENTS FOR HYDROXYL RADICAL  * * * * * * * * * * * * OH
      IF( IDORN )  181,182,182
  181 AOH100 = DOHNIT(21)
      CALL FITTER(17,ALTKM,DOHNIT, 7, 1, 2,CCOH)
      GO TO 184
  182 AOH100 = DOHDAY(21)
      CALL FITTER(17,ALTKM,DOHDAY, 7, 1, 2,CCOH)
  184 AOH080 = AOHDNF( 80. )
      BOH080 = -ALOG(AOH100/AOH080)/(ALTKM(21)-ALTKM(17))
C
C * * * FIT COEFFICIENTS FOR HYDROPEROXYL RADICAL * * * * * * * * * * HO2
      IF( IDORN )  186,188,188
  186 CONTINUE
      CALL FITTER(14,ALTKM,HO2NIT, 7, 1, 2,CHO2)
      GO TO 190
  188 CONTINUE
      CALL FITTER(14,ALTKM,HO2DAY, 6, 1, 2,CHO2)
      CHO2(8) = 0.0
  190 AHO275 = HO2DAY(16)
      AHO295 = HO2DAY(20)
      AHO265 = AHO2FF( 65. )
      BHO265 = -ALOG(AHO275/AHO265)/(ALTKM(16)-ALTKM(13))
      BHO275 = -ALOG(AHO295/AHO275)/(ALTKM(20)-ALTKM(16))
      HO2100 = AHO275*EXP( -BHO275*(100. - 75.) )
C
C * * * FIT COEFFICIENTS FOR ATOMIC OXYGEN  * * * * * * * * * * * * O(1D)
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      IF( IDORN )  1082,1081,1081
 1081 OD47 = 7.0E+02
      OD25 = OIDDAY(6)
      OD40 = OIDDAY(9)
      OD65 = OIDDAY(14)
      OD80 = OIDDAY(17)
      OD100 = OIDDAY(21)
      OD110 = OIDDAY(23)
      OD120 = OIDDAY(25)
      OD160 = OIDDAY(33)
      SOD40 = 7.0/ALOG(OD47/OD40)
      SOD47A = (22./15.)*(SOD40 - 7.0/ALOG(OD47/OD25))
      SOD65 = 18./ALOG(OD47/OD65)
      SOD47B = (33./15.)*(SOD65 - 18./ALOG(OD47/OD80))
      SNO100 = 20./ALOG(OD100/OD80)
      SOD110 = 10./ALOG(OD120/OD110)
      SOD120 = 2.0*(SOD110 - 10./ALOG(OD120/OD100))
      SIO120 = 40./ALOG(OD120/OD160)
 1082 CONTINUE
C
C * * * FIT COEFFICIENTS FOR NITROUS OXIDE  * * * * * * * * * * * * * N2O
      CALL FITTER(12,ALTKM,DN2O, 8 , 1 , 2 ,CN2O)
      CN2O55 = AN2OFF( 55. )
      BLEXP = 1.0/( 1.0 + EXP( 0.17*(PIPLAT - 23.) ) )
      RETURN
CC
CC
  200 CONTINUE
      IF( ZH.NE.ZHFLAG )  CALL ATMOSU(2,ZH)
CCC
C            AN ERRONEOUS CONDITION WILL OCCUR IF SPCMIN IS CALLED WITH
C            KK=2 AND A GIVEN VALUE OF ZH IF ATMOSU HAS NOT BEEN CALLED
C            FIRST WITH KK=2 AND FOR THE SAME VALUE OF ZH.
C            THE VARIABLE ZHFLAG IS USED TO DETECT THIS CONDITION AND
C            TO MAKE THE REQUIRED CALL TO ATMOSU.
C            ZHFLAG IS INITIALIZED TO AN ARBITRARY NEGATIVE VALUE IN
C            THE INITIALIZATION CALL TO ATMOSU.
CCC
      IF( ZH.EQ.SPIFLG )  RETURN
CCC
C            AN ERRONEOUS CONDITION WILL OCCUR IF IONOSU IS CALLED WITH
C            JJ=2 AND A GIVEN VALUE OF ZH IF SPCMIN HAS NOT BEEN CALLED
C            FIRST WITH JJ=2 AND FOR THE SAME VALUE OF ZH.
C            THE VARIABLE SPIFLG IS USED TO DETECT THIS CONDITION AND
C            TO MAKE THE REQUIRED CALL TO SPCMIN.
CCC
C            THE OPTIMUM ORDER IS ""CALL ATMOSU(2,ZH)"" THEN
C            ""CALL SPCMIN(2,ZH)"" AND THEN ""CALL IONOSU(2,ZH)"".
C            ZHFLAG AND SPIFLG WILL DETECT CALLS MADE IN ANY OTHER ORDER.
CCC
C            SPIFLG IS INITIALIZED TO AN ARBITRARY NEGATIVE VALUE IN
C            THE INITIALIZATION CALL TO ATMOSU.
CCC
      SPIFLG = ZH
C
C * * * * COMPUTE DENSITY OF N * * * * * * * * * * * * * * * * * SNI(7)=N
      IF( ZH.LT.H4S100 )  GO TO 210
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      IF( ZH.GT.H4S160 )  GO TO 212
      T1N4SZ = ANN4S( ZH )
      GO TO 214
  210 T1N4SZ = A4S100*EXP(0.144*(ZH-H4S100))
      GO TO 214
  212 T1N4SZ = A4S160*EXP(-0.0178*(ZH-H4S160))
  214 T4N4SZ = 1.0 + EXP(-0.02*(ZH-220.))
      SNI( 7) = T1N4SZ*T2N4S*EXP(T3N4S + T4N4S/T4N4SZ) * T5N4S
C
C * * * * * COMPUTE DENSITY OF EXCITED ATOMIC NITROGEN  * * SNI(24)=N(2D)
      IF( ZH.LT.H2D125 )  GO TO 216
      IF( ZH.GT.H2D200 )  GO TO 218
      T7N2DZ = ANN2D( ZH )
      GO TO 220
  216 T7N2DZ = A2D125*EXP(+0.184*(ZH-H2D125))
      GO TO 220
  218 T7N2DZ = A2D200*EXP(-0.0282*(ZH-H2D200))
  220 SNI(24) = (SNI(7)/T1N4SZ)*T7N2DZ*T8N2DZ
C
C * * * * * COMPUTE DENSITY OF EXCITED ATOMIC NITROGEN  * * SNI(27)=N(2P)
C          F2P2D=ASSIGNED VALUE OF THE RATIO OF THE PRODUCTION RATE OF
C                N(2P) TO THAT OF N(2D).
      F2P2D = 0.01
      R2P2D = 0.01
      IF( ZH.GE.119.90 )  R2P2D = 5.58-04*F2P2D*EXP(900./ZH)
      SNI(27) = R2P2D*SNI(24)
C
C * * * * * COMPUTE DENSITY OF GROUND-STATE ATOMIC NITROGEN SNI(23)=N(4S)
      SNI(23) = SNI(7) - SNI(24) - SNI(27)
C
C * * * * * COMPUTE DENSITY OF NO * * * * * * * * * * * * * * * * SNI(8)=NO
      IF( ZH.GT.HNO100 )  GO TO 227
      IF( IDORN.GE.0 )  GO TO 225
      IF( ZH.GE.HNO085 )  GO TO 225
CC          IF GET TO THIS POINT THEN ZH.LT.85. KM AND IT IS NIGHTTIME.
      IF( ZH.GE.HNO060 )  GO TO 223
      IF( ZH.GE.HNO050 )  GO TO 221
      SNI(8) = 1.0
      GO TO 229
  221 Z60MZH = HNO060-ZH
      SOFZNO = SNO060 - 0.20*(SNO060-SNO055)*Z60MZH
      CCOFZH = 1.0 + EXP(-0.22*(ZH-72.))
      SNI(8) = ANO060*EXP(ALOGGL/CCOFZH - Z60MZH/SOFZNO)
      SNI(8) = AMAX1( 1.0,SNI(8) )
      GO TO 229
  223 Z60MZH = HNO060-ZH
      CCOFZH = 1.0 + EXP(-0.22*(ZH-72.))
      SNI(8) = ANO060*EXP(ALOGGL/CCOFZH - Z60MZH/SNO085)
      GO TO 229
  225 SNI(8) = ANODAF( ZH )
      CCOFZH = 1.0 + EXP(-0.22*(ZH-72.))
      SNI(8) = SNI(8) * EXP(ALOGGL/CCOFZH)
      GO TO 229
  227 ZHM100 = ZH-HNO100
      SOFZNO = 1.1*(1.0-EXP(-0.066*ZHM100))
      AAZF = GNO100 + A215FL*ZHM100
      SNI(8) = EXP( AAZF + SOFZNO*TNOSIN + ALOGGL )
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  229 CONTINUE                                                          SPCMIN
C                                                                       SPCMIN
C * * * * COMPUTE DENSITY OF O2(1 DELTA G)  * * * * * * * SNI(13)=O2(SDG) SPCMIN
      IF( ZH.LT.ZO2100 )  GO TO 231                                     SPCMIN
  230 SNI(13) = AO2090*EXP(-BO2090*(ZH-ZO2090))                         SPCMIN
      GO TO 238                                                         SPCMIN
  231 IF( IDORN )  232,235,235                                          SPCMIN
C          NIGHTTIME O2(1 DELTA G)                                      SPCMIN
  232 IF( ZH.GT.ZO2070 )  GO TO 233                                     SPCMIN
      SNI(13) = AO2070                                                  SPCMIN
      GO TO 238                                                         SPCMIN
  233 IF( ZH.GT.ZO2080 )  GO TO 234                                     SPCMIN
      SNI(13) = AO2070*EXP(-BO2070*(ZH-ZO2070))                         SPCMIN
      GO TO 238                                                         SPCMIN
  234 ZHMKM = ZH-ZO2080                                                 SPCMIN
      SNI(13) = 10.**(((((Z(1)*ZHMKM + Z(2))*ZHMKM + Z(3))*ZHMKM        SPCMIN
     *                 + Z(4))*ZHMKM + Z(5))*ZHMKM + Z(6))              SPCMIN
      GO TO 238                                                         SPCMIN
C          DAYTIME O2(1 DELTA G)                                        SPCMIN
  235 IF( ZH.GE.ZO2090 )  GO TO 230                                     SPCMIN
      IF( ZH.GE.ZO2050 )  GO TO 236                                     SPCMIN
      SNI(13) = AO2SDF( ZH )                                            SPCMIN
      GO TO 238                                                         SPCMIN
  236 IF( ZH.GT.ZO2075 )  GO TO 237                                     SPCMIN
      SNI(13) = AO2050*EXP(-BO2050*(ZH-ZO2050))                         SPCMIN
      GO TO 238                                                         SPCMIN
  237 ZHMKM = ZH-ZO2075                                                 SPCMIN
      SNI(13) = 10.**(((((Y(1)*ZHMKM + Y(2))*ZHMKM + Y(3))*ZHMKM        SPCMIN
     *                 + Y(4))*ZHMKM + Y(5))*ZHMKM + Y(6))              SPCMIN
  238 CONTINUE                                                          SPCMIN
C                                                                       SPCMIN
C * * * * COMPUTE DENSITY OF CO  (CARBON MONOXIDE) * * * * * SNI(20)=CO SPCMIN
      IF( ZH.GE.150. )  GO TO 2001                                      SPCMIN
      SNI(20) = AFCOAF( ZH )                                            SPCMIN
      GO TO 2002                                                        SPCMIN
 2001 SNI(20) = COZ150*EXP(-0.0047*(ZH-150.))                           SPCMIN
 2002 SNI(20) = COMPCC*RHO*SNI(20)                                      SPCMIN
C                                                                       SPCMIN
C * * * * COMPUTE DENSITY OF CH4 (METHANE)  * * * * * * * * * SNI(22)=CH4 SPCMIN
C          CONVERT TO MOLECULES/CC                                      SPCMIN
C          CH4PCC = 1.0E-06 * 6.022045E+23 / 16.043                     SPCMIN
      IF( ZH.GE.120. )  GO TO 2382                                      SPCMIN
      IF( ZH.GT. 10. )  GO TO 2381                                      SPCMIN
      SNI(22) = CH4PCC*RHO*CH4TKM                                       SPCMIN
      GO TO 2383                                                        SPCMIN
 2381 SNI(22) = CH4PCC*RHO*ACH4FF( ZH )                                 SPCMIN
      GO TO 2383                                                        SPCMIN
 2382 SNI(22) = CH4PCC*RHO*CH4120*EXP(-0.176*(ZH-120.))                 SPCMIN
 2383 CONTINUE                                                          SPCMIN
C                                                                       SPCMIN
C * * * * COMPUTE DENSITY OF O3 (OZONE)  * * * * * * * * * * * SNI(14)=O3 SPCMIN
      IF( ZH.LT.ZO3055 )  GO TO 243                                     SPCMIN
      IF( IDORN )  239,244,244                                          SPCMIN
C          NIGHTTIME O3                                                 SPCMIN
  239 IF( ZH.GE.ZO3N70 )  GO TO 240                                     SPCMIN
C          NIGHT 5TH-DEGREE POLYNOMIAL, 55.0 .LE. ZH .LT. 70.0          SPCMIN
      ZHMKM = ZH-ZO3N55                                                 SPCMIN
```

```
      SNI(14) = 10.**(((((V03(1)*ZHMKM + V03(2))*ZHMKM + V03(3))*ZHMKM
     *                  + V03(4))*ZHMKM + V03(5))*ZHMKM + V03(6))
      GO TO 247
  240 IF( ZH.GT.Z03N75 )  GO TO 241
C         NIGHT EXPONENTIAL, 70.0 .LE. ZH .LE. 75.0
      SNI(14) = A03N70*EXP(-B03N70*(ZH-Z03N70))
      GO TO 247
  241 IF( ZH.GE.Z03N90 )  GO TO 242
C         NIGHT 5TH-DEGREE POLYNOMIAL, 75.0 .LT. ZH .LT. 90.0
      ZHMKM = ZH-Z03N75
      SNI(14) = 10.**(((((W03(1)*ZHMKM + W03(2))*ZHMKM + W03(3))*ZHMKM
     *                  + W03(4))*ZHMKM + W03(5))*ZHMKM + W03(6))
      GO TO 247
C         NIGHT EXPONENTIAL, ZH .GE. 90.0 KM.
  242 SNI(14) = A03N90*EXP(-B03N90*(ZH-Z03N90))
      GO TO 247
C         IF ZH.LT.55. KM,  BOTH DAY AND NIGHT USE FOLLOWING.
  243 CONTINUE
      CALL OZONE(2,ZH,OZ3)
      SNI(14) = OZ3
      GO TO 247
C         DAYTIME O3
  244 IF( ZH.GT.Z03D75 )  GO TO 245
      ZHMKM = ZH-Z03D55
      SNI(14) = 10.**(((((T03(1)*ZHMKM + T03(2))*ZHMKM + T03(3))*ZHMKM
     *                  + T03(4))*ZHMKM + T03(5))*ZHMKM + T03(6))
      GO TO 247
  245 IF( ZH.GE.Z03D90 )  GO TO 246
      ZHMKM = ZH-Z03D75
      SNI(14) = 10.**(((((U03(1)*ZHMKM + U03(2))*ZHMKM + U03(3))*ZHMKM
     *                  + U03(4))*ZHMKM + U03(5))*ZHMKM + U03(6))
      GO TO 247
C         DAY EXPONENTIAL, ZH .GE. 90.0 KM
  246 SNI(14) = A03D90*EXP(-B03D90*(ZH-Z03D90))
C         CONVERT FROM MASS-MIXING RATIO TO NUMBER DENSITY.
  247 SNI(14) = OZ3PCC*RHO*SNI(14)
C
C * * * * COMPUTE DENSITY OF NO2  * * * * * * * * * * * * * * SNI(15)=NO2
      IF( IDOWN )  248,252,252
C         NIGHTTIME NO2
  248 IF( ZH.GE.HNO255 )  GO TO 250
      SNI(15) = ANO2FF( ZH ) + ANODAF( ZH ) - SNI(8)
      GO TO 261
  250 IF( ZH.GT.HNO265 )  GO TO 251
      SNI(15) = ANO265 * RNO2FA**((ZH-HNO265)/HNO2JN)
      GO TO 261
  251 IF( ZH.GT.HNO282 )  GO TO 252
      SNI(15) = ANO282 * RNO282**((ZH-HNO282)/HNO2JN)
      GO TO 261
C         DAYTIME NO2
  252 IF( ZH.GT.HNO22D )  GO TO 253
      SNI(15) = ANO2FF( ZH )
      GO TO 261
  253 SNI(15) = ANO2FD * RNO212**((ZH-HNO22D)/HNO2JD)
  261 CONTINUE
C
C * * * * COMPUTE DENSITY OF H2O  * * * * * * * * * * * * * * SNI(16)=H2O
```

```
      IF( ZH.GE.120. )  GO TO 263
      IF( WVFLAG.EQ.0.0 )  GO TO 254
      CALL WVOPT(2,ZH,H2OMR)
      SMI(16) = H2OMR
      GO TO 264
  254 IF( ZH.GE. 45. )  GO TO 262
      CALL WATER(2,ZH,CH2O)
      SMI(16) = CH2O
      GO TO 264
  262 SMI(16) = AH2OFF( ZH )
      GO TO 264
  263 SMI(16) = H2O120*EXP(-0.0575*(ZH-120.))
C          CONVERT TO MOLECULES/CC
C          H2OPCC = 1.0E-06 * 6.022045E+23 / 18.016
  264 SMI(16) = H2OPCC*RHO*SMI(16)
C
C * * * * CALCULATE RELATIVE HUMIDITY * * * * SMI(25)=RELATIVE HUMIDITY
      EH2O = 0.0
      EICE = 0.0
      IF( ( TT .GE. 173.15 ) .AND. ( TT .LE. 373.15 ) )
     *CALL H2OSVP(TT,EH2O,EICE)
      SMI(25) = 0.0
      IF( EH2O.GT.0.0 )  SMI(25) = 1.380622E-17*TT/EH2O*SMI(16)
C
C * * * * COMPUTE DENSITY OF ATOMIC HYDROGEN H  * * * * * * * * SMI(17)=H
      IF( ZH.GT.86. )  GO TO 2266
      IF( IDURN )  2261,2263,2263
 2261 IF( ZH.GE.74. )  GO TO 2262
      SMI(17) = 1.0
      GO TO 2268
 2262 SOFZ = S86 - (S86-S80)*(86.-ZH)/6.
      SMI(17) = H86*EXP(-(86.-ZH)/SOFZ)
      SMI(17) = AMAX1( 1., SMI(17) )
      GO TO 2268
 2263 IF( ZH.GT.40. )  GO TO 2265
      IF( ZH.GT.35. )  GO TO 2264
      SMI(17) = H30*EXP((ZH-30.)/S3035)
      SMI(17) = AMAX1( 1.0,SMI(17) )
      GO TO 2268
 2264 SMI(17) = H35*EXP((ZH-35.)/S3540)
      GO TO 2268
 2265 SMI(17) = H40*EXP((ZH-40.)/S4086)
      GO TO 2268
 2266 IF( ZH.GT.100. )  GO TO 2267
      SMI(17) = H86*EXP(-(ZH-86.)/S86100)
      GO TO 2268
 2267 SMI(17) = 3.77E+12*EXP(-0.1174*ZH) + 4.07E+06*ZH**(-0.7169)
 2268 CONTINUE
C
C * * * * COMPUTE DENSITY OF HYDROXYL RADICAL OH * * * * * * SMI(18)=OH
      IF( ZH.GE.100. )  GO TO 265
      IF( ZH.GE. 80. )  GO TO 260
      SMI(18) = AOHOMF( ZH )
      GO TO 266
  260 SMI(18) = AOH080*EXP(-BOH080*(ZH-80.))
      GO TO 266
  265 SMI(18) = 10. + 2.*(AOH100-10.)/(1.0+EXP(0.46*(ZH-100.)))
```

```
  266 CONTINUE
C
C * * * * COMPUTE DENSITY HYDROPEROXYL RADICAL HO2  * * * * SNI(19)=HO2
      IF( ZH.GE.100. )  GO TO 269
      IF( ZH.GE. 75. )  GO TO 268
      IF( ZH.GE. 65. )  GO TO 267
      SNI(19) = AHO2FF( ZH )
      GO TO 270
  267 SNI(19) = AHO265*EXP(-BHO265*(ZH-65.))
      GO TO 270
  268 FZ75 = 1.0
      IF( ZH .LT. 85.0 )  FZ75 = 10.0**( 1.0 - 0.2*ABS(ZH-80.) )
      SNI(19) = FZ75*AHO275*EXP(-BHO275*(ZH-75.))
      GO TO 270
  269 SNI(19) = HO2100*EXP(-0.378*(ZH-100.))
  270 CONTINUE
C
C * * * * COMPUTE DENSITY OF ATOMIC OXYGEN  O(1D) * * * * SNI(26)=O(1D)
      IF( IDORN )  271,272,272
  271 SNI(26) = 1.0
      GO TO 279
  272 IF( ZH.GT.160. )  GO TO 278
      IF( ZH.GT.120. )  GO TO 277
      IF( ZH.GT.100. )  GO TO 276
      IF( ZH.GT. 80. )  GO TO 275
      IF( ZH.GT. 47. )  GO TO 274
      IF( ZH.GT. 20. )  GO TO 273
      SNI(26) = 1.0
      GO TO 279
  273 SOFZA = SOD47A - (SOD47A-SOD40)*(47.-ZH)/7.
      SNI(26) = OD47*EXP(-(47.-ZH)/SOFZA)
      SNI(26) = AMAX1( 1.0,SNI(26) )
      GO TO 279
  274 SOFZB = SOD47B - (SOD47B-SOD65)*(ZH-47.)/18.
      SNI(26) = OD47*EXP(-(ZH-47.)/SOFZB)
      GO TO 279
  275 SNI(26) = OD80*EXP((ZH-80.)/S80100)
      GO TO 279
  276 SOFZC = SOD120 - (SOD120-SOD110)*(120.-ZH)/10.
      SNI(26) = OD120*EXP(-(120.-ZH)/SOFZC)
      GO TO 279
  277 SNI(26) = OD120*EXP(-(ZH-120.)/S10120)
      GO TO 279
  278 SNI(26) = (OD160/S3ZOD)*SNI(3)
  279 CONTINUE
C
C * * * * COMPUTE DENSITY OF NITROUS OXIDE  N2O * * * * * * SNI(21)=N2O
      IF( ZH.GE.55. )  GO TO 280
      SNI(21) = AN2OFF( ZH )
      GO TO 281
  280 SNI(21) = CN2O55
  281 CSHARG = 0.26*(ZH-30.)
      COSHZ = (EXP(+CSHARG) + EXP(-CSHARG))/2.
      SUMSNI = SNI(1) + SNI(2) + SNI(3) + SNI(4) + SNI(5) + SNI(6)
      SNI(21) = 1.0E-09*SUMSNI*SNI(21)*( 1.0 + BLEXP*2.92/(1.0+COSHZ) )
  299 RETURN
      END
```

```
      SUBROUTINE TEMPZH
CCC
C         SUBROUTINE TEMPZH DETERMINES THE TEMPERATURE PROFILE
C         (TABULAR, 0(4)120 KM), BY INTERPOLATING THE DATA BASE
C         (US STD 1966) FOR LATITUDE AND SEASON, TO BE USED AS INPUT
C         TO THE MAJOR ATMOSPHERIC SPECIES MODEL FOR THE LOW-ALTITUDE
C         RANGE FROM 0- TO 120-KM ALTITUDE.
C         THE USER MAY BYPASS THE CODE'S SPECIFICATION OF TEMPERATURE
C         PROFILE IN THE LOW-ALTITUDE (0 TO 120-KM) REGION BY --
C         (1) REQUIRING THE DRIVING ROUTINE TO SET TPFLAG TO A NONZERO
C         VALUE, WHICH IS TRANSFERRED TO SUBROUTINE TEMPZH THROUGH
C         COMMON ZHTEMP, AND (2) ALLOWING SUBROUTINE TEMPZH TO READ THE
C         USER-SPECIFIED PROFILE AT ALTITUDES ZZ=0.0(4.0)120. KM .
CCC
CCC       THIS IS A NEW ROUTINE FOR ROSCOE-IR.
CCC
C         INPUT PARAMETERS
C            TIME COMMON
C               PLAT = NORTH LATITUDE OF POINT P (RADIANS)
C                FST = FRACTION OF SUMMER TEMPERATURE PROFILE TO BE
C                      USED, WITH (1.-FST) OF THE WINTER TEMPERATURE
C                      PROFILE, IN DETERMINING THE TEMPERATURE PROFILE
C                      FOR A GIVEN DAY OF THE YEAR AT A GIVEN LATITUDE.
C            ZHTEMP COMMON
C             TPFLAG = FLAG FOR OPTIONAL TREATMENT OF TEMPERATURE
C                      PROFILE.
C                      .EQ. 0.0  NORMAL TREATMENT
C                      .NE. 0.0  OPTIONAL TREATMENT, ALLOWING SUBROUTINE
C                      TEMPZH TO READ THE USER-SPECIFIED PROFILE AT
C                      ALTITUDES ZZ = 0.0(4.0)120. KM.
CCC
C         OUTPUT PARAMETERS
C            ZHTEMP COMMON
C               (TZH(I),I=1,31) = TEMPERATURE PROFILE, DETERMINED BY
C                                 INTERPOLATION OF THE DATA BASE
C                                 (US STD 1966) FOR LATITUDE AND SEASON,
C                                 USED AS INPUT TO THE MAJOR ATMOSPHERIC
C                                 SPECIES MODEL FOR THE LOW-ALTITUDE
C                                 RANGE FROM 0- TO 120-KM ALTITUDE.
CCC
      COMMON/TIME/ IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,GAT,FYR,FST,RHOSKM
     *            ,CHI
      COMMON/ZHTEMP/  NZHT,ZHTZ(3),ZHT(31),TZHZ(3),TZH(31),TPFLAG
      DIMENSION  ANNUAL(31),TMPJAN(31,4),TMPJUL(31,4)
C         ZHT(I) ARE THE (NZHT=31) ALTITUDES AT WHICH THE TEMPERATURE
C         PROFILES ARE DEFINED.
      DATA  (ZHT(I),I=1,31) / 0.0,4.0,8.0,12.,16.,20.,24.,28.,32.,36.,
     *                        40.,44.,48.,52.,56.,60.,64.,68.,72.,76.,
     *    80.,84.,88.,92.,96.,100.,104.,108.,112.,116.,120. /
C         ANNUAL(I), TEMPERATURES FOR 15-DEG N ANNUAL  PROFILE (US-66).
      DATA  (ANNUAL(I),I=1,31) / 302.59,277.44,250.37,223.64,197.02,
     *                           206.71,219.23,227.94,236.63,245.32,
     *      253.99,262.66,270.15,269.24,261.39,253.10,239.40,225.72,
     *      212.06,198.41,184.78,177.10,177.05,179.50,185.77,190.70,
     *      205.98,229.78,253.25,315.82,379.70 /
C         TMPJAN(I,1), TEMPERATURES FOR 30-DEG N JAN. PROFILE (US-66).
      DATA  (TMPJAN(I,1),I=1,31) / 288.52,268.44,242.32,216.40,205.91,
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```
     *                                  207.92,216.90,224.83,232.74,242.14,   TEMPZH
     * 251.62,261.08,269.15,268.14,260.28,252.04,239.90,227.77,215.66,   TEMPZH
     * 203.56,191.47,191.10,191.04,199.56,211.72,222.43,237.88,256.88,   TEMPZH
     * 275.76,304.46,333.30 /                                            TEMPZH
C        TMPJAN(I,2), TEMPERATURES FOR 45-DEG N JAN. PROFILE (US-66).    TEMPZH
      DATA  (TMPJAN(I,2),I=1,31) / 272.59,255.79,231.72,218.66,216.67,   TEMPZH
     *                                  215.15,215.15,215.85,219.02,230.92,   TEMPZH
     * 243.17,255.41,265.65,265.65,258.63,250.77,242.93,234.76,226.54,   TEMPZH
     * 218.34,210.14,201.89,199.54,201.02,210.50,218.58,232.65,250.58,   TEMPZH
     * 268.65,301.06,333.30 /                                            TEMPZH
C        TMPJAN(I,3), TEMPERATURES FOR 60-DEG N JAN. PROFILE (US-66).    TEMPZH
      DATA  (TMPJAN(I,3),I=1,31) / 257.28,247.81,220.55,217.15,216.56,   TEMPZH
     *                                  214.17,211.79,214.06,218.03,224.76,   TEMPZH
     * 234.65,244.53,254.40,260.15,257.30,250.89,248.93,246.97,241.12,   TEMPZH
     * 232.51,223.91,215.27,206.63,205.55,212.70,218.49,230.24,245.33,   TEMPZH
     * 261.48,297.50,333.30 /                                            TEMPZH
C        TMPJAN(I,4), TEMPERATURES FOR 75-DEG N JAN. PROFILE (US-66).    TEMPZH
      DATA  (TMPJAN(I,4),I=1,31) / 254.00,239.89,217.86,213.25,210.05,   TEMPZH
     *                                  207.65,207.65,212.50,218.03,224.76,   TEMPZH
     * 234.65,244.53,254.40,260.15,257.30,250.89,248.93,246.97,241.12,   TEMPZH
     * 232.51,223.91,215.27,206.63,205.55,212.70,218.49,230.24,245.33,   TEMPZH
     * 261.48,297.50,333.30 /                                            TEMPZH
C        TMPJUL(I,1), TEMPERATURES FOR 30-DEG N JULY PROFILE (US-66).    TEMPZH
      DATA  (TMPJUL(I,1),I=1,31) / 304.58,277.87,252.41,224.42,203.15,   TEMPZH
     *                                  211.75,219.90,227.83,235.74,245.14,   TEMPZH
     * 254.62,264.08,272.15,271.14,263.28,254.79,239.91,225.04,210.19,   TEMPZH
     * 195.36,180.54,172.50,172.45,175.71,183.55,190.03,209.16,237.66,   TEMPZH
     * 265.72,322.72,379.70 /                                            TEMPZH
C        TMPJUL(I,2), TEMPERATURES FOR 45-DEG N JULY PROFILE (US-66).    TEMPZH
      DATA  (TMPJUL(I,2),I=1,31) / 296.22,273.57,248.26,222.30,215.65,   TEMPZH
     *                                  219.17,223.94,229.49,237.81,247.64,   TEMPZH
     * 257.52,267.39,275.65,275.65,266.87,257.05,244.52,226.89,209.28,   TEMPZH
     * 191.69,174.12,165.10,165.06,169.98,180.96,190.51,214.04,246.42,   TEMPZH
     * 278.63,329.46,379.70 /                                            TEMPZH
C        TMPJUL(I,3), TEMPERATURES FOR 60-DEG N JULY PROFILE (US-66).    TEMPZH
      DATA  (TMPJUL(I,3),I=1,31) / 288.45,265.87,239.18,225.15,225.15,   TEMPZH
     *                                  225.15,226.56,232.52,238.47,250.18,   TEMPZH
     * 262.05,272.48,276.82,277.15,271.99,262.73,244.26,225.83,207.41,   TEMPZH
     * 189.01,170.64,161.71,161.66,167.51,179.67,190.39,217.12,252.57,   TEMPZH
     * 288.06,334.14,379.70 /                                            TEMPZH
C        TMPJUL(I,4), TEMPERATURES FOR 75-DEG N JULY PROFILE (US-66).    TEMPZH
      DATA  (TMPJUL(I,4),I=1,31) / 278.92,262.09,235.87,229.65,230.15,   TEMPZH
     *                                  230.15,230.71,235.48,241.00,250.18,   TEMPZH
     * 262.05,272.48,276.82,277.15,271.99,262.73,244.26,225.83,207.41,   TEMPZH
     * 189.01,170.64,161.71,161.66,167.51,179.67,190.39,217.12,252.57,   TEMPZH
     * 288.06,334.14,379.70 /                                            TEMPZH
      DATA  PI / 3.141592653590 /, NZHT / 31 /                           TEMPZH
CCC                                                                      TEMPZH
C        IF TPFLAG HAS BEEN SET (NON ZERO) USER READS IN HIS OWN         TEMPZH
C        TEMPERATURE PROFILE AT ALTITUDES  ZZ = 0.0 (4.0) 120. KM.       TEMPZH
CCC                                                                      TEMPZH
      IF( TPFLAG.EQ.0.0 )  GO TO 8                                       TEMPZH
      READ(5,101)  (TZH(N),N=1,NZHT)                                     TEMPZH
  101 FORMAT (8E10.4)                                                    TEMPZH
      GO TO 99                                                           TEMPZH
    8 PI180 = PI/180.                                                    TEMPZH
C        DETERMINE INDEX, LATBND, OF 15-DEG LATITUDE BAND,               TEMPZH
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C        INCREASING POLEWARD.
      ALAT = ABS(PLAT)/PI180
      LATBND = (ALAT+15.)/15.
      IF( LATBND.GT.6 )  LATBND = 6
C        DETERMINE INDEX, IB, OF LATITUDE BOUNDARY, WITH IB=0,1,2,3,4
C        CORRESPONDING TO LATITUDES 15-, 30-, 45-, 60-, AND 75-DEGREES,
C        RESPECTIVELY.
      IB = LATBND-1
      IF( LATBND.EQ.6 )  IB = IB-1
C        DETERMINE FRACTIONAL VALUE OF POSITION OF INTEREST WITHIN
C        LATITUDE BAND.
      FLAT = ALAT/15. - FLOAT(IB)
      FLATM1 = 1.0-FLAT
      FSTM1 = 1.0-FST
      GO TO (11,21,31,31,31,41), LATBND
C        DETERMINE TEMPERATURE PROFILE FOR 0- TO 15-DEG LATITUDE BAND
C        (NO LATITUDE OR SEASONAL DEPENDENCE).
   11 DO 10 N=1,NZHT
      TZH(N) = ANNUAL(N)
   10 CONTINUE
      GO TO 99
C        DETERMINE TEMPERATURE PROFILE FOR POSITION WITHIN 15- TO
C        30-DEG LATITUDE BAND (SEASONAL DEPENDENCE).
   21 DO 20 N=1,NZHT
      T30 = FST*TMPJUL(N,IB) + FSTM1*TMPJAN(N,IB)
      TZH(N) = FLATM1*ANNUAL(N) + FLAT*T30
   20 CONTINUE
      GO TO 99
C        DETERMINE TEMPERATURE PROFILE FOR POSITION WITHIN 30- TO
C        45-DEG,  45- TO 60-DEG,  OR  60- TO 75-DEG LATITUDE BAND
C        (SEASONAL DEPENDENCE).
   31 DO 30 N=1,NZHT
      TLBND = FST*TMPJUL(N,IB-1) + FSTM1*TMPJAN(N,IB-1)
      TUBND = FST*TMPJUL(N, IB ) + FSTM1*TMPJAN(N, IB )
      TZH(N) = FLATM1*TLBND + FLAT*TUBND
   30 CONTINUE
      GO TO 99
C        DETERMINE TEMPERATURE PROFILE FOR 75- TO 90-DEG LATITUDE BAND
C        (SEASONAL DEPENDENCE).
   41 DO 40 N=1,NZHT
      TZH(N) = FST*TMPJUL(N,IB) + FSTM1*TMPJAN(N,IB)
   40 CONTINUE
   99 RETURN
      END
```

```
      SUBROUTINE WATER(KK,ZH,H2O)
CCC
C         SUBROUTINE WATER COMPUTES THE LONGITUDE, LATITUDE, AND SEASON
C         DEPENDENCE OF WATER VAPOR FOR ALTITUDES FROM 0- TO 45-KM.
C         (FOR HIGHER ALTITUDES, SEE SUBROUTINE SPCMIN)
CCC
CCC       THIS IS A NEW ROUTINE FOR ROSCOE-IR.
CCC
C         INPUT PARAMETERS
C            ARGUMENT LIST
C                KK = CALCULATION FLAG
C                   = 1, CALCULATE INITIALIZATION PARAMETERS
C                   = 2, CALCULATE WATER VAPOR MIXING RATIO FOR
C                        0- TO 45-KM ALTITUDE
C                ZH = ALTITUDE OF INTEREST, FROM 0 TO 45 KM
C            ATMOUP COMMON
C               RHO = MASS DENSITY OF DRY AIR, G/CM**3
C            TIME COMMON
C               PLAT = NORTH LATITUDE OF POINT P (RADIANS)
C               PLON = EAST LONGITUDE OF POINT P (RADIANS)
C                FYR = FRACTIONAL SEASON-YEAR, BEING 0 ON 1-JAN IN
C                      NORTHERN HEMISPHERE AND ON 1-JULY IN SOUTHERN
C                      HEMISPHERE
C             RHO5KM = MASS DENSITY OF DRY AIR AT 5-KM ALTITUDE, G/CM**3
C         OUTPUT PARAMETER
C            ARGUMENT LIST
C               H2O = MIXING RATIO OF WATER VAPOR AT ALTITUDE ZH, PPMM
CCC
C         DEFINITIONS OF DATA QUANTITIES
C            (ALRZ(I,IX),I=1,3) = SMALL A-COEFFICIENTS IN CUBIC FOR
C                                 LARGE-A COEFFICIENT A(IX,ZH) FOR
C                 QUASI-HOMOGENEOUS MOISTURE REGION IX IN 0- TO 5-KM
C                 FORMULA
C             (BLR(IX),IX=1,6) = LARGE B-COEFFICIENTS IN REGION IX IN
C                                0- TO 5-KM FORMULA
CCC
      DIMENSION  ALRZ(3,6),BLR(6)
      COMMON/ATMOUP/ HL,SBAR,IDORN,PP,RHO,TT,SNI(30),HRHO,FERSEQ
      COMMON/TIME/ IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,GAT,FYR,FST,RHO5KM
     *             ,CHI
      DATA  (ALRZ(I,1),I=1,18) /  0.1485, 0.0372, 0.0, 0.3253, 0.0069,
     * 0.0052, 0.3107, 0.0253, 0.0, 0.4080, 0.0337, 0.0, 1.0, 0.1002,
     * 0.0120, 1.1390, 0.1062, 0.0086 /
      DATA  (BLR(I),I=1,6) /  2.854, 2.537, 2.467, 2.024, 1.852, 1.289 /
      DATA  PI / 3.141592653590 /
CCC
      GO TO (100,200), KK
C         INITIALIZATION, CALLED FROM SUBROUTINE SPCMIN DURING ITS
C         INITIALIZATION.
  100 PI180 = PI/180.
      DLON = PLON/PI180
      DLAT = (PI/2. - PLAT)/PI180
      ALAT = ABS(PLAT)/PI180
CCC
CCC       DETERMINE INDEX IX, OF QUASI-HOMOGENEOUS MOISTURE REGION.
CCC
      IF( (DLAT.GE.30.) .AND. (DLAT.LE.150.) )  GO TO 102
```

```
      IX = 6
      GO TO 122
  102 IF( DLAT.LE.125. )  GO TO 104
      IX = 4
      GO TO 122
  104 IF( DLAT.LE.120. )  GO TO 106
      IX = 3
      GO TO 122
  106 IF( DLAT.LT.60. )  GO TO 110
      IF( (DLAT.GE.105.) .AND. ((DLON.GE.120.) .AND. (DLON.LE.150.)) )
     * GO TO 108
      IF( (DLAT.LE.80.) .AND. ((DLON.GE.350.) .OR. (DLON.LE.50.)) )
     * GO TO 108
      IX = 1
      GO TO 122
  108 IX = 2
      GO TO 122
  110 IF( DLAT.LT.50. )  GO TO 114
      IF( (DLAT.LT.55.) .AND. ((DLON.GT.235.) .AND. (DLON.LE.240.)) )
     * GO TO 112
      IX = 3
      GO TO 122
  112 IX = 4
      GO TO 122
  114 IF( (DLON.GT.230.) .AND. (DLON.LT.255.) )  GO TO 118
      IF( (DLAT.LT.45.) .AND. ((DLON.GE.255.) .AND. (DLON.LE.303.)) )
     * GO TO 116
      IF( (DLON.GE.110.) .AND. (DLON.LE.135.) )  GO TO 116
      IF( (DLAT.LT.40.) .AND. ((DLON.GT.30.) .AND. (DLON.LT.110.)) )
     * GO TO 116
      IX = 4
      GO TO 122
  116 IX = 5
      GO TO 122
  118 IF( DLAT.LT.40. )  GO TO 120
      IF( DLON.LE.240. )  GO TO 112
      IF( (DLAT.LT.45.) .AND. ((DLON.GE.247.) .AND. (DLON.LT.255.)) )
     * GO TO 112
      IX = 3
      GO TO 122
  120 IF( DLON.GE.247. )  GO TO 116
      IX = 3
  122 CONTINUE
CCC
CCC        EVALUATE PARAMETERS AT 5- AND 14-KM ALTITUDE.
CCC
      FYR360 = 360.*FYR-120.
      SINDAY = SIN( FYR360*PI180 )
C          EVALUATE NATURAL LOG OF H2O MIXING RATIO AT 5 KM, ZMR005
      ZHKM = 5.0
      AA = (ALRZ(3,IX)*ZHKM + ALRZ(2,IX))*ZHKM + ALRZ(1,IX)
      BB = BLR(IX) - (0.4945 + 2.33E-04*ALAT)*ZHKM
      IF( IX.EQ.7 .OR. IX.EQ.5 .OR. IX.EQ.6 )  GO TO 126
  124 ZMR005 = EXP( AA*SINDAY+BB )
      ZMR005 = ALOG( ZMR005/RHO5KM )
      GO TO 128
  126 BB = BB - (0.1170+5.91E-03*ALAT)*EXP(-ZHKM)
```

```
      GO TO 124
C          EVALUATE NATURAL LOG OF H2O MIXING RATIO AT 14 KM, ZMR014
  128 ZHKM = 14.
      CC = FYR360 - 6.92*ALAT/(1.0+EXP(-0.805*(ZHKM-18.)))
      DD = 0.0619*ZHKM*EXP(-0.0226*ZHKM)
      DLBLB1 = 1.0/(1.0+EXP(0.44*(ALAT-28.)))
      DD = DD + 30.9*DLBLB1*EXP(-0.221*ZHKM)
      ZMR014 = DD*(1.0+323.*EXP(-0.448*ZHKM)*SIN(CC*PI180))
      WRITE(6,901)  IX,FYR,FST
  901 FORMAT (1H0,24H  FROM SUBROUTINE WATER-,5H  IX=,I3,5X,5H FYR=,
     * F8.5,5X,5H FST=,F8.5)
      RETURN
  200 CONTINUE
      IF( ZH.GE.14. )  GO TO 212
      IF( ZH.GE. 5. )  GO TO 214
      AA = (ALRZ(3,IX)*ZH + ALRZ(2,IX))*ZH + ALRZ(1,IX)
      BB = BLZ(IX) - (0.4845 + 2.33E-04*ALAT)*ZH
      IF( IX.EQ.2 .OR. IX.EQ.5 .OR. IX.EQ.6 )  GO TO 210
  208 SMR = EXP( AA*SINDAY+BB )
      SMR = SMR/RHO
      GO TO 216
  210 BB = BB - (0.1170 + 5.91E-03*ALAT)*EXP(-ZH)
      GO TO 208
  212 CC = FYR360 - 6.92*ALAT/(1.0+EXP(-0.805*(ZH-18.)))
      DD = 0.0619*ZH*EXP(-0.0226*ZH)
      DD = DD + 30.9*DLBLB1*EXP(-0.221*ZH)
      SMR = EXP( DD*(1.0+323.*EXP(-0.448*ZH)*SIN(CC*PI180)) )
      GO TO 216
  214 SMR = EXP( ZMR014+(ZMR005-ZMR014)*(14.-ZH)/9. )
  216 H2O = SMR
      RETURN
      END
```

```
      SUBROUTINE WVOPT(JJ,HKM,H2OMR)
CCC
C         SUBROUTINE WVOPT ALLOWS THE USER TO BYPASS THE NORMAL
C         TREATMENT (ACHIEVED BY SETTING WVFLAG=0.0) OF WATER VAPOR IN
C         SUBROUTINE SPCHIN FOR THE ALTITUDE RANGE FROM 0. TO 120. KM.
C         THE USER EFFECTS THE BYPASS BY READING IN WVFLAG.GT.0.0 AND
C         HIS OWN DATA IN ONE OF FOUR OPTIONAL FORMS ACCORDING TO
C         METHOD = 1,2,3,4.
C         IT IS ANTICIPATED THAT THE USER WILL BE MOST INTERESTED IN
C         USING HIS OWN LOW-ALTITUDE DATA OVER THE ALTITUDE RANGE FROM
C         HH(1)=0.0 TO HH(NOP), BUT HE MUST ALSO ACTUALLY READ IN DATA
C         OVER THE REMAINING HIGHER-ALTITUDE RANGE FROM HH(NOP+1) TO
C         HH(NZH)=120.  IF THE USER HAS NO PERSONAL PREFERANCE FOR DATA
C         IN THE HIGHER-ALTITUDE RANGE, HE MAY FIND IT CONVENIENT TO
C         USE THE DATA IN A DATA STATEMENT IN SUBROUTINE SPCHIN, GIVEN
C         AT ALTITUDES 20(5)120 KM AND IN UNITS OF PARTS PER MILLION BY
C         MASS (PPMM).
CCC
CCC       THIS IS A NEW ROUTINE FOR ROSCOE-IR.
CCC
C         INPUT PARAMETERS
C            ARGUMENT LIST
C                 JJ - =1 FOR INITIALIZATION CALL
C                      =2 NORMAL OPERATION CALL
C                HKM - ALTITUDE OF INTEREST, KM  (USED ONLY IF JJ=2)
C            ATMOUP COMMON
C                RHO - DENSITY,  GRAMS/CM**3
C                 TT - TEMPERATURE, DEGREES KELVIN
C            VPC     COMMON
C             METHOD - FLAG INDICATING ONE OF FOUR OPTIONS,
C                      =1 DATA VALUES IN PARTS PER MILLION BY MASS
C                      =2 DATA VALUES IN ABSOLUTE HUMIDITY,
C                            GRAMS/METERS**3
C                      =3 DATA VALUES IN RELATIVE HUMIDITY, PERCENT
C                            (10 PERCENT IS INPUT AS 10. NOT 0.10)
C                      =4 DATA VALUES IN DEW-POINT TEMPERATURE, DEG K
C
C               NOTE - FOR METHOD = 2,3, OR 4 THE SUBROUTINE CONVERTS
C                      THE FIRST NOP VALUES OF THE DATA INTO PARTS
C                      PER MILLION BY MASS, DURING INITIALIZATION.
C            DATA READ IN
C              HH(N) - ALTITUDE ARRAY, 0.0 TO 120.0 KM
C             WVC(N) - H2O DATA USING ONE OF THE FOUR OPTIONS.
C                      FOR N=1,NOP,  DATA HAVE DIMENSIONS DICTATED BY
C                      THE OPTION USED.  FOR N=NOP+1,NZH,  DATA HAVE
C                      DIMENSIONS OF PARTS PER MILLION BY MASS.
C                      NOP = NZH IS A VALID INPUT CONDITION.
C         OUTPUT PARAMETER
C            ARGUMENT LIST
C              H2OMR - WATER VAPOR CONTENT OF MOIST AIR IN UNITS OF
C                      PARTS PER MILLION BY MASS AT ALTITUDE HKM.
CCC
      DIMENSION  HH(61),WVC(61)
      COMMON/ATMOUP/ HL,S3AR,IDORN,PP,RHO,TT,SNI(33),HRHO,FENSEQ
      COMMON/VPC/  WVFLAG,METHOD,H2O120
      DATA  GASC,ZMH2O / 8.31416781E+07,18.016 /
      GO TO (100,200),  JJ
```

```
CC        INITIALIZATION, CALLED FROM MAIN PROGRAM AFTER SUBROUTINE      WVOPT
CC        ATMOSU HAS BEEN INITIALIZED.                                   WVOPT
  100 IF( METHOD )  111,111,112                                          WVOPT
  111 RETURN                                                             WVOPT
  112 READ(5,103)  NZH,NOP                                               WVOPT
  103 FORMAT (2I5)                                                       WVOPT
      READ(5,105)  (HH(N),WVC(N),N=1,NZH)                                WVOPT
  105 FORMAT (8E10.4)                                                    WVOPT
      MTH = METHOD                                                       WVOPT
      GO TO (120,140,160,180),  MTH                                      WVOPT
  120 RETURN                                                             WVOPT
CC        METHOD-2  INITIALIZATION.                                      WVOPT
  140 DO 144 N=1,NOP                                                     WVOPT
      ZZ = HH(N)                                                         WVOPT
      CALL ATMOSU(2,ZZ)                                                  WVOPT
      WVC(N) = WVC(N)/RHO                                                WVOPT
CC        WATER-VAPOR-CONTENT DATA, WVC(N) NOW EXPRESSED IN UNITS OF     WVOPT
CC        PARTS PER MILLION BY MASS.                                     WVOPT
  144 CONTINUE                                                           WVOPT
      GO TO 111                                                          WVOPT
CC        METHOD-3  INITIALIZATION.                                      WVOPT
  160 RZM = GASC/ZMH2O                                                   WVOPT
      DO 164 N=1,NOP                                                     WVOPT
      ZZ = HH(N)                                                         WVOPT
      CALL ATMOSU(2,ZZ)                                                  WVOPT
      VPH2O = 0.0                                                        WVOPT
      VPICE = 0.0                                                        WVOPT
      IF( ( TT .GE. 173.15 ) .AND. ( TT .LE. 373.15 ) )                  WVOPT
     *CALL H2OSVP(TT,VPH2O,VPICE)                                        WVOPT
CC        NOW HAVE SATURATED VAPOR PRESSURE OVER A WATER SURFACE AT      WVOPT
CC        TEMPERATURE TT, VPH2O (MILLIBARS).                             WVOPT
      WVC(N) = 1.0E+07*WVC(N)*VPH2O/(RZM*TT*RHO)                         WVOPT
  164 CONTINUE                                                           WVOPT
      GO TO 111                                                          WVOPT
CC        METHOD-4  INITIALIZATION.                                      WVOPT
  180 RZM = GASC/ZMH2O                                                   WVOPT
      DO 184 N=1,NOP                                                     WVOPT
      TD = WVC(N)                                                        WVOPT
      ZZ = HH(N)                                                         WVOPT
      CALL ATMOSU(2,ZZ)                                                  WVOPT
      VPH2O = 0.0                                                        WVOPT
      VPICE = 0.0                                                        WVOPT
      IF( ( TT .GE. 173.15 ) .AND. ( TT .LE. 373.15 ) )                  WVOPT
     *CALL H2OSVP(TT,VPH2O,VPICE)                                        WVOPT
      WVC(N) = 1.0E+09*VPH2O/(RZM*TT*RHO)                                WVOPT
  184 CONTINUE                                                           WVOPT
      GO TO 111                                                          WVOPT
CC        START LOGARITHMIC INTERPOLATION SECTION, CALLED FROM MAIN      WVOPT
CC        PROGRAM AT ALTITUDE HKM=120. AS PART OF THE INITIALIZATION     WVOPT
CC        PROCEDURE AND FROM THE H2O PORTION OF SUBROUTINE SPCMIN        WVOPT
CC        DURING OPERATION.                                              WVOPT
  200 CONTINUE                                                           WVOPT
      NX1 = 1                                                            WVOPT
      NX3 = NZH                                                          WVOPT
 1092 NX2 = ( NX1+NX3 )/2                                                WVOPT
CC        NX1,NX2, AND NX3 ARE TRIAL INDICES USED IN THE SEARCH ROUTINE. WVOPT
      IF( NX2.EQ.NX1 ) GO TO 1102                                        WVOPT
```

```
      IF( HKM-HH(NX2) ) 1094,1102,1100                                  WVOPT
 1094 IF( NX2-NX1-1 ) 1098,1096,1098                                    WVOPT
CC          NNX = INDEX NUMBER OF THE TABULAR ALTITUDE AT OR JUST BELOW WVOPT
CC          THE ALTITUDE OF INTEREST (HKM).                             WVOPT
 1096 NNX = NX1                                                         WVOPT
      GO TO 1106                                                        WVOPT
 1098 NX3 = NX2                                                         WVOPT
      GO TO 1092                                                        WVOPT
 1100 IF( WX3-NX2-1 ) 1104,1102,1104                                    WVOPT
 1102 NNX = NX2                                                         WVOPT
      GO TO 1106                                                        WVOPT
 1104 NX1 = NX2                                                         WVOPT
      GO TO 1092                                                        WVOPT
CC          ZD = FRACTIONAL DISTANCE THAT THE ALTITUDE OF INTEREST IS   WVOPT
CC          ABOVE THE LOWER OF THE TWO ADJACENT TABULATED ALTITUDES.    WVOPT
 1106 ZD = ( HKM-HH(NNX) )/( HH(NNX+1)-HH(NNX) )                        WVOPT
      H2OMR = WVC(NNX)*( WVC(NNX+1)/WVC(NNX) )**ZD                      WVOPT
      RETURN                                                            WVOPT
      END                                                               WVOPT
```

```
      SUBROUTINE ZTTOUT                                                 ZTTOUT     2
CCC                                                                     ZTTOUT     3
C         SUBROUTINE ZTTOUT CONVERTS A GREGORIAN CALENDAR DATE (20 TH   ZTTOUT     4
C         CENTURY YEAR IYRS, MONTH IMONS, DAY IDAYS) AND ZONE TIME ZT   ZTTOUT     5
C         AT EAST LONGITUDE PLON TO GREGORIAN CALENDAR DATE AND MEAN    ZTTOUT     6
C         TIME UT AT GREENWICH.                                         ZTTOUT     7
CCC                                                                     ZTTOUT     8
C         REVISION 02 (11/18/74) PROVIDES...                            ZTTOUT     9
C            1. TEST FOR LEGAL INPUT DATE.                              ZTTOUT    10
C         REVISION  03(10/15/77)  PROVIDES...                           ZTTOUT    11
C            2. CORRECTED COMPUTATION OF THE ZONE DESCRIPTION, ZD,      ZTTOUT    12
C               WHEN ZD SHOULD BE 0.                                    ZTTOUT    13
C            3. REVISED COMMENT CARDS.                                  ZTTOUT    14
C         REVISION 04  (03/01/78)  PROVIDES...                          ZTTOUT    15
C            4. REVISED TIME COMMON FOR RUSCOE-IR.                      ZTTOUT    16
C         REVISION 05 (02/08/79) PROVIDES...                            ZTTOUT    17
C            5. CONVERSION OF PLON TO THE CORRESPONDING POSITIVE        ZTTOUT    18
C               QUANTITY IF INPUTTED AS A NEGATIVE QUANTITY.            ZTTOUT    19
C     INPUT PARAMETERS                                                  ZTTOUT    20
C              IYRS - NUMBER OF THE YEAR IN THE 1900 S (E.G., 1974      ZTTOUT    21
C                     BECOMES 74), IN LOCAL TIME ZONE.                  ZTTOUT    22
C             IMONS - NUMBER OF THE MONTH (E.G., FEBRUARY BECOMES 2),   ZTTOUT    23
C                     IN LOCAL TIME ZONE.                               ZTTOUT    24
C             IDAYS - DAY OF THE MONTH, IN LOCAL TIME ZONE.             ZTTOUT    25
C                ZT - ZONE TIME FOR THE 15-DEGREE LONGITUDE INTERVAL    ZTTOUT    26
C                     CONTAINING PLON (DECIMAL HRS)                     ZTTOUT    27
C                     NOTE.  A VALUE OF 24.0, TREATED BY THE CODE AS    ZTTOUT    28
C                     ILLEGAL, MUST BE INPUTTED AS 0.0 ON THE NEXT DAY. ZTTOUT    29
C              PLON - EAST LONGITUDE OF POINT P (RADIANS)               ZTTOUT    30
C              (PLON MUST BE POSITIVE)                                  ZTTOUT    31
CCC                                                                     ZTTOUT    32
C     OUTPUT PARAMETERS                                                 ZTTOUT    33
C              IYRS - A POSSIBLY REVISED VALUE OF THE INPUT PARAMETER,  ZTTOUT    34
C                     CORRESPONDING TO GREENWICH.                       ZTTOUT    35
C             IMONS - A POSSIBLY REVISED VALUE OF THE INPUT PARAMETER,  ZTTOUT    36
C                     CORRESPONDING TO GREENWICH.                       ZTTOUT    37
C             IDAYS - A POSSIBLY REVISED VALUE OF THE INPUT PARAMETER,  ZTTOUT    38
C                     CORRESPONDING TO GREENWICH.                       ZTTOUT    39
C                UT - UNIVERSAL TIME (DECIMAL HRS)                      ZTTOUT    40
CCC                                                                     ZTTOUT    41
C     DEFINITION OF DATA                                                ZTTOUT    42
C         IDAYMO(I) = DAYS IN THE I TH MONTH OF A NON-LEAP YEAR         ZTTOUT    43
CCC                                                                     ZTTOUT    44
      COMMON/TIME/ IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,CAT,FYR,FST,RHOSKM  KOMM07     2
     *     ,CHI                                                         KOMM07     3
      DIMENSION  IDAYMO(12)                                             ZTTOUT    46
      DATA  (IDAYMO(I),I=1,12) / 31,28,31,30,31,30,31,31,30,31,30,31 /  ZTTOUT    47
      DATA  PI / 3.141592653590 /                                       ZTTOUT    48
CCC                                                                     ZTTOUT    49
C         CONVERSION FROM ZONE TIME ZT TO GREENWICH MEAN TIME (I.E.,    ZTTOUT    50
C         UNIVERSAL TIME UT) IS DONE BY FIRST FINDING THE TIME ZONE     ZTTOUT    51
C         CONTAINING THE LONGITUDE PLON.                                ZTTOUT    52
C         N7PT5 IS THE INTEGRAL NUMBER OF 7.5-DEGREE INTERVALS IN THE   ZTTOUT    53
C         WESTERLY DIRECTION FROM GREENWICH TO THE LONGITUDE OF INTEREST ZTTOUT   54
C         PLON.  N7PT5 MAY BE 0 OR ANY INTEGER UP TO AND INCLUDING 47.  ZTTOUT    55
C         HOWEVER, THE TIME-ZONE NUMBER IZONE IS 0 FOR N7PT5 EQUAL TO   ZTTOUT    56
C         0 OR 47.  IZONE RANGES FROM 0 TO 23.                          ZTTOUT    57
```

```
CCC
C         TEST WHETHER INPUT DATE IS LEGAL.
      IF( ZT.LT.0.0 .OR. ZT.GE.24. )  GO TO 999
      IF( IYRS.LT.1 .OR. IYRS.GT.99 )  GO TO 999
      IF( IMONS.LT.1 .OR. IMONS.GT.12 )  GO TO 999
C         IF YRS IS A LEAP YEAR, SET IDAYMO(2) = 29
      LEAP = MOD(IYRS,4)
      IF( LEAP.EQ.0 )  IDAYMO(2) = 29
      IF( IDAYS.LT.1 .OR. IDAYS.GT.IDAYMO(IMONS) )  GO TO 999
      PI2 = 2.*PI
      PID2 = PI/2.
      RADDEG = PI/180.
      IF( PLON .LT. 0.0 )  PLON = PLON + PI2
      N7PT5 = (PI2-PLON)/(7.5*RADDEG)
      IF( N7PT5-47 )  10,20,20
   10 IZONE = (N7PT5+1)/2
      GO TO 30
   20 IZONE = 24
   30 ZONE = FLOAT(IZONE)
CCC
C         SHIFT TO CONVENTIONAL ZONE DESCRIPTION, ZD (SEE, E.G.,
C         AMERICAN PRACTICAL NAVIGATOR (ORIGINALLY BY N. BOWDITCH),
C         U.S. NAVY H.O. PUB. NO. 9, P.489, OF 1962 CORRECTED REPRINT
C         EDITION, AVAILABLE FROM U.S. GOV. PRINTING OFFICE).
CCC
      IF( PLON.GT.PI )  GO TO 35
      ZD = ZONE-24.
      GO TO 40
   35 ZD = ZONE
   40 UT = ZT+ZD
C         MUST SHIFT TO NEXT DAY IF(UT.GE.24.)
      IF( UT.GE.24. )  GO TO 50
C         MUST SHIFT TO PREVIOUS DAY IF(UT.LT.0.)
      IF( UT.LT.0.0 )  GO TO 45
C         NO SHIFT IS NECESSARY IF(UT.GE.0.0 .AND. UT.LT.24.)
      GO TO 60
   45 UT = UT+24.
      IDAYS = IDAYS-1
C         CORRECT MONTH AND YEAR IF NECESSARY, DUE TO CHANGING THE DATE
C         IN CONVERTING TO UT.
C         CORRECT IDAYS AND IMONS IF MONTH DECREASED AT GREENWICH
      IF( IDAYS.GE.1 )  GO TO 60
      IDAYS = IDAYMO(IMONS-1)
      IMONS = IMONS-1
C         CORRECT IMONS AND IYRS IF YEAR DECREASED AT GREENWICH
      IF( IMONS.GE.1 )  GO TO 60
      IMONS = 12
      IYRS = IYRS-1
      GO TO 60
   50 UT = UT-24.
      IDAYS = IDAYS+1
C         CORRECT MONTH AND YEAR IF NECESSARY, DUE TO CHANGING THE DATE
C         IN CONVERTING TO UT.
C         IF YRS IS A LEAP YEAR, SET IDAYMO(2) = 29
      LEAP = MOD(IYRS,4)
      IF(  LEAP.EQ.0  )  IDAYMO(2) = 29
C         CORRECT IDAYS AND IMONS IF MONTH INCREASED AT GREENWICH
      IF( IDAYS.LE.IDAYMO( IMONS) )  GO TO 60
      IDAYS = 1
      IMONS = IMONS+1
C         CORRECT IMONS AND IYRS IF YEAR INCREASED AT GREENWICH
      IF( IMONS.LE.12 )  GO TO 60
      IMONS = 1
      IYRS = IYRS+1
   60 RETURN
  999 WRITE(6,777)
  777 FORMAT (40H0   * * * ILLEGAL DATE INPUTTED * * *     )
      CALL EXIT
      END
```

TEST VALUES READ IN

NALTS = 182

I	ALTS(I),KM	I	ALTS(I),KM	I	ALTS(I),KM	I	ALTS(I),KM	I	ALTS(I),KM	I	ALTS(I),KM
1	0.00	2	1.00	3	2.00	4	3.00	5	4.00	6	5.00
7	6.00	8	7.00	9	8.00	10	9.00	11	10.00	12	11.00
13	12.00	14	13.00	15	14.00	16	15.00	17	16.00	18	17.00
19	18.00	20	19.00	21	20.00	22	21.00	23	22.00	24	23.00
25	24.00	26	25.00	27	26.00	28	27.00	29	28.00	30	29.00
31	30.00	32	31.00	33	32.00	34	33.00	35	34.00	36	35.00
37	36.00	38	37.00	39	38.00	40	39.00	41	40.00	42	41.00
43	42.00	44	43.00	45	44.00	46	45.00	47	46.00	48	47.00
49	48.00	50	49.00	51	50.00	52	51.00	53	52.00	54	53.00
55	54.00	56	55.00	57	56.00	58	57.00	59	58.00	60	59.00
61	60.00	62	61.00	63	62.00	64	63.00	65	64.00	66	65.00
67	66.00	68	67.00	69	68.00	70	69.00	71	70.00	72	71.00
73	72.00	74	73.00	75	74.00	76	75.00	77	76.00	78	77.00
79	78.00	80	79.00	81	80.00	82	81.00	83	82.00	84	83.00
85	84.00	86	85.00	87	86.00	88	87.00	89	88.00	90	89.00
91	90.00	92	91.00	93	92.00	94	93.00	95	94.00	96	95.00
97	96.00	98	97.00	99	98.00	100	99.00	101	100.00	102	101.00
103	102.00	104	103.00	105	104.00	106	105.00	107	106.00	108	107.00
109	108.00	110	109.00	111	110.00	112	111.00	113	112.00	114	113.00
115	114.00	116	115.00	117	116.00	118	117.00	119	118.00	120	119.00
121	119.99	122	120.00	123	121.00	124	122.00	125	123.00	126	124.00
127	125.00	128	130.00	129	135.00	130	140.00	131	145.00	132	150.00
133	160.00	134	170.00	135	180.00	136	190.00	137	200.00	138	220.00
139	240.00	140	260.00	141	280.00	142	300.00	143	320.00	144	340.00
145	360.00	146	380.00	147	400.00	148	420.00	149	440.00	150	460.00
151	480.00	152	500.00	153	520.00	154	540.00	155	560.00	156	580.00
157	600.00	158	620.00	159	640.00	160	660.00	161	680.00	162	700.00
163	720.00	164	740.00	165	760.00	166	780.00	167	800.00	168	820.00
169	840.00	170	860.00	171	880.00	172	900.00	173	920.00	174	940.00
175	960.00	176	980.00	177	1000.00	178	1040.00	179	1080.00	180	1120.00
181	1160.00	182	1200.00								

```
 IYRS =   79   IMONS =     7   IDAYS =     1
   ZT =  .1200E+02 HRS     GCO =   .5500E+02 DEG     GLO =   .2400E+03 DEG
NWFLAG=    0.00             METHOD=    0            TPFLAG=    0.00
```

INITIALIZATION CALL

```
  FROM SUBROUTINE WATER-  IX=  3      FYW=  .49589      FST=  .99178
TIF = 1848.560 DEG K,  TAU =  1.41853E-02 1/KM, FROM SUBROUTINE ATMOSU (FORMAT 8001)

 IYRS =   79   IMONS =     7   IDAYS =     1
   ZT =  .1200E+02 HRS     GCO =   .9599E+00 RAD     GLO =   .4189E+01 RAD

IDONE =    1      UT =  .2000E+02     GAT =  [illegible]     PLAT =   .6109E+00    PLON =   .4189E+01
```

HL = 11.95 HRS (LOCAL TIME AT GRID ORIGIN), SOLAR FLUX SRAR = 237.52 1.E-22 W/(M SQ HZ),
FROM PROGRAM DAVATM (FORMAT 2003)

ALT	N2 1/CC	O2 1/CC	O 1/CC	AR 1/CC	HE 1/CC	CO2 1/CC	E 1/CC	O+ 1/CC	NO+ 1/CC	QDEP 1/(CC SEC)
	N 1/CC	NO 1/CC	NO2 1/CC	O2(SPG) 1/CC	O3 1/CC	H2O 1/CC	E 1/CC	O+ 1/CC	N+ 1/CC	N+ 1/CC
	PRESSURE DYNES/CM**2	PERSEW	DENSITY GRAMS/CC	DEN SC HT KM	TEMP DEG K	E TEMP DEG K	H 1/CC	OH 1/CC	HO2 1/CC	CO 1/CC
	H2O 1/CC	CH4 1/CC	N (4S) 1/CC	N (2D) 1/CC	N (2P) 1/CC	O (1D) 1/CC	SAT. VP WATER	SAT. VP ICE	N2+ 1/CC	O2+ 1/CC
							REL. HUMID. PERCENT			
0.00	1.906E+19	5.155E+18	5.745E+02	2.199E+17	1.130E+15	7.818E+15	0.	0.	0.	1.815E+02
	6.989E+00	9.848E+09	2.619E+10	2.601E+06	6.298E+11	5.135E+17	0.	0.	0.	0.
	1.013E+06	0.	1.175E-03	8.101E+00	3.004E+02	3.004E+02	1.000E+00	9.863E+05	1.015E+05	3.089E+12
	7.582E+12	3.365E+13	6.989E+00	1.261E-05	1.261E-07	1.000E+00	3.622E+01	0.	0.	0.
							5.881E+01			
1.00	1.699E+19	4.597E+18	1.071E+03	1.961E+17	1.008E+15	6.972E+15	0.	0.	0.	1.588E+02
	8.073E+00	9.036E+09	2.299E+10	1.159E+06	5.809E+11	3.206E+17	0.	0.	0.	0.
	9.046E+05	-2.349E-06	1.048E-03	9.377E+00	3.007E+02	3.007E+02	1.000E+00	1.023E+06	1.583E+05	2.488E+12
	6.350E+12	3.001E+13	8.073E+00	1.516E-05	1.516E-07	1.000E+00	3.690E+01	0.	0.	0.
							3.608E+01			
2.00	1.536E+19	4.156E+18	1.811E+03	1.773E+17	9.110E+14	6.303E+15	0.	0.	0.	1.389E+02
	9.325E+00	7.715E+09	1.822E+10	1.119E+06	5.444E+11	2.002E+17	0.	0.	0.	0.
	8.670E+05	-8.260E-06	9.473E-04	1.044E+01	2.967E+02	2.967E+02	1.000E+00	1.045E+06	2.393E+05	2.169E+12
	5.453E+12	2.713E+13	9.325E+00	1.823E-05	1.823E-07	1.000E+00	2.909E+01	0.	0.	0.
							2.819E+01			
3.00	1.401E+19	3.789E+18	2.842E+03	1.616E+17	8.304E+14	5.746E+15	0.	0.	0.	1.216E+02
	1.077E+01	6.243E+09	1.353E+10	1.589E+06	5.175E+11	1.250E+17	0.	0.	0.	0.
	7.184E+05	-1.697E-05	8.635E-04	1.108E+01	2.898E+02	2.898E+02	1.000E+00	1.055E+06	3.516E+05	1.984E+12
	4.790E+12	2.473E+13	1.077E+01	2.192E-05	2.192E-07	1.000E+00	1.893E+01	0.	0.	0.
							2.641E+01			
4.00	1.281E+19	3.465E+18	4.221E+03	1.478E+17	7.595E+14	5.255E+15	0.	0.	0.	1.064E+02
	1.244E+01	4.872E+09	9.714E+09	2.518E+06	5.173E+11	7.802E+16	0.	0.	0.	0.
	6.375E+05	-2.790E-05	7.897E-04	1.124E+01	2.812E+02	2.812E+02	1.000E+00	1.055E+06	5.030E+05	1.858E+12
	4.289E+12	2.262E+13	1.244E+01	2.635E-05	2.635E-07	1.000E+00	1.074E+01	0.	0.	0.
							2.821E+01			
5.00	1.171E+19	3.168E+18	6.029E+03	1.351E+17	6.943E+14	4.804E+15	0.	0.	0.	9.307E+01
	1.417E+01	3.723E+09	6.902E+09	4.390E+06	5.406E+11	4.871E+16	0.	0.	0.	0.
	5.635E+05	-4.063E-05	7.213E-04	1.100E+01	2.719E+02	2.719E+02	1.000E+00	1.049E+06	7.015E+05	1.749E+12
	3.895E+12	2.068E+13	1.437E+01	3.169E-05	3.169E-07	1.000E+00	5.562E+00	5.488E+00	0.	0.
							3.287E+01			
6.00	1.067E+19	2.887E+18	8.388E+03	1.231E+17	6.327E+14	4.378E+15	0.	0.	0.	8.143E+01
	1.660E+01	2.826E+09	4.947E+09	7.036E+06	5.689E+11	2.133E+16	0.	0.	0.	0.
	4.960E+05	-5.483E-05	6.579E-04	1.051E+01	2.626E+02	2.626E+02	1.000E+00	1.040E+06	9.556E+05	1.635E+12
	3.570E+12	1.884E+13	1.660E+01	3.810E-05	3.810E-07	1.000E+00	2.739E+00	2.468E+00	0.	0.
							2.823E+01			
7.00	9.675E+18	2.617E+18	1.149E+04	1.116E+17	5.737E+14	3.969E+15	0.	0.	0.	7.125E+01
	1.914E+01	2.155E+09	3.628E+09	1.058E+07	5.996E+11	9.291E+15	0.	0.	0.	0.
	4.346E+05	-7.031E-05	5.963E-04	9.903E+00	2.538E+02	2.538E+02	1.000E+00	1.030E+06	1.273E+06	1.503E+12
	3.288E+12	1.709E+13	1.918E+01	4.580E-05	4.580E-07	1.000E+00	1.326E+00	1.096E+00	0.	0.
							2.455E+01			
8.00	8.717E+18	2.356E+18	1.563E+04	1.006E+17	5.163E+14	3.576E+15	0.	0.	0.	6.234E+01
	2.216E+01	1.667E+09	2.743E+09	1.502E+07	6.224E+11	4.022E+15	0.	0.	0.	0.

	3.742E+05	[illegible]	5.374E-04	9.290E+00	2.457E+02	2.457E+02	1.000E+00	1.022E+06	1.661E+06	1.354E+12
	3.076E+12	1.539E+13	2.216E+01	5.507E-05	5.507E-07	1.000E+00	6.491E-01	4.955E-01	0.	0.
							2.102E+01			
9.00	7.500E+18	2.110E+18	2.124E+04	9.000E+16	4.675E+14	3.200E+15	0.	0.	0.	5.455E+01
	2.559E+01	1.319E+09	2.167E+09	2.045E+07	6.201E+11	1.729E+15	0.	0.	0.	0.
	3.294E+05	-1.048E-04	4.609E-04	8.719E+00	2.366E+02	2.366E+02	1.000E+00	1.016E+06	2.125E+06	1.192E+12
	2.776E+12	1.377E+13	2.559E+01	6.621E-05	6.621E-07	1.000E+00	3.286E-01	2.337E-01	0.	0.
							1.733E+01			
10.00	6.930E+18	1.875E+18	2.899E+04	7.996E+16	4.109E+14	2.843E+15	0.	0.	0.	4.773E+01
	2.957E+01	1.074E+09	1.783E+09	2.726E+07	6.386E+11	7.382E+14	0.	0.	0.	0.
	2.850E+05	-1.239E-04	4.273E-04	8.212E+00	2.373E+02	2.323E+02	1.000E+00	1.015E+06	2.669E+06	1.025E+12
	2.526E+12	1.224E+13	2.957E+01	7.960E-05	7.960E-07	1.000E+00	1.751E-01	1.171E-01	0.	0.
							1.353E+01			
11.00	6.115E+18	1.654E+18	3.986E+04	7.055E+16	3.626E+14	2.509E+15	0.	0.	0.	4.176E+01
	3.415E+01	9.039E+08	1.533E+09	3.614E+07	7.514E+11	3.129E+14	0.	0.	0.	0.
	2.457E+05	-1.442E-04	3.770E-04	7.776E+00	2.271E+02	2.271E+02	1.000E+00	1.019E+06	3.294E+06	8.624E+11
	2.274E+12	1.075E+13	3.415E+01	9.571E-05	9.571E-07	1.000E+00	9.944E-02	6.316E-02	0.	0.
							9.865E+00			
12.00	5.359E+18	1.450E+18	5.536E+04	6.184E+16	3.178E+14	2.199E+15	0.	0.	0.	3.654E+01
	3.945E+01	7.876E+08	1.377E+09	4.622E+07	9.434E+11	1.318E+14	0.	0.	0.	0.
	2.112E+05	-1.659E-04	3.304E-04	7.408E+00	2.227E+02	2.227E+02	1.000E+00	1.031E+06	3.999E+06	7.118E+11
	2.020E+12	9.281E+12	3.945E+01	1.151E-04	1.151E-06	1.000E+00	6.076E-02	3.698E-02	0.	0.
							8.667E+00			
13.00	4.669E+18	1.263E+18	7.773E+04	5.387E+16	2.768E+14	1.915E+15	0.	0.	0.	3.197E+01
	4.559E+01	7.119E+08	1.289E+09	6.509E+07	1.191E+12	5.515E+13	0.	0.	0.	0.
	1.810E+05	-1.892E-04	2.878E-04	7.100E+00	2.191E+02	2.191E+02	1.000E+00	1.050E+06	4.778E+06	5.781E+11
	1.768E+12	7.896E+12	4.558E+01	1.384E-04	1.384E-06	1.000E+00	4.015E-02	2.361E-02	0.	0.
							4.156E+00			
14.00	4.045E+18	1.094E+18	1.104E+05	4.667E+16	2.398E+14	1.659E+15	0.	0.	0.	2.797E+01
	5.265E+01	6.667E+08	1.253E+09	8.885E+07	1.487E+12	2.296E+13	0.	0.	0.	0.
	1.549E+05	-2.140E-04	2.494E-04	6.847E+00	2.163E+02	2.163E+02	1.000E+00	1.078E+06	5.625E+06	4.635E+11
	1.523E+12	6.642E+12	5.265E+01	1.664E-04	1.664E-06	1.000E+00	2.874E-02	1.646E-02	0.	0.
							2.385E+00			
15.00	3.467E+18	9.432E+17	1.585E+05	4.023E+16	2.067E+14	1.430E+15	0.	0.	0.	2.447E+01
	6.082E+01	6.462E+08	1.259E+09	1.221E+08	1.836E+12	1.739E+13	0.	0.	0.	0.
	1.322E+05	-2.406E-04	2.150E-04	6.640E+00	2.142E+02	2.142E+02	1.000E+00	1.116E+06	6.528E+06	3.682E+11
	1.291E+12	5.541E+12	6.082E+01	2.000E-04	2.000E-06	1.000E+00	2.229E-02	1.251E-02	0.	0.
							2.308E+00			
16.00	2.993E+18	8.097E+17	2.298E+05	3.454E+16	1.775E+14	1.228E+15	0.	0.	0.	2.141E+01
	7.076E+01	6.465E+08	1.302E+09	1.677E+08	2.242E+12	1.354E+13	0.	0.	0.	0.
	1.128E+05	-2.691E-04	1.845E-04	6.473E+00	2.128E+02	2.128E+02	1.000E+00	1.165E+06	7.474E+06	2.908E+11
	1.076E+12	4.596E+12	7.026E+01	2.405E-04	2.405E-06	1.000E+00	1.867E-02	1.034E-02	0.	0.
							2.130E+00			
17.00	2.561E+18	6.927E+17	3.362E+05	2.955E+16	1.518E+14	1.050E+15	0.	0.	0.	1.874E+01
	8.117E+01	6.655E+08	1.378E+09	2.284E+08	2.707E+12	1.079E+13	0.	0.	0.	0.
	9.609E+04	-2.997E-04	1.579E-04	6.342E+00	2.120E+02	2.120E+02	1.000E+00	1.226E+06	8.448E+06	2.291E+11
	8.830E+11	3.798E+12	8.117E+01	2.892E-04	2.892E-06	1.000E+00	1.683E-02	9.249E-03	0.	0.
							1.876E+00			
18.00	2.184E+18	5.908E+17	4.954E+05	2.520E+16	1.295E+14	8.961E+14	0.	0.	0.	1.639E+01
	9.377E+01	7.071E+08	1.483E+09	3.057E+08	3.221E+12	9.646E+12	0.	0.	0.	0.
	8.185E+04	-3.324E-04	1.347E-04	6.241E+00	2.117E+02	2.117E+02	1.000E+00	1.302E+06	9.432E+06	1.805E+11
	7.140E+11	3.133E+12	9.377E+01	3.477E-04	3.477E-06	1.000E+00	1.622E-02	8.893E-03	0.	0.
							1.630E+00			
19.00	1.859E+18	5.028E+17	7.341E+05	2.145E+16	1.102E+14	7.626E+14	0.	0.	0.	1.434E+01
	1.083E+02	7.561E+08	1.616E+09	3.798E+08	3.761E+12	8.010E+12	0.	0.	0.	0.
	6.973E+04	-3.675E-04	1.146E-04	6.166E+00	2.119E+02	2.119E+02	1.000E+00	1.393E+06	1.041E+07	1.426E+11
	5.695E+11	2.563E+12	1.083E+02	4.180E-04	4.180E-06	1.000E+00	1.663E-02	9.130E-03	0.	0.
							1.410E+00			
20.00	1.579E+18	4.273E+17	1.092E+06	1.822E+16	9.365E+13	6.480E+14	0.	0.	0.	1.255E+01
	1.251E+02	8.272E+08	1.772E+09	5.089E+08	4.245E+12	7.130E+12	0.	0.	0.	0.

	5.342E+04	-4.051E-04	9.747E-05	6.114E+00	2.125E+02	2.125E+02	1.000E+00	1.502E+06	1.135E+07	1.133E+11
	4.49ME+11	2.132E+12	1.251E+02	5.026E-04	5.026E-06	1.000E+00	1.799E-02	9.937E-03	0.	0.
							1.163E+00			
21.00	1.340E+18	3.626E+17	1.628E+06	1.547E+16	7.948E+13	5.499E+14	0.	0.	0.	1.098E+01
	1.446E+02	9.153E+08	1.944E+09	6.297E+08	4.716E+12	6.246E+12	0.	0.	0.	0.
	5.067E+04	-4.452E-04	8.264E-05	6.083E+00	2.135E+02	2.135E+02	1.000E+00	1.631E+06	1.226E+07	9.050E+10
	3.500E+11	1.762E+12	1.446E+02	6.044E-04	6.044E-06	1.081E+00	2.040E-02	1.138E-02	0.	0.
							9.024E-01			
22.00	1.137E+18	3.076E+17	2.428E+06	1.312E+16	6.742E+13	4.665E+14	0.	0.	0.	9.608E+00
	1.670E+02	1.020E+09	2.125E+09	7.589E+08	4.945E+12	5.414E+12	0.	0.	0.	0.
	4.324E+04	-4.880E-04	7.010E-05	6.069E+00	2.149E+02	2.149E+02	1.000E+00	1.783E+06	1.310E+07	7.301E+10
	2.705E+11	1.460E+12	1.670E+02	7.267E-04	7.267E-06	2.196E+00	2.408E-02	1.360E-02	0.	0.
							6.668E-01			
23.00	9.643E+17	2.608E+17	3.616E+06	1.113E+16	5.718E+13	3.956E+14	0.	0.	0.	8.406E+00
	1.929E+02	1.139E+09	2.303E+09	8.950E+08	4.985E+12	4.672E+12	0.	0.	0.	0.
	3.695E+04	-5.336E-04	5.945E-05	6.071E+00	2.165E+02	2.165E+02	1.000E+00	1.959E+06	1.380E+07	5.936E+10
	2.075E+11	1.213E+12	1.929E+02	8.736E-04	8.736E-06	4.045E+00	2.938E-02	1.685E-02	0.	0.
							4.753E-01			
24.00	8.190E+17	2.213E+17	5.371E+06	9.438E+15	4.850E+13	3.356E+14	0.	0.	0.	7.355E+00
	2.229E+02	1.271E+09	2.466E+09	1.039E+09	4.959E+12	4.026E+12	0.	0.	0.	0.
	3.161E+04	-5.820E-04	5.043E-05	6.086E+00	2.184E+02	2.184E+02	1.000E+00	2.163E+06	1.452E+07	4.872E+10
	1.581E+11	1.010E+12	2.229E+02	1.051E-03	1.051E-05	6.888E+00	3.679E-02	2.148E-02	0.	0.
							3.299E-01			
25.00	6.943E+17	1.878E+17	7.943E+06	8.011E+15	4.117E+13	2.848E+14	0.	0.	0.	6.435E+00
	2.575E+02	1.410E+09	2.597E+09	1.194E+09	4.825E+12	3.467E+12	0.	0.	0.	0.
	2.709E+04	-6.334E-04	4.280E-05	6.114E+00	2.204E+02	2.204E+02	1.000E+00	2.398E+06	1.509E+07	4.037E+10
	1.198E+11	8.439E+11	2.575E+02	1.263E-03	1.263E-05	1.100E+01	4.701E-02	2.801E-02	0.	0.
							2.244E-01			
26.00	5.898E+17	1.595E+17	1.166E+07	6.805E+15	3.497E+13	2.420E+14	0.	0.	0.	5.631E+00
	2.975E+02	1.552E+09	2.683E+09	1.383E+09	4.560E+12	2.986E+12	0.	0.	0.	0.
	2.325E+04	-6.877E-04	3.636E-05	6.152E+00	2.227E+02	2.227E+02	1.000E+00	2.667E+06	1.554E+07	3.376E+10
	9.033E+10	7.064E+11	2.975E+02	1.519E-03	1.519E-05	1.665E+01	6.095E-02	3.710E-02	0.	0.
							1.506E-01			
27.00	5.016E+17	1.357E+17	1.707E+07	5.788E+15	2.974E+13	2.058E+14	0.	0.	0.	4.927E+00
	3.437E+02	1.690E+09	2.712E+09	1.608E+09	4.195E+12	2.572E+12	0.	0.	0.	0.
	1.998E+04	-7.451E-04	3.093E-05	6.199E+00	2.251E+02	2.251E+02	1.000E+00	2.972E+06	1.588E+07	2.849E+10
	6.770E+10	5.925E+11	3.437E+02	1.827E-03	1.827E-05	2.411E+01	7.976E-02	4.969E-02	0.	0.
							1.002E-01			
28.00	4.272E+17	1.156E+17	2.476E+07	4.929E+15	2.533E+13	1.753E+14	0.	0.	0.	4.311E+00
	3.971E+02	1.816E+09	2.677E+09	1.897E+09	3.775E+12	2.216E+12	0.	0.	0.	0.
	1.720E+04	-8.055E-04	2.634E-05	6.254E+00	2.275E+02	2.275E+02	1.000E+00	3.316E+06	1.611E+07	2.425E+10
	5.044E+10	4.977E+11	3.971E+02	2.196E-03	2.196E-05	3.361E+01	1.049E-01	6.694E-02	0.	0.
							6.639E-02			
29.00	3.643E+17	9.856E+16	3.562E+07	4.204E+15	2.160E+13	1.495E+14	0.	0.	0.	3.772E+00
	4.587E+02	1.923E+09	2.577E+09	2.279E+09	3.341E+12	1.911E+12	0.	0.	0.	0.
	1.484E+04	-8.689E-04	2.246E-05	6.317E+00	2.301E+02	2.301E+02	1.424E+00	3.700E+06	1.622E+07	2.080E+10
	3.732E+10	4.183E+11	4.587E+02	2.641E-03	2.641E-05	4.535E+01	1.381E-01	9.036E-02	0.	0.
							4.397E-02			
30.00	3.113E+17	8.420E+16	5.079E+07	3.591E+15	1.846E+13	1.277E+14	0.	0.	0.	3.300E+00
	5.300E+02	2.005E+09	2.416E+09	2.790E+09	2.921E+12	1.649E+12	0.	0.	0.	0.
	1.282E+04	-9.354E-04	1.919E-05	6.384E+00	2.327E+02	2.327E+02	2.900E+00	4.125E+06	1.622E+07	1.797E+10
	2.742E+10	3.516E+11	5.300E+02	3.176E-03	3.176E-05	5.953E+01	1.814E-01	1.218E-01	0.	0.
							2.921E-02			
31.00	2.664E+17	7.205E+16	7.177E+07	3.073E+15	1.579E+13	1.093E+14	0.	0.	0.	2.887E+00
	6.123E+02	2.056E+09	2.205E+09	3.477E+09	2.531E+12	1.425E+12	0.	0.	0.	0.
	1.109E+04	-1.005E-03	1.642E-05	6.457E+00	2.353E+02	2.353E+02	5.887E+00	4.590E+06	1.611E+07	1.561E+10
	1.999E+10	2.953E+11	6.123E+02	3.819E-03	3.819E-05	7.628E+01	2.372E-01	1.634E-01	0.	0.
							1.951E-02			
32.00	2.283E+17	6.177E+16	1.004E+08	2.635E+15	1.354E+13	9.368E+13	0.	0.	0.	2.526E+00
	7.074E+02	2.074E+09	1.959E+09	4.389E+09	2.180E+12	1.232E+12	0.	0.	0.	0.

	3.616E+03	-1.077E-03	1.406E-05	6.532E+00	2.379E+02	2.379E+02	1.175E+01	5.094E+06	1.591E+07	1.364E+10
	1.447E+10	2.477E+11	7.074E+02	4.592E-03	4.592E-05	9.563E+01	3.081E-01	2.177E-01	0.	0.
							1.313E-02			
33.00	1.961E+17	5.305E+16	1.392E+08	2.263E+15	1.163E+13	8.046E+13	0.	0.	0.	2.210E+00
	8.173E+02	2.053E+09	1.695E+09	5.575E+09	1.870E+12	1.066E+12	0.	0.	0.	0.
	8.349E+03	-1.152E-03	1.209E-05	6.611E+00	2.405E+02	2.405E+02	2.426E+01	5.632E+06	1.563E+07	1.197E+10
	1.040E+10	2.072E+11	8.173E+02	5.522E-03	5.522E-05	1.179E+02	3.969E-01	2.877E-01	0.	0.
							8.919E-03			
34.00	1.687E+17	4.565E+16	1.910E+08	1.947E+15	1.001E+13	6.923E+13	0.	0.	0.	1.934E+00
	9.443E+02	2.012E+09	1.430E+09	7.063E+09	1.593E+12	9.235E+11	0.	0.	0.	0.
	7.260E+03	-1.231E-03	1.040E-05	6.691E+00	2.431E+02	2.431E+02	4.926E+01	6.199E+06	1.527E+07	1.054E+10
	7.425E+09	1.729E+11	9.443E+02	6.640E-03	6.640E-05	1.428E+02	5.063E-01	3.764E-01	0.	0.
							6.121E-03			
35.00	1.454E+17	3.934E+16	2.594E+08	1.676E+15	8.624E+12	5.967E+13	0.	0.	0.	1.692E+00
	1.091E+03	1.937E+09	1.176E+09	8.543E+09	1.364E+12	8.009E+11	0.	0.	0.	0.
	6.322E+03	-1.312E-03	8.967E-06	6.773E+00	2.456E+02	2.456E+02	1.000E+02	6.787E+06	1.484E+07	9.305E+09
	5.273E+09	1.437E+11	1.091E+03	7.985E-03	7.985E-05	1.706E+02	6.393E-01	4.872E-01	0.	0.
							4.247E-03			
36.00	1.256E+17	3.397E+16	3.489E+08	1.449E+15	7.447E+12	5.153E+13	0.	0.	0.	1.481E+00
	1.260E+03	1.841E+09	9.449E+08	1.084E+10	1.161E+12	6.953E+11	0.	0.	0.	0.
	5.513E+03	-1.395E-03	7.743E-06	6.855E+00	2.480E+02	2.480E+02	3.314E+02	7.384E+06	1.436E+07	8.236E+09
	3.726E+09	1.189E+11	1.260E+03	9.602E-03	9.602E-05	2.011E+02	7.985E-01	6.233E-01	0.	0.
							2.982E-03			
37.00	1.086E+17	2.937E+16	4.647E+08	1.254E+15	6.442E+12	4.457E+13	0.	0.	0.	1.295E+00
	1.456E+03	1.728E+09	7.426E+08	1.293E+10	9.857E+11	6.043E+11	0.	0.	0.	0.
	4.815E+03	-1.481E-03	6.698E-06	6.938E+00	2.504E+02	2.504E+02	1.099E+03	7.980E+06	1.384E+07	7.304E+09
	2.621E+09	9.792E+10	1.456E+03	1.155E-02	1.155E-04	2.343E+02	9.861E-01	7.879E-01	0.	0.
							2.118E-03			
38.00	9.414E+16	2.547E+16	6.127E+08	1.086E+15	5.582E+12	3.862E+13	0.	0.	0.	1.133E+00
	1.683E+03	1.606E+09	5.723E+08	1.493E+10	8.351E+11	5.257E+11	0.	0.	0.	0.
	4.210E+03	-1.570E-03	5.804E-06	7.019E+00	2.527E+02	2.527E+02	3.641E+03	8.560E+06	1.328E+07	6.488E+09
	1.836E+09	8.019E+10	1.683E+03	1.388E-02	1.388E-04	2.703E+02	1.204E+00	9.839E-01	0.	0.
							1.523E-03			
39.00	8.170E+16	2.210E+16	7.999E+08	9.427E+14	4.845E+12	3.352E+13	0.	0.	0.	9.918E-01
	1.944E+03	1.479E+09	4.331E+08	1.668E+10	7.057E+11	4.578E+11	0.	0.	0.	0.
	3.686E+03	-1.662E-03	5.037E-06	7.101E+00	2.549E+02	2.549E+02	1.207E+04	9.108E+06	1.271E+07	5.771E+09
	1.280E+09	6.530E+10	1.944E+03	1.670E-02	1.670E-04	3.089E+02	1.453E+00	1.214E+00	0.	0.
							1.108E-03			
40.00	7.103E+16	1.921E+16	1.034E+09	8.196E+14	4.212E+12	2.914E+13	0.	0.	0.	8.677E-01
	2.246E+03	1.352E+09	3.275E+08	1.811E+10	5.944E+11	3.990E+11	0.	0.	0.	0.
	3.230E+03	-1.756E-03	4.379E-06	7.181E+00	2.570E+02	2.570E+02	4.000E+04	9.610E+06	1.212E+07	5.140E+09
	8.891E+08	5.285E+10	2.246E+03	2.008E-02	2.008E-04	3.500E+02	1.734E+00	1.47[illegible]E+00	0.	0.
							8.165E-04			
41.00	6.184E+16	1.673E+16	1.325E+09	7.136E+14	3.667E+12	2.537E+13	0.	0.	0.	7.592E-01
	2.595E+03	1.230E+09	2.369E+08	1.928E+10	4.990E+11	3.481E+11	0.	0.	0.	0.
	2.835E+03	-1.852E-03	3.813E-06	7.261E+00	2.590E+02	2.590E+02	4.731E+04	1.005E+07	1.152E+07	4.585E+09
	6.150E+08	4.250E+10	2.595E+03	2.415E-02	2.415E-04	3.936E+02	2.044E+00	1.778E+00	0.	0.
							6.088E-04			
42.00	5.393E+16	1.459E+16	1.681E+09	6.222E+14	3.198E+12	2.212E+13	0.	0.	0.	6.643E-01
	2.999E+03	1.113E+09	1.720E+08	2.040E+10	4.171E+11	3.040E+11	0.	0.	0.	0.
	2.490E+03	-1.950E-03	3.325E-06	7.340E+00	2.608E+02	2.608E+02	5.595E+04	1.042E+07	1.092E+07	4.097E+09
	4.237E+08	3.397E+10	2.999E+03	2.904E-02	2.904E-04	4.394E+02	2.383E+00	2.110E+00	0.	0.
							4.595E-04			
43.00	4.709E+16	1.274E+16	2.112E+09	5.434E+14	2.792E+12	1.932E+13	0.	0.	0.	5.812E-01
	3.465E+03	1.005E+09	1.237E+08	2.177E+10	3.471E+11	2.657E+11	0.	0.	0.	0.
	2.189E+03	-2.050E-03	2.903E-06	7.418E+00	2.626E+02	2.626E+02	6.617E+04	1.069E+07	1.032E+07	3.669E+09
	2.909E+08	2.698E+10	3.465E+03	3.492E-02	3.492E-04	4.875E+02	2.743E+00	2.472E+00	0.	0.
							3.512E-04			
44.00	4.118E+16	1.114E+16	2.630E+09	4.752E+14	2.442E+12	1.690E+13	0.	0.	0.	5.086E-01
	4.003E+03	9.056E+08	8.836E+07	2.381E+10	2.874E+11	2.325E+11	0.	0.	0.	0.

	1.996E+03	-2.153E-03	2.539E-06	7.496E+00	2.642E+02	2.642E+02	7.826E+04	1.088E+07	9.735E+06	3.294E+09
	1.990E+08	2.130E+10	4.003E+03	4.200E-02	4.200E-04	5.378E+02	3.120E+00	2.857E+00	0.	0.
							2.718E-04			
45.00	3.606E+16	9.755E+15	3.244E+09	4.161E+14	2.138E+12	1.480E+13	0.	0.	0.	4.450E-01
	4.676E+03	8.152E+08	6.280E+07	2.696E+10	2.367E+11	2.017E+11	0.	0.	0.	0.
	1.646E+03	-2.257E-03	2.223E-06	7.573E+00	2.657E+02	2.657E+02	9.256E+04	1.096E+07	9.159E+06	2.967E+09
	1.358E+08	1.672E+10	4.626E+03	5.050E-02	5.050E-04	5.900E+02	3.502E+00	3.254E+00	0.	0.
							2.113E-04			
46.00	3.162E+16	8.554E+15	3.964E+09	3.649E+14	1.875E+12	1.297E+13	0.	0.	0.	3.893E-01
	5.345E+03	7.337E+08	4.450E+07	3.163E+10	1.937E+11	1.759E+11	0.	0.	0.	0.
	1.495E+03	-2.362E-03	1.950E-06	7.650E+00	2.670E+02	2.670E+02	1.095E+05	1.094E+07	8.596E+06	2.683E+09
	9.239E+07	1.305E+10	5.345E+03	6.074E-02	6.074E-04	6.441E+02	3.878E+00	3.650E+00	0.	0.
							1.672E-04			
47.00	2.777E+16	7.511E+15	4.800E+09	3.204E+14	1.646E+12	1.139E+13	0.	0.	0.	3.407E-01
	6.176E+03	6.604E+08	3.151E+07	3.771E+10	1.576E+11	1.533E+11	0.	0.	0.	0.
	1.318E+03	-2.468E-03	1.712E-06	7.726E+00	2.682E+02	2.682E+02	1.295E+05	1.082E+07	8.048E+06	2.437E+09
	6.269E+07	1.014E+10	6.176E+03	7.304E-02	7.304E-04	7.000E+02	4.232E+00	4.028E+00	0.	0.
							1.342E-04			
48.00	2.441E+16	6.603E+15	5.759E+09	2.817E+14	1.447E+12	1.001E+13	0.	0.	0.	2.981E-01
	7.136E+03	5.947E+08	2.234E+07	4.357E+10	1.274E+11	1.336E+11	0.	0.	0.	0.
	1.163E+03	-2.575E-03	1.505E-06	7.803E+00	2.691E+02	2.691E+02	1.531E+05	1.061E+07	7.515E+06	2.226E+09
	4.239E+07	7.845E+09	7.136E+03	8.785E-02	8.785E-04	6.781E+02	4.546E+00	4.368E+00	0.	0.
							1.092E-04			
49.00	2.149E+16	5.813E+15	6.846E+09	2.479E+14	1.274E+12	8.816E+12	0.	0.	0.	2.608E-01
	8.246E+03	5.357E+08	1.588E+07	4.463E+10	1.023E+11	1.164E+11	0.	0.	0.	0.
	1.026E+03	-2.682E-03	1.325E-06	7.879E+00	2.699E+02	2.699E+02	1.811E+05	1.032E+07	6.998E+06	2.046E+09
	2.852E+07	6.045E+09	8.245E+03	1.056E-01	1.056E-03	6.559E+02	4.802E+00	4.647E+00	0.	0.
							9.033E-05			
50.00	1.894E+16	5.123E+15	8.063E+09	2.185E+14	1.123E+12	7.769E+12	0.	0.	0.	2.282E-01
	9.528E+03	4.626E+08	1.134E+07	3.500E+10	8.160E+10	1.014E+11	0.	0.	0.	0.
	9.053E+02	-2.789E-03	1.168E-06	7.955E+00	2.704E+02	2.704E+02	2.142E+05	9.957E+06	6.496E+06	1.894E+09
	1.993E+07	4.643E+09	9.528E+03	1.271E-01	1.271E-03	6.334E+02	4.981E+00	4.843E+00	0.	0.
							7.598E-05			
51.00	1.671E+16	4.520E+15	9.409E+09	1.928E+14	9.909E+11	6.856E+12	0.	0.	0.	1.996E-01
	1.101E+04	4.346E+08	8.145E+06	3.177E+10	6.469E+10	8.825E+10	0.	0.	0.	0.
	8.004E+02	-2.896E-03	1.030E-06	8.029E+00	2.706E+02	2.706E+02	2.533E+05	9.534E+06	6.008E+06	1.767E+09
	1.254E+07	3.558E+09	1.101E+04	1.528E-01	1.528E-03	6.106E+02	5.060E+00	4.936E+00	0.	0.
							6.509E-05			
52.00	1.476E+16	3.993E+15	1.088E+10	1.703E+14	8.753E+11	6.056E+12	0.	0.	0.	1.747E-01
	1.272E+04	3.911E+08	5.893E+06	2.883E+10	5.097E+10	7.677E+10	0.	0.	0.	0.
	7.069E+02	-3.001E-03	9.101E-07	8.102E+00	2.705E+02	2.705E+02	2.996E+05	9.067E+06	5.535E+06	1.662E+09
	8.076E+06	2.722E+09	1.272E+04	1.838E-01	1.838E-03	5.875E+02	5.042E+00	4.911E+00	0.	0.
							5.687E-05			
53.00	1.305E+16	3.531E+15	1.246E+10	1.506E+14	7.741E+11	5.356E+12	0.	0.	0.	1.528E-01
	1.470E+04	3.513E+08	4.300E+06	2.617E+10	3.993E+10	6.674E+10	0.	0.	0.	0.
	6.243E+02	-3.104E-03	8.049E-07	8.171E+00	2.702E+02	2.702E+02	3.543E+05	8.571E+06	5.075E+06	1.578E+09
	5.072E+06	2.080E+09	1.470E+04	2.210E-01	2.210E-03	5.641E+02	4.905E+00	4.760E+00	0.	0.
							5.075E-05			
54.00	1.156E+16	3.126E+15	1.415E+10	1.333E+14	6.853E+11	4.741E+12	0.	0.	0.	1.337E-01
	1.699E+04	3.140E+08	3.166E+06	2.375E+10	3.111E+10	5.798E+10	0.	0.	0.	0.
	5.512E+02	-3.205E-03	7.125E-07	8.237E+00	2.695E+02	2.695E+02	4.191E+05	8.050E+06	4.627E+06	1.512E+09
	3.039E+06	1.589E+09	1.699E+04	2.658E-01	2.658E-03	5.404E+02	4.654E+00	4.486E+00	0.	0.
							4.634E-05			
55.00	1.024E+16	2.770E+15	1.592E+10	1.182E+14	6.072E+11	4.201E+12	0.	0.	0.	1.170E-01
	1.963E+04	2.811E+08	2.355E+06	2.155E+10	2.455E+10	5.033E+10	0.	0.	0.	0.
	4.865E+02	-3.303E-03	6.313E-07	8.296E+00	2.684E+02	2.684E+02	4.956E+05	7.540E+06	4.192E+06	1.464E+09
	1.703E+06	1.215E+09	1.963E+04	3.197E-01	3.197E-03	5.165E+02	4.301E+00	4.103E+00	0.	0.
							4.336E-05			
56.00	9.041E+15	2.457E+15	1.776E+10	1.048E+14	5.385E+11	3.726E+12	0.	0.	0.	1.024E-01
	2.268E+04	2.500E+08	1.770E+06	1.956E+10	2.110E+10	4.365E+10	0.	0.	0.	0.

	4.292E+02	-3.397E-03	5.599E-07	8.351E+00	2.670E+02	2.670E+02	5.862E+05	7.029E+06	3.770E+06	1.432E+09
	1.515E+06	9.292E+08	2.268E+04	3.346E-01	3.346E-03	4.923E+02	3.865E+00	3.636E+00	0.	0.
							4.163E-05			
57.00	8.059E+15	2.180E+15	1.964E+10	9.299E+13	4.779E+11	3.306E+12	0.	0.	0.	4.958E-02
	2.621E+04	2.213E+08	1.346E+06	1.775E+10	1.727E+10	1.782E+10	0.	0.	0.	0.
	3.783E+02	-3.487E-03	4.969E-07	8.395E+00	2.652E+02	2.652E+02	6.933E+05	6.532E+06	3.360E+06	1.415E+09
	1.344E+06	7.120E+08	2.621E+04	4.625E-01	4.625E-03	4.679E+02	3.371E+00	3.117E+00	0.	0.
							4.108E-05			
58.00	7.156E+15	1.936E+15	2.153E+10	8.257E+13	4.243E+11	2.936E+12	0.	0.	0.	7.837E-02
	3.029E+04	1.947E+08	1.034E+06	1.611E+10	1.371E+10	3.273E+10	0.	0.	0.	0.
	3.332E+02	-3.572E-03	4.412E-07	8.428E+00	2.631E+02	2.631E+02	8.199E+05	6.057E+06	2.965E+06	1.414E+09
	1.193E+06	5.467E+08	3.029E+04	5.563E-01	5.563E-03	4.434E+02	2.850E+00	2.580E+00	0.	0.
							4.172E-05			
59.00	6.356E+15	1.719E+15	2.342E+10	7.334E+13	3.769E+11	2.608E+12	0.	0.	0.	6.857E-02
	3.501E+04	1.702E+08	8.043E+05	1.162E+10	1.071E+10	2.829E+10	0.	0.	0.	0.
	2.932E+02	-3.652E-03	3.919E-07	8.447E+00	2.606E+02	2.606E+02	9.697E+05	5.608E+06	2.585E+06	1.427E+09
	1.060E+06	4.208E+08	3.501E+04	6.692E-01	6.692E-03	4.187E+02	2.332E+00	2.061E+00	0.	0.
							4.364E-05			
60.00	5.647E+15	1.528E+15	2.528E+10	6.515E+13	3.348E+11	2.317E+12	0.	0.	0.	6.000E-02
	4.046E+04	1.478E+08	6.325E+05	1.327E+10	8.299E+09	2.443E+10	0.	0.	0.	0.
	2.576E+02	-3.726E-03	3.481E-07	8.452E+00	2.577E+02	2.577E+02	1.147E+06	5.189E+06	2.224E+06	1.455E+09
	9.416E+05	3.247E+08	4.046E+04	8.049E-01	8.049E-03	3.938E+02	1.846E+00	1.586E+00	0.	0.
							4.708E-05			
61.00	5.016E+15	1.357E+15	2.709E+10	5.786E+13	2.974E+11	2.058E+12	0.	0.	0.	7.801E-02
	4.675E+04	1.273E+08	5.031E+05	1.205E+10	6.429E+09	2.106E+10	0.	0.	0.	0.
	2.260E+02	-3.794E-03	3.093E-07	8.439E+00	2.545E+02	2.545E+02	1.356E+06	4.801E+06	1.883E+06	1.497E+09
	8.364E+05	2.514E+08	4.675E+04	9.681E-01	9.681E-03	3.690E+02	1.412E+00	1.176E+00	0.	0.
							5.239E-05			
62.00	4.455E+15	1.205E+15	2.884E+10	5.140E+13	2.641E+11	1.828E+12	0.	0.	0.	1.024E-01
	5.403E+04	1.089E+08	4.045E+05	1.093E+10	4.996E+09	1.813E+10	0.	0.	0.	0.
	1.979E+02	-3.856E-03	2.747E-07	8.407E+00	2.510E+02	2.510E+02	1.604E+06	4.444E+06	1.566E+06	1.555E+09
	7.427E+05	1.952E+08	5.403E+04	1.164E+00	1.164E-02	3.441E+02	1.044E+00	8.395E-01	0.	0.
							6.018E-05			
63.00	3.954E+15	1.070E+15	3.051E+10	4.562E+13	2.344E+11	1.622E+12	0.	0.	0.	1.319E-01
	6.244E+04	9.250E+07	3.287E+05	9.923E+09	3.901E+09	1.558E+10	0.	0.	0.	0.
	1.730E+02	-3.912E-03	2.438E-07	8.356E+00	2.472E+02	2.472E+02	1.897E+06	4.119E+06	1.276E+06	1.628E+09
	6.592E+05	1.521E+08	6.244E+04	1.401E+00	1.401E-02	3.192E+02	7.454E-01	5.775E-01	0.	0.
							7.133E-05			
64.00	3.506E+15	9.484E+14	3.210E+10	4.046E+13	2.079E+11	1.438E+12	0.	0.	0.	1.714E-01
	7.217E+04	7.799E+07	2.697E+05	9.006E+09	3.058E+09	1.336E+10	0.	0.	0.	0.
	1.510E+02	-3.961E-03	2.162E-07	8.284E+00	2.432E+02	2.432E+02	2.244E+06	3.822E+06	1.015E+06	1.717E+09
	5.845E+05	1.188E+08	7.216E+04	1.685E+00	1.685E-02	2.945E+02	5.144E-01	3.831E-01	0.	0.
							8.722E-05			
65.00	3.105E+15	8.401E+14	3.362E+10	3.583E+13	1.841E+11	1.274E+12	0.	0.	0.	2.229E-01
	8.340E+04	6.532E+07	2.235E+05	8.174E+09	2.402E+09	1.144E+10	0.	0.	0.	0.
	1.314E+02	-4.008E-03	1.915E-07	8.193E+00	2.390E+02	2.390E+02	2.654E+06	3.553E+06	7.870E+05	1.822E+09
	5.177E+05	9.306E+07	8.340E+04	2.027E+00	2.027E-02	2.700E+02	3.434E-01	2.453E-01	0.	0.
							1.099E-04			
66.00	2.746E+15	7.429E+14	3.506E+10	3.169E+13	1.629E+11	1.127E+12	0.	0.	0.	2.898E-01
	9.639E+04	5.438E+07	1.868E+05	7.419E+09	1.886E+09	9.769E+09	0.	0.	0.	0.
	1.141E+02	-4.047E-03	1.693E-07	8.083E+00	2.347E+02	2.347E+02	3.139E+06	3.308E+06	1.033E+06	1.943E+09
	4.579E+05	7.309E+07	9.639E+04	2.438E+00	2.438E-02	2.458E+02	2.221E-01	1.520E-01	0.	0.
							1.425E-04			
67.00	2.425E+15	6.558E+14	3.646E+10	2.798E+13	1.438E+11	9.947E+11	0.	0.	0.	3.768E-01
	1.114E+05	4.506E+07	1.574E+05	6.733E+09	1.476E+09	8.325E+09	0.	0.	0.	0.
	9.878E+01	-4.082E-03	1.495E-07	7.956E+00	2.302E+02	2.302E+02	3.712E+06	3.084E+06	1.357E+06	2.079E+09
	4.042E+05	5.752E+07	1.114E+05	2.932E+00	2.932E-02	2.219E+02	1.394E-01	9.127E-02	0.	0.
							1.898E-04			
68.00	2.136E+15	5.777E+14	3.783E+10	2.464E+13	1.266E+11	8.762E+11	0.	0.	0.	4.898E-01
	1.288E+05	3.720E+07	1.336E+05	6.111E+09	1.147E+09	7.076E+09	0.	0.	0.	0.

	8.537E+01	-4.111E-03	1.317E-07	7.313E+00	2.256E+02	2.256E+02	4.391E+06	2.679E+06	1.782E+06	2.231E+09
	3.560E+05	4.539E+07	1.288E+05	3.528E+00	3.528E-02	1.988E+02	8.509E-02	5.331E-02	0.	0.
							2.591E-04			
69.00	1.877E+15	5.077E+14	3.921E+10	2.165E+13	1.113E+11	7.699E+11	0.	0.	0.	6.369E-01
	1.485E+05	3.064E+07	1.141E+05	5.546E+09	8.841E+08	5.998E+09	0.	0.	0.	0.
	7.344E+01	-4.141E-03	1.157E-07	7.657E+00	2.211E+02	2.211E+02	5.173E+06	2.688E+06	2.340E+06	2.396E+09
	3.129E+05	3.578E+07	1.488E+05	4.243E+00	4.243E-02	1.759E+02	5.069E-02	3.039E-02	0.	0.
							3.611E-04			
70.00	1.645E+15	4.449E+14	4.062E+10	1.898E+13	9.752E+10	6.747E+11	0.	0.	0.	8.280E-01
	1.720E+05	2.522E+07	3.808E+04	5.034E+09	6.742E+08	5.069E+09	0.	0.	0.	0.
	6.304E+01	-4.166E-03	1.014E-07	7.491E+00	2.165E+02	2.165E+02	6.141E+06	2.507E+06	3.073E+06	2.571E+09
	2.742E+05	2.825E+07	1.720E+05	5.105E+00	5.105E-02	1.539E+02	2.957E-02	1.697E-02	0.	0.
							5.125E-04			
71.00	1.437E+15	3.887E+14	4.212E+10	1.658E+13	8.520E+10	5.895E+11	0.	0.	0.	1.077E+00
	1.988E+05	2.078E+07	8.471E+04	4.569E+09	5.090E+08	4.270E+09	0.	0.	0.	0.
	5.394E+01	-4.188E-03	8.459E-08	7.318E+00	2.121E+02	2.121E+02	7.263E+06	2.334E+06	4.036E+06	2.755E+09
	2.395E+05	2.230E+07	1.988E+05	6.141E+00	6.141E-02	1.329E+02	1.696E-02	9.326E-03	0.	0.
							7.373E-04			
72.00	1.251E+15	3.385E+14	4.374E+10	1.444E+13	7.419E+10	5.133E+11	0.	0.	0.	1.400E+00
	2.298E+05	1.718E+07	7.348E+04	4.147E+09	3.812E+08	3.585E+09	0.	0.	0.	0.
	4.600E+01	-4.210E-03	7.714E-08	7.140E+00	2.077E+02	2.077E+02	8.590E+06	2.163E+06	5.299E+06	2.942E+09
	2.088E+05	1.759E+07	2.298E+05	7.387E+00	7.387E-02	1.129E+02	9.604E-03	5.070E-03	0.	0.
							1.070E-03			
73.00	1.046E+15	2.937E+14	4.555E+10	1.253E+13	6.438E+10	4.454E+11	0.	0.	0.	1.820E+00
	2.656E+05	1.427E+07	6.397E+04	3.763E+09	2.846E+08	2.999E+09	0.	0.	0.	0.
	3.910E+01	-4.231E-03	6.694E-08	6.960E+00	2.035E+02	2.035E+02	1.016E+07	1.993E+06	6.959E+06	3.126E+09
	1.810E+05	1.386E+07	2.656E+05	8.887E+00	8.887E-02	9.415E+01	5.399E-03	2.740E-03	0.	0.
							1.560E-03			
74.00	9.387E+14	2.539E+14	4.761E+10	1.083E+13	5.566E+10	3.851E+11	0.	0.	0.	2.366E+00
	3.070E+05	1.193E+07	5.584E+04	3.416E+09	2.134E+08	2.498E+09	0.	0.	0.	0.
	3.313E+01	-4.253E-03	5.787E-08	6.781E+00	1.994E+02	1.994E+02	1.202E+07	1.820E+06	9.138E+06	3.302E+09
	1.565E+05	1.089E+07	3.070E+05	1.069E+01	1.069E-01	7.681E+01	3.028E-03	1.481E-03	0.	0.
							2.271E-03			
75.00	8.084E+14	2.187E+14	4.998E+10	9.328E+12	4.793E+10	3.316E+11	0.	0.	0.	3.076E+00
	3.548E+05	1.037E+07	4.895E+04	3.100E+09	1.626E+08	2.072E+09	0.	0.	0.	0.
	2.798E+01	-4.275E-03	4.984E-08	6.605E+00	1.955E+02	1.955E+02	1.421E+07	1.641E+06	1.200E+07	3.461E+09
	1.348E+05	8.544E+06	3.548E+05	1.286E+01	1.286E-01	6.103E+01	1.705E-03	8.056E-04	0.	0.
							3.282E-03			
76.00	6.934E+14	1.876E+14	5.276E+10	8.001E+12	4.112E+10	2.845E+11	0.	0.	0.	3.999E+00
	4.101E+05	8.581E+06	4.281E+04	2.719E+09	1.245E+08	1.711E+09	0.	0.	0.	0.
	2.355E+01	-4.300E-03	4.275E-08	6.434E+00	1.919E+02	1.919E+02	1.681E+07	1.456E+06	1.147E+07	3.597E+09
	1.156E+05	6.680E+06	4.101E+05	1.547E+01	1.547E-01	4.697E+01	9.688E-04	4.435E-04	0.	0.
							4.679E-03			
77.00	5.924E+14	1.602E+14	5.602E+10	6.836E+12	3.513E+10	2.430E+11	0.	0.	0.	5.199E+00
	4.741E+05	7.494E+06	3.755E+04	2.343E+09	9.826E+07	1.405E+09	0.	0.	0.	0.
	1.976E+01	-4.327E-03	3.652E-08	6.270E+00	1.885E+02	1.885E+02	1.988E+07	1.265E+06	1.097E+07	3.702E+09
	9.876E+04	5.205E+06	4.741E+05	1.862E+01	1.862E-01	3.478E+01	5.592E-04	2.487E-04	0.	0.
							6.538E-03			
78.00	5.040E+14	1.353E+14	5.987E+10	5.816E+12	2.989E+10	2.068E+11	0.	0.	0.	6.760E+00
	5.480E+05	6.475E+06	3.296E+04	2.094E+09	8.376E+07	1.148E+09	0.	0.	0.	0.
	1.653E+01	-4.358E-03	3.108E-08	6.113E+00	1.853E+02	1.853E+02	2.351E+07	1.071E+06	1.049E+07	3.770E+09
	8.403E+04	4.040E+06	5.480E+05	2.240E+01	2.240E-01	2.454E+01	3.300E-04	1.429E-04	0.	0.
							8.090E-03			
79.00	4.271E+14	1.153E+14	6.444E+10	[illegible]	2.533E+10	1.752E+11	0.	0.	0.	8.789E+00
	6.335E+05	5.747E+06	2.893E+04	1.777E+09	7.357E+07	7.316E+08	0.	0.	0.	0.
	1.377E+01	-4.393E-03	2.633E-08	5.966E+00	1.824E+02	1.824E+02	2.781E+07	8.788E+05	1.003E+07	3.794E+09
	7.171E+04	3.123E+06	6.334E+05	2.695E+01	2.695E-01	1.627E+01	2.003E-04	8.474E-05	0.	0.
							1.172E-02			
80.00	3.673E+14	9.749E+13	6.947E+10	4.159E+12	2.137E+10	1.477E+11	0.	0.	0.	1.143E+01
	7.323E+05	5.194E+06	2.537E+04	2.050E+09	6.086E+07	7.512E+08	0.	0.	0.	0.

	1.140E+01	-1.433E-03	2.222E-05	3.320E+00	1.740E+02	1.730E+02	3.283E+07	6.336E+05	9.593E+06	3.772E+09
	5.010E+04	2.454E+06	7.322E+05	3.242E+01	3.242E-01	1.003E+01	1.256E-04	5.213E-05	0.	0.
							1.483E-02			
81.00	3.041E+14	5.174E+13	7.631E+10	3.497E+12	1.797E+10	1.243E+11	0.	0.	0.	1.446E+01
	6.465E+05	4.750E+06	2.227E+04	2.243E+09	6.948E+07	6.014E+08	0.	0.	0.	0.
	9.524E+00	-4.474E-03	1.868E-08	5.700E+00	1.775E+02	1.775E+02	3.889E+07	4.364E+05	3.652E+06	3.702E+09
	5.052E+04	1.643E+06	8.464E+05	3.701E+01	3.701E-01	1.245E+01	8.223E-05	3.348E-05	0.	0.
							1.792E-02			
82.00	2.533E+14	6.852E+13	8.394E+10	2.929E+12	1.505E+10	1.041E+11	0.	0.	0.	1.932E+01
	9.785E+05	4.448E+06	1.952E+04	2.560E+09	1.031E+08	4.776E+08	0.	0.	0.	0.
	7.846E+00	-4.530E-03	1.565E-08	5.582E+00	1.755E+02	1.755E+02	4.600E+07	2.752E+05	1.390E+06	3.586E+09
	4.232E+04	1.406E+06	9.785E+05	4.693E+01	4.693E-01	1.550E+01	5.627E-05	2.257E-05	0.	0.
							2.057E-02			
83.00	2.118E+14	5.725E+13	9.298E+10	2.444E+12	1.256E+10	8.690E+10	0.	0.	0.	2.511E+01
	1.131E+06	4.240E+06	1.710E+04	2.761E+09	1.130E+08	3.761E+08	0.	0.	0.	0.
	6.514E+00	-4.588E-03	1.306E-08	5.176E+00	1.738E+02	1.738E+02	5.440E+07	1.733E+05	5.292E+05	3.426E+09
	3.532E+04	1.069E+06	1.131E+06	5.647E+01	5.647E-01	1.930E+01	4.052E-05	1.605E-05	0.	0.
							2.227E-02			
84.00	1.762E+14	4.760E+13	1.036E+11	2.033E+12	1.045E+10	7.227E+10	0.	0.	0.	3.265E+01
	1.398E+06	4.127E+06	1.496E+04	3.353E+09	1.320E+08	2.934E+08	0.	0.	0.	0.
	5.378E+00	-4.654E-03	1.086E-08	5.380E+00	1.724E+02	1.724E+02	6.434E+07	1.092E+05	2.014E+05	3.230E+09
	2.937E+04	8.104E+05	1.308E+06	6.795E+01	6.795E-01	2.402E+01	0.	0.	0.	0.
							0.			
85.00	1.461E+14	3.945E+13	1.162E+11	1.685E+12	6.661E+09	5.992E+10	0.	0.	0.	4.245E+01
	1.512E+06	4.107E+06	1.308E+04	3.600E+09	1.356E+08	2.266E+08	0.	0.	0.	0.
	4.432E+00	-4.723E-03	9.005E-09	5.295E+00	1.714E+02	1.714E+02	7.610E+07	6.876E+04	7.668E+04	3.004E+09
	2.436E+04	6.123E+05	1.512E+06	8.176E+01	8.176E-01	2.991E+01	0.	0.	0.	0.
							0.			
86.00	1.208E+14	3.260E+13	1.308E+11	1.393E+12	7.161E+09	4.955E+10	0.	0.	0.	5.519E+01
	1.748E+06	4.183E+06	1.142E+04	3.562E+09	1.251E+08	1.731E+08	0.	0.	0.	0.
	3.649E+00	-4.812E-03	7.446E-09	5.221E+00	1.706E+02	1.706E+02	9.000E+07	4.331E+04	4.626E+04	2.757E+09
	2.014E+04	4.615E+05	1.748E+06	9.838E+01	9.838E-01	3.723E+01	0.	0.	0.	0.
							0.			
87.00	9.960E+13	2.647E+13	1.478E+11	1.149E+12	5.906E+09	4.086E+10	0.	0.	0.	7.175E+01
	2.071E+06	4.369E+06	9.972E+03	3.187E+09	1.019E+08	1.308E+08	0.	0.	0.	0.
	3.002E+00	-4.905E-03	6.140E-09	5.158E+00	1.702E+02	1.702E+02	8.325E+07	2.728E+04	2.791E+04	2.498E+09
	1.661E+04	3.473E+05	2.021E+06	1.184E+02	1.184E+00	4.635E+01	0.	0.	0.	0.
							0.			
88.00	8.196E+13	2.209E+13	1.673E+11	9.457E+11	4.660E+09	3.363E+10	0.	0.	0.	9.329E+01
	2.336E+06	4.686E+06	8.699E+03	2.565E+09	7.343E+07	9.753E+07	0.	0.	0.	0.
	2.470E+00	-5.009E-03	5.053E-09	5.106E+00	1.701E+02	1.701E+02	7.700E+07	1.718E+04	1.684E+04	2.236E+09
	1.367E+04	2.612E+05	2.336E+06	1.424E+02	1.424E+00	5.771E+01	0.	0.	0.	0.
							0.			
89.00	6.733E+13	1.812E+13	1.894E+11	7.768E+11	3.992E+09	2.762E+10	0.	0.	0.	1.213E+02
	2.701E+06	5.166E+06	7.587E+03	1.481E+09	4.795E+07	7.190E+07	0.	0.	0.	0.
	2.032E+00	-5.124E-03	4.151E-09	5.063E+00	1.703E+02	1.703E+02	7.122E+07	1.082E+04	1.016E+04	1.978E+09
	1.124E+04	1.966E+05	2.701E+06	1.714E+02	1.714E+00	7.184E+01	0.	0.	0.	0.
							0.			
90.00	5.522E+13	1.483E+13	2.141E+11	6.172E+11	3.274E+09	2.266E+10	1.353E+04	4.932E-04	9.887E+03	1.577E+02
	3.123E+06	5.862E+06	6.616E+03	1.300E+09	2.990E+07	5.227E+07	1.497E+04	4.001E-04	1.499E+04	3.869E-10
	1.673E+00	-5.251E-03	3.405E-09	5.032E+00	1.709E+02	1.709E+02	6.587E+07	6.817E+03	6.130E+03	1.731E+09
	9.220E+03	1.481E+05	3.123E+06	2.063E+02	2.063E+00	8.944E+01	0.	0.	1.810E+00	3.645E+03
							0.			
91.00	4.525E+13	1.212E+13	2.412E+11	5.221E+11	2.683E+09	1.850E+10	1.653E+04	1.233E-03	1.200E+04	2.338E+02
	3.611E+06	6.847E+06	5.770E+03	8.883E+08	1.868E+07	3.748E+07	1.829E+04	1.004E-03	1.829E+04	9.834E-10
	1.378E+00	-5.390E-03	2.790E-09	5.010E+00	1.718E+02	1.718E+02	6.093E+07	4.294E+03	3.698E+03	1.499E+09
	7.559E+03	1.118E+05	3.610E+06	2.482E+02	2.482E+00	1.114E+02	0.	0.	2.387E+00	4.526E+03
							0.			
92.00	3.705E+13	9.288E+12	2.703E+11	4.275E+11	2.197E+09	1.520E+10	2.019E+04	3.077E-03	1.462E+04	3.469E+02
	4.175E+06	8.227E+06	5.036E+03	6.070E+08	1.167E+07	2.650E+07	2.236E+04	2.522E-03	2.236E+04	2.502E-09

	1.137E+00	-5.544E-03	2.284E-09	4.994E+00	1.730E+02	1.730E+02	5.636E+07	2.704E+03	2.231E+03	1.287E+09
	6.144E+03	3.470E+04	4.174E+06	2.987E+02	2.987E+00	1.386E+02	0.	0.	3.171E+00	5.566E+03
							0.			
93.00	3.033E+13	3.054E+12	3.066E+11	3.300E+11	1.798E+09	1.249E+10	2.466E+04	7.650E-03	1.787E+04	5.152E+02
	4.827E+06	1.014E+07	4.398E+03	4.148E+06	7.282E+06	1.847E+07	2.737E+04	6.313E-03	2.737E+04	6.361E-09
	9.402E-01	-5.712E-03	1.370E-09	4.996E+00	1.745E+02	1.745E+02	5.213E+07	1.703E+03	1.346E+03	1.096E+09
	5.075E+03	6.453E+04	4.826E+06	3.595E+02	3.595E+00	1.726E+02	4.598E-05	1.830E-05	4.251E+00	6.787E+03
							9.676E-04			
94.00	2.493E+13	6.551E+12	3.310E+11	2.865E+11	1.472E+09	1.019E+10	3.012E+04	1.886E-02	2.190E+04	7.658E+02
	5.541E+06	1.275E+07	3.846E+03	2.835E+08	4.546E+06	1.270E+07	3.354E+04	1.571E-02	3.354E+04	1.614E-08
	7.788E-01	-5.875E-03	1.531E-09	5.003E+00	1.763E+02	1.763E+02	4.821E+07	1.073E+03	8.122E+02	9.266E+08
	4.161E+03	4.940E+04	5.581E+06	4.326E+02	4.326E+00	2.147E+02	6.518E-05	2.629E-05	5.763E+00	8.215E+03
							4.741E-04			
95.00	2.334E+13	5.321E+12	3.604E+11	2.347E+11	1.206E+09	8.344E+09	3.679E+04	4.613E-02	2.688E+04	1.138E+03
	6.533E+06	1.621E+07	3.368E+03	1.937E+08	2.839E+06	8.610E+06	4.114E+04	3.872E-02	4.114E+04	4.083E-08
	6.467E-01	-6.095E-03	1.254E-09	5.020E+00	1.784E+02	1.784E+02	4.460E+07	6.758E+02	4.900E+02	7.790E+08
	3.414E+03	3.806E+04	6.453E+06	5.206E+02	5.206E+00	2.675E+02	9.691E-05	3.973E-05	7.911E+00	9.898E+03
							2.188E-04			
96.00	1.667E+13	4.317E+12	3.870E+11	1.324E+11	9.886E+08	6.840E+09	4.493E+04	1.112E-01	3.299E+04	1.690E+03
	7.462E+06	2.052E+07	2.355E+03	1.124E+08	1.775E+06	5.764E+06	5.047E+04	9.420E-02	5.047E+04	1.027E-07
	5.385E-01	-6.313E-03	1.028E-09	5.040E+00	1.808E+02	1.808E+02	4.125E+07	4.257E+02	2.956E+02	6.517E+08
	2.804E+03	2.954E+04	7.462E+06	6.266E+02	6.266E+00	3.330E+02	1.503E-04	6.280E-05	1.100E+01	1.193E+04
							9.570E-05			
97.00	1.368E+13	3.497E+12	4.092E+11	1.579E+11	8.114E+08	5.614E+09	5.488E+04	2.632E-01	4.037E+04	2.504E+03
	8.629E+06	2.531E+07	2.598E+03	9.045E+07	1.111E+06	3.813E+06	6.189E+04	2.252E-01	6.189E+04	2.562E-07
	4.497E-01	-6.549E-03	8.437E-10	5.081E+00	1.835E+02	1.835E+02	3.815E+07	2.681E+02	1.784E+02	5.433E+08
	2.308E+03	2.310E+04	8.628E+06	7.541E+02	7.541E+00	4.146E+02	2.422E-04	1.034E-04	1.552E+01	1.450E+04
							3.989E-05			
98.00	1.125E+13	2.830E+12	4.254E+11	1.299E+11	6.670E+08	4.615E+09	6.703E+04	6.092E-01	4.903E+04	3.691E+03
	9.978E+06	2.944E+07	2.289E+03	6.180E+07	6.964E+05	2.490E+06	7.574E+04	5.266E-01	7.574E+04	6.320E-07
	3.768E-01	-6.804E-03	6.935E-10	5.126E+00	1.865E+02	1.865E+02	3.529E+07	1.689E+02	1.076E+02	4.517E+08
	1.903E+03	1.821E+04	9.977E+06	9.076E+02	9.076E+00	5.162E+02	4.032E-04	1.764E-04	2.215E+01	1.798E+04
							1.594E-05			
99.00	9.264E+12	2.287E+12	4.343E+11	1.069E+11	5.493E+08	3.801E+09	8.187E+04	1.372E+00	5.877E+04	5.394E+03
	1.154E+07	3.088E+07	2.023E+03	4.223E+07	4.373E+05	1.620E+06	9.230E+04	1.198E+00	9.236E+04	1.536E-06
	3.169E-01	-7.081E-03	5.712E-10	5.179E+00	1.898E+02	1.898E+02	3.264E+07	1.064E+02	6.492E+01	3.751E+08
	1.573E+03	1.447E+04	1.154E+07	1.092E+03	1.092E+01	6.426E+02	6.917E-04	3.110E-04	3.196E+01	2.307E+04
							6.137E-06			
100.00	7.646E+12	1.851E+12	4.350E+11	3.822E+10	4.534E+08	3.137E+09	1.000E+05	2.988E+00	6.909E+04	7.790E+03
	1.334E+07	2.746E+07	1.793E+03	2.886E+07	2.752E+05	1.043E+06	1.120E+05	2.637E+00	1.120E+05	3.668E-06
	2.675E-01	-7.372E-03	4.714E-10	5.241E+00	1.934E+02	1.934E+02	3.019E+07	6.700E+01	3.917E+01	3.112E+08
	1.303E+03	1.159E+04	1.334E+07	1.315E+03	1.315E+01	8.000E+02	1.220E-03	5.657E-04	4.646E+01	3.086E+04
							2.286E-06			
101.00	6.326E+12	1.498E+12	4.272E+11	7.299E+10	3.751E+08	2.619E+09	1.070E+05	4.554E+00	7.103E+04	8.048E+03
	1.586E+07	2.892E+07	1.594E+03	1.772E+07	1.736E+05	6.712E+05	1.150E+05	4.061E+00	1.150E+05	6.401E-06
	2.267E-01	-7.700E-03	3.900E-10	5.311E+00	1.973E+02	1.973E+02	2.686E+07	5.412E+01	2.684E+01	2.584E+08
	1.082E+03	9.343E+03	1.586E+07	1.583E+03	1.583E+01	1.079E+03	2.711E-03	1.061E-03	4.931E+01	3.088E+04
							8.269E-07			
102.00	5.247E+12	1.214E+12	4.114E+11	6.354E+10	3.111E+08	2.207E+09	1.039E+05	6.778E+00	7.299E+04	8.306E+03
	1.867E+07	3.034E+07	1.421E+03	1.348E+07	1.098E+05	4.307E+05	1.181E+05	6.105E+00	1.181E+05	1.100E-05
	1.929E-01	-8.046E-03	3.235E-10	5.189E+00	2.015E+02	2.015E+02	2.390E+07	4.249E+01	1.839E+01	2.148E+08
	9.014E+02	7.590E+03	1.867E+07	1.905E+03	1.905E+01	1.380E+03	4.114E-03	2.052E-03	5.334E+01	3.089E+04
							2.915E-07			
103.00	4.355E+12	9.864E+11	3.887E+11	5.036E+10	2.588E+08	1.864E+09	1.060E+05	9.826E+00	7.499E+04	8.562E+03
	2.181E+07	3.169E+07	1.272E+03	9.209E+06	6.967E+04	2.774E+05	1.213E+05	8.952E+00	1.213E+05	1.865E-05
	1.648E-01	-8.417E-03	2.691E-10	5.474E+00	2.062E+02	2.062E+02	2.127E+07	3.292E+01	1.260E+01	1.789E+08
	7.529E+02	6.191E+03	2.180E+07	2.293E+03	2.293E+01	1.694E+03	7.864E-03	4.094E-03	5.879E+01	3.091E+04
							1.004E-07			
104.00	3.641E+12	8.047E+11	3.607E+11	4.202E+10	2.157E+08	1.563E+09	1.080E+05	1.390E+01	7.700E+04	8.816E+03
	2.526E+07	3.278E+07	1.142E+03	6.233E+06	4.432E+04	1.798E+05	1.246E+05	1.280E+01	1.246E+05	3.120E-05

AD-A084 993 SCIENCE APPLICATIONS INC LA JOLLA CA F/G 4/1
ROSCOE MANUAL, VOLUME 14A-1 - AMBIENT ATMOSPHERE (MAJOR AND MIN--ETC(U)
JUN 79 D A HAMLIN, M R SCHOONOVER DNA001-76-C-0194
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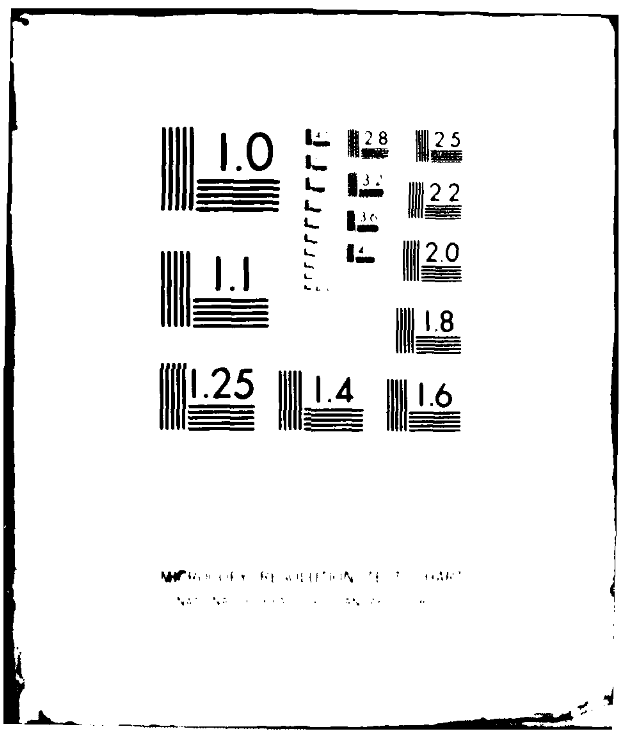
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	6.305E+02	5.067E+03	2.526E+07	2.760E+03	2.760E+01	2.015E+03	1.544E-02	8.434E-03	6.594E+01	3.094E+04
							3.398E-08			
105.00	3.049E+12	6.598E+11	3.292E+11	3.516E+10	1.807E+08	1.300E+09	1.101E+05	1.920E+01	7.902E+04	9.066E+03
	2.906E+07	3.420E+07	1.029E+03	4.300E+06	2.829E+04	1.178E+05	1.280E+05	1.787E+01	1.280E+05	5.160E-05
	1.220E-01	-9.245E-03	1.879E-10	5.666E+00	2.170E+02	2.170E+02	1.685E+07	2.039E+01	5.917E+00	1.252E+08
	5.294E+02	4.151E+03	2.906E+07	3.322E+03	3.322E+01	2.339E+03	3.110E-02	1.792E-02	7.514E+01	3.097E+04
							1.135E-08			
106.00	2.559E+12	5.440E+11	2.963E+11	2.952E+10	1.517E+08	1.073E+09	1.122E+05	2.591E+01	6.106E+04	9.310E+03
	3.320E+07	3.534E+07	9.301E+02	2.938E+06	1.811E+04	7.835E+04	1.316E+05	2.437E+01	1.316E+05	8.437E-05
	1.056E-01	-9.705E-03	1.577E-10	5.771E+00	2.231E+02	2.231E+02	1.500E+07	1.679E+01	4.055E+00	1.053E+08
	4.458E+02	3.395E+03	3.320E+07	3.999E+03	3.999E+01	2.662E+03	6.413E-02	3.921E-02	8.681E+01	3.102E+04
							3.764E-09			
107.00	2.155E+12	4.512E+11	2.636E+11	2.486E+10	1.278E+08	8.812E+08	1.143E+05	3.426E+01	8.311E+04	9.540E+03
	3.770E+07	3.642E+07	8.435E+02	2.008E+06	1.163E+04	5.313E+04	1.353E+05	3.255E+01	1.352E+05	1.365E-04
	9.186E-02	-1.020E-02	1.329E-10	5.880E+00	2.299E+02	2.299E+02	1.335E+07	1.436E+01	2.778E+00	8.887E+07
	3.764E+02	2.766E+03	3.769E+07	4.814E+03	4.814E+01	2.981E+03	1.349E-01	8.807E-02	1.014E+02	3.108E+04
							1.250E-09			
108.00	1.821E+12	3.763E+11	2.325E+11	2.101E+10	1.080E+08	7.206E+08	1.165E+05	4.454E+01	8.516E+04	9.779E+03
	4.255E+07	3.741E+07	7.675E+02	1.372E+06	7.494E+03	3.689E+04	1.391E+05	4.273E+01	1.390E+05	2.184E-04
	8.027E-02	-1.073E-02	1.123E-10	5.993E+00	2.372E+02	2.372E+02	1.189E+07	1.280E+01	1.904E+00	7.532E+07
	3.186E+02	2.238E+03	4.255E+07	5.796E+03	5.796E+01	3.295E+03	2.881E-01	2.023E-01	1.194E+02	3.115E+04
							4.194E-10			
109.00	1.543E+12	3.155E+11	2.040E+11	1.781E+10	9.152E+07	5.883E+08	1.187E+05	5.716E+01	8.724E+04	1.000E+04
	4.778E+07	3.833E+07	7.004E+02	9.376E+05	4.844E+03	2.633E+04	1.430E+05	5.532E+01	1.430E+05	3.436E-04
	7.046E-02	-1.131E-02	9.516E-11	6.109E+00	2.453E+02	2.453E+02	1.058E+07	1.179E+01	1.305E+00	6.410E+07
	2.706E+02	1.793E+03	4.777E+07	6.977E+03	6.977E+01	3.601E+03	6.221E-01	4.727E-01	1.412E+02	3.123E+04
							1.433E-10			
110.00	1.312E+12	2.656E+11	1.789E+11	1.514E+10	7.782E+07	4.800E+08	1.209E+05	7.272E+01	8.934E+04	1.022E+04
	5.338E+07	3.917E+07	6.410E+02	6.407E+05	3.141E+03	1.938E+04	1.471E+05	7.096E+01	1.471E+05	5.408E-04
	6.214E-02	-1.193E-02	8.091E-11	6.226E+00	2.540E+02	2.540E+02	9.427E+06	1.113E+01	8.940E-01	5.476E+07
	2.304E+02	1.419E+03	5.337E+07	8.400E+03	8.400E+01	3.900E+03	1.350E+00	1.118E+00	1.671E+02	3.131E+04
							5.033E-11			
111.00	1.119E+12	2.242E+11	1.571E+11	1.292E+10	6.637E+07	3.916E+08	1.231E+05	9.216E+01	9.147E+04	1.043E+04
	5.936E+07	3.994E+07	5.881E+02	4.378E+05	2.043E+03	1.475E+04	1.514E+05	9.057E+01	1.513E+05	8.363E-04
	5.505E-02	-1.260E-02	6.901E-11	6.342E+00	2.634E+02	2.634E+02	8.397E+06	1.072E+01	6.126E-01	4.697E+07
	1.968E+02	1.105E+03	5.935E+07	1.011E+04	1.011E+02	4.190E+03	2.933E+00	2.666E+00	1.972E+02	3.138E+04
							1.829E-11			
112.00	9.575E+11	1.896E+11	1.388E+11	1.105E+10	5.677E+07	3.194E+08	1.254E+05	1.169E+02	9.365E+04	1.064E+04
	6.573E+07	4.063E+07	5.409E+02	2.992E+05	1.333E+03	1.161E+04	1.558E+05	1.156E+02	1.557E+05	1.278E-03
	4.900E-02	-1.334E-02	5.903E-11	6.455E+00	2.737E+02	2.737E+02	7.481E+06	1.045E+01	4.197E-01	4.044E+07
	1.686E+02	8.466E+02	6.571E+07	1.218E+04	1.218E+02	4.471E+03	6.346E+00	0.	2.315E+02	3.142E+04
							6.912E-12			
113.00	8.214E+11	1.604E+11	1.237E+11	9.478E+09	4.871E+07	2.599E+08	1.277E+05	1.489E+02	9.587E+04	1.084E+04
	7.243E+07	4.124E+07	4.985E+02	2.044E+05	8.717E+02	9.446E+03	1.604E+05	1.473E+02	1.603E+05	1.928E-03
	4.382E-02	-1.413E-02	5.064E-11	6.565E+00	2.847E+02	2.847E+02	6.667E+06	1.029E+01	2.876E-01	3.494E+07
	1.450E+02	6.369E+02	7.247E+07	1.466E+04	1.466E+02	4.743E+03	1.361E+01	0.	2.693E+02	3.144E+04
							2.728E-12			
114.00	7.067E+11	1.353E+11	1.113E+11	8.154E+09	4.190E+07	2.108E+08	1.301E+05	1.910E+02	9.815E+04	1.104E+04
	7.963E+07	4.178E+07	4.603E+02	1.397E+05	5.719E+02	7.916E+03	1.652E+05	1.877E+02	1.651E+05	2.871E-03
	3.917E-02	-1.501E-02	4.357E-11	6.672E+00	2.966E+02	2.966E+02	5.943E+06	1.018E+01	1.971E-01	3.028E+07
	1.250E+02	4.710E+02	7.961E+07	1.765E+04	1.765E+02	5.006E+03	2.880E+01	0.	3.101E+02	3.142E+04
							1.126E-12			
115.00	6.098E+11	1.144E+11	1.012E+11	7.036E+09	3.616E+07	1.700E+08	1.324E+05	2.470E+02	1.005E+05	1.123E+04
	8.717E+07	4.275E+07	4.257E+02	9.546E+04	3.763E+02	6.790E+03	1.702E+05	2.408E+02	1.700E+05	4.219E-03
	3.554E-02	-1.596E-02	3.760E-11	6.776E+00	3.092E+02	3.092E+02	5.299E+06	1.011E+01	1.351E-01	2.632E+07
	1.092E+02	3.432E+02	8.714E+07	2.125E+04	2.125E+02	5.259E+03	5.977E+01	0.	3.534E+02	3.135E+04
							4.850E-13			
116.00	5.280E+11	9.643E+10	9.281E+10	6.092E+09	3.131E+07	1.363E+08	1.348E+05	3.208E+02	1.029E+05	1.142E+04
	9.510E+07	4.266E+07	3.941E+02	6.523E+04	2.485E+02	5.899E+03	1.754E+05	3.102E+02	1.751E+05	6.121E-03

	3.223E-02	-1.575E-02	3.253E-11	6.678E+00	3.227E+02	3.227E+02	4.726E+06	1.007E+01	9.254E-02	2.296E+07
	9.404E+01	2.476E+02	9.507E+07	2.559E+04	2.559E+02	5.504E+03	1.209E+02	0.	3.993E+02	3.124E+04
							2.174E-13			
117.00	4.590E+11	8.145E+10	6.545E+10	5.296E+09	2.722E+07	1.086E+08	1.373E+05	4.157E+02	1.053E+05	1.161E+04
	1.031E+08	4.300E+07	3.653E+02	4.157E+04	1.647E+02	5.113E+03	1.807E+05	3.985E+02	1.803E+05	4.771E-03
	2.916E-02	-1.809E-02	2.830E-11	6.976E+00	3.369E+02	3.369E+02	4.217E+06	1.005E+01	6.341E-02	2.011E+07
	8.206E+01	1.785E+02	1.034E+08	3.081E+04	3.081E+02	5.741E+03	2.364E+02	0.	4.492E+02	3.110E+04
							1.006E-13			
118.00	4.011E+11	6.933E+10	7.836E+10	4.629E+09	2.379E+07	8.643E+07	1.397E+05	5.297E+02	1.077E+05	1.180E+04
	1.121E+08	4.327E+07	3.399E+02	3.046E+04	1.098E+02	4.331E+03	1.862E+05	5.032E+02	1.857E+05	1.243E-02
	2.696E-02	-1.923E-02	2.473E-11	7.072E+00	3.515E+02	3.515E+02	3.764E+06	1.003E+01	4.345E-02	1.769E+07
	7.195E+01	1.302E+02	1.121E+08	3.710E+04	3.710E+02	5.968E+03	4.423E+02	0.	5.072E+02	3.097E+04
							4.752E-14			
119.00	3.531E+11	6.016E+10	7.071E+10	4.074E+09	2.094E+07	6.919E+07	1.422E+05	6.482E+02	1.101E+05	1.200E+04
	1.212E+08	4.349E+07	3.146E+02	2.081E+04	7.368E+01	3.490E+03	1.916E+05	6.105E+02	1.910E+05	1.746E-02
	2.466E-02	-2.036E-02	2.177E-11	7.165E+00	3.660E+02	3.660E+02	3.361E+06	1.002E+01	2.977E-02	1.566E+07
	6.345E+01	9.788E+01	1.212E+08	4.468E+04	4.468E+02	6.186E+03	7.815E+02	0.	5.816E+02	3.090E+04
							2.257E-14			
119.99	3.143E+11	5.413E+10	6.180E+10	3.627E+09	1.864E+07	5.661E+07	1.447E+05	7.357E+02	1.123E+05	1.220E+04
	1.306E+08	4.365E+07	2.924E+02	1.428E+04	5.015E+01	2.590E+03	1.968E+05	6.886E+02	1.962E+05	2.431E-02
	2.274E-02	-2.145E-02	1.938E-11	7.254E+00	3.797E+02	3.797E+02	3.006E+06	1.001E+01	2.048E-02	1.401E+07
	5.640E+01	7.794E+01	1.305E+08	5.370E+04	5.343E+02	6.398E+03	0.	0.	6.877E+02	3.099E+04
							0.			
120.00	3.140E+11	5.409E+10	6.170E+10	3.623E+09	1.862E+07	5.650E+07	1.447E+05	7.363E+02	1.123E+05	1.221E+04
	1.307E+08	4.365E+07	2.922E+02	1.422E+04	4.997E+01	2.581E+03	1.969E+05	6.891E+02	1.962E+05	2.439E-02
	2.273E-02	-1.171E-05	1.936E-11	7.254E+00	3.798E+02	3.798E+02	3.002E+06	1.001E+01	2.040E-02	1.400E+07
	5.634E+01	7.782E+01	1.306E+08	5.380E+04	5.350E+02	6.400E+03	0.	0.	6.890E+02	3.100E+04
							0.			
121.00	2.744E+11	4.673E+10	5.585E+10	3.058E+09	1.783E+07	4.714E+07	1.473E+05	8.572E+02	1.156E+05	1.157E+04
	1.405E+08	4.376E+07	2.714E+02	9.719E+03	3.334E+01	2.132E+03	2.101E+05	7.936E+02	2.094E+05	3.193E-02
	2.102E-02	-1.264E-05	1.694E-11	7.703E+00	4.005E+02	4.564E+02	2.684E+06	1.001E+01	1.398E-02	1.230E+07
	4.941E+01	5.709E+01	1.404E+08	6.479E+04	6.055E+02	6.361E+03	0.	0.	7.373E+02	3.013E+04
							0.			
122.00	2.417E+11	4.070E+10	5.084E+10	2.606E+09	1.711E+07	3.971E+07	1.499E+05	1.032E+03	1.182E+05	1.146E+04
	1.506E+08	4.382E+07	2.523E+02	6.641E+03	2.241E+01	1.774E+03	2.190E+05	9.451E+02	2.181E+05	4.297E-02
	1.952E-02	-1.357E-05	1.493E-11	8.151E+00	4.209E+02	4.999E+02	2.400E+06	1.000E+01	9.580E-03	1.088E+07
	4.366E+01	4.220E+01	1.505E+08	7.802E+04	6.861E+02	6.321E+03	0.	0.	8.191E+02	2.978E+04
							0.			
123.00	2.142E+11	3.570E+10	4.652E+10	2.239E+09	1.646E+07	3.375E+07	1.525E+05	1.239E+03	1.208E+05	1.146E+04
	1.610E+08	4.383E+07	2.345E+02	4.538E+03	1.516E+01	1.486E+03	2.272E+05	1.124E+03	2.260E+05	5.740E-02
	1.817E-02	-1.450E-05	1.325E-11	8.599E+00	4.410E+02	5.378E+02	2.148E+06	1.000E+01	6.564E-03	9.678E+06
	3.883E+01	3.141E+01	1.609E+08	9.396E+04	7.782E+02	6.283E+03	0.	0.	9.117E+02	2.951E+04
							0.			
124.00	1.911E+11	3.152E+10	4.276E+10	1.937E+09	1.586E+07	2.691E+07	1.551E+05	1.482E+03	1.233E+05	1.150E+04
	1.718E+08	4.379E+07	2.181E+02	3.101E+03	1.032E+01	1.253E+03	2.350E+05	1.331E+03	2.336E+05	7.595E-02
	1.701E-02	-1.544E-05	1.183E-11	9.046E+00	4.608E+02	5.726E+02	1.923E+06	1.000E+01	4.498E-03	8.656E+06
	3.475E+01	2.351E+01	1.716E+08	1.132E+05	8.835E+02	6.244E+03	0.	0.	1.014E+03	2.930E+04
							0.			
125.00	1.713E+11	2.800E+10	3.947E+10	1.688E+09	1.534E+07	2.494E+07	1.578E+05	1.762E+03	1.258E+05	1.159E+04
	1.827E+08	4.372E+07	2.029E+02	2.119E+03	7.067E+00	1.062E+03	2.425E+05	1.568E+03	2.410E+05	9.946E-02
	1.595E-02	-1.639E-05	1.062E-11	9.493E+00	4.803E+02	6.053E+02	1.724E+06	1.000E+01	3.082E-03	7.779E+06
	3.126E+01	1.770E+01	1.826E+08	1.363E+05	1.004E+03	6.206E+03	0.	0.	1.124E+03	2.913E+04
							0.			
130.00	1.061E+11	1.660E+10	2.781E+10	9.188E+08	1.320E+07	1.300E+07	1.716E+05	3.871E+03	1.373E+05	1.227E+04
	2.397E+08	4.281E+07	1.438E+02	3.158E+02	1.135E+00	4.963E+02	2.787E+05	3.302E+03	2.754E+05	3.317E-01
	1.199E-02	-2.109E-05	6.617E-12	1.172E+01	5.738E+02	7.505E+02	1.012E+06	1.000E+01	4.656E-04	4.873E+06
	1.968E+01	4.575E+00	2.394E+08	3.143E+05	1.755E+03	6.017E+03	0.	0.	1.810E+03	2.866E+04
							0.			
135.00	7.124E+10	1.075E+10	2.085E+10	5.530E+08	1.169E+07	7.537E+06	1.862E+05	7.459E+03	1.474E+05	1.319E+04
	2.947E+08	4.126E+07	1.081E+02	4.705E+01	1.980E-01	2.518E+02	3.136E+05	6.021E+03	3.076E+05	8.975E-01

	9.43?E-03	-2.574E-05	4.476E-12	1.392E+01	6.607E+02	8.772E+02	6.143E+05	1.000E+01	7.035E-05	3.377E+06
	1.344E+01	1.294E+00	2.940E+08	6.665E+05	2.380E+03	5.834E+03	0.	0.	2.732E+03	2.857E+04
							0.			
140.00	5.063E+10	7.397E+09	1.633E+10	3.370E+08	1.056E+07	4.707E+06	2.015E+05	1.307E+04	1.554E+05	1.416E+04
	3.389E+08	3.331E+07	8.997E+01	7.010E+00	3.657E-02	1.353E+02	3.471E+05	9.879E+03	3.372E+05	2.031E+00
	7.651E-03	-3.025E-05	3.206E-12	1.610E+01	7.416E+02	9.916E+02	3.921E+05	1.000E+01	1.063E-05	2.473E+06
	9.713E+00	3.814E-01	3.376E+08	1.288E+06	4.388E+03	5.657E+03	0.	0.	3.894E+03	2.905E+04
							0.			
145.00	3.752E+10	5.328E+09	1.320E+10	2.427E+08	9.684E+06	3.108E+06	2.175E+05	2.140E+04	1.606E+05	1.506E+04
	3.651E+08	3.714E+07	8.210E+01	1.044E+00	7.047E-03	7.585E+01	3.786E+05	1.507E+04	3.635E+05	3.936E+00
	6.351E-03	-3.458E-05	2.396E-12	1.826E+01	8.169E+02	1.096E+03	2.674E+05	1.000E+01	1.605E-06	1.727E+06
	7.319E+00	1.182E-01	3.629E+08	2.247E+06	6.133E+03	5.485E+03	0.	0.	5.274E+03	3.027E+04
							0.			
150.00	2.871E+10	3.971E+09	1.094E+10	1.716E+08	8.976E+06	2.140E+06	2.343E+05	3.294E+04	1.624E+05	1.580E+04
	3.722E+08	3.488E+07	7.403E+01	1.556E-01	1.402E-03	4.391E+01	4.073E+05	2.164E+04	3.857E+05	6.696E+00
	5.364E-03	-3.871E-05	1.849E-12	2.038E+01	8.870E+02	1.193E+03	1.969E+05	1.000E+01	2.425E-07	1.365E+06
	5.694E+00	3.784E-02	3.687E+08	3.512E+06	7.793E+03	5.318E+03	0.	0.	6.825E+03	3.214E+04
							0.			
160.00	1.803E+10	2.381E+09	7.927E+09	9.369E+07	7.906E+06	1.113E+06	2.698E+05	6.724E+04	1.566E+05	1.662E+04
	3.664E+08	3.041E+07	4.638E+01	3.455E-03	5.966E-05	1.581E+01	4.548E+05	3.866E+04	4.161E+05	1.533E+01
	3.980E-03	-4.630E-05	1.183E-12	2.453E+01	1.013E+03	1.366E+03	1.332E+05	1.000E+01	5.535E-09	8.333E+05
	3.699E+00	4.166E-03	3.602E+08	6.183E+06	9.429E+03	5.000E+03	0.	0.	1.017E+04	3.579E+04
							0.			
170.00	1.214E+10	1.537E+09	6.050E+09	5.561E+07	7.129E+06	6.332E+05	3.076E+05	1.157E+05	1.386E+05	1.626E+04
	3.168E+08	2.627E+07	3.330E+01	7.069E-05	2.719E-06	6.100E+00	4.838E+05	5.881E+04	4.250E+05	2.535E+01
	3.066E-03	-5.296E-05	8.111E-13	2.852E+01	1.122E+03	1.517E+03	1.106E+05	1.000E+01	1.263E-10	5.450E+05
	2.573E+00	4.913E-04	3.092E+08	7.632E+06	8.360E+03	3.816E+03	0.	0.	1.313E+04	4.020E+04
							0.			
180.00	8.571E+09	1.044E+09	4.789E+09	3.502E+07	6.537E+06	3.836E+05	3.474E+05	1.749E+05	1.151E+05	1.500E+04
	2.749E+08	2.259E+07	2.391E+01	1.703E-06	1.301E-07	2.471E+00	4.956E+05	7.955E+04	4.161E+05	3.623E+01
	2.426E-03	-5.866E-05	5.838E-13	3.235E+01	1.217E+03	1.650E+03	1.009E+05	1.000E+01	2.883E-12	3.743E+05
	1.876E+00	6.084E-05	2.670E+08	7.877E+06	6.429E+03	3.021E+03	0.	0.	1.518E+04	4.224E+04
							0.			
190.00	6.266E+09	7.367E+08	3.894E+09	2.303E+07	6.067E+06	2.434E+05	3.886E+05	2.396E+05	9.086E+04	1.320E+04
	2.392E+08	1.937E+07	1.717E+01	3.780E-08	6.456E-09	1.037E+00	4.928E+05	9.856E+04	3.942E+05	4.637E+01
	1.953E-03	-6.350E-05	4.357E-13	3.601E+01	1.299E+03	1.766E+03	9.539E+04	1.000E+01	6.580E-14	2.665E+05
	1.420E+00	7.811E-06	2.312E+08	7.984E+06	5.009E+03	2.456E+03	0.	0.	1.608E+04	4.200E+04
							0.			
200.00	4.705E+09	5.352E+08	3.212E+09	1.566E+07	5.683E+06	1.600E+05	4.304E+05	3.051E+05	6.930E+04	1.123E+04
	2.086E+08	1.660E+07	1.233E+01	8.391E-10	3.293E-10	4.479E-01	4.796E+05	1.146E+05	3.649E+05	5.468E+01
	1.606E-03	-6.750E-05	3.343E-13	3.950E+01	1.370E+03	1.870E+03	9.144E+04	1.000E+01	1.502E-15	1.951E+05
	1.104E+00	1.031E-06	2.011E+08	7.521E+06	3.724E+03	2.038E+03	0.	0.	1.594E+04	4.005E+04
							0.			
220.00	2.614E+09	3.009E+08	2.327E+09	7.787E+06	5.089E+06	7.471E+04	5.127E+05	4.273E+05	3.817E+04	7.661E+03
	1.593E+08	1.216E+07	6.354E+00	4.135E-13	9.113E-13	8.878E-02	4.366E+05	1.376E+05	2.989E+05	6.450E+01
	1.119E-03	-7.326E-05	2.093E-13	4.595E+01	1.485E+03	2.044E+03	8.520E+04	1.000E+01	7.823E-19	1.112E+05
	7.090E-01	1.911E-08	1.546E+03	4.065E+06	1.534E+03	1.468E+03	0.	0.	1.370E+04	3.358E+04
							0.			
240.00	1.778E+09	1.795E+08	1.747E+09	4.145E+06	4.643E+06	3.751E+04	5.875E+05	5.300E+05	2.055E+04	5.028E+03
	1.216E+08	8.903E+06	3.276E+00	2.038E-16	2.675E-15	1.867E-02	3.870E+05	1.504E+05	2.366E+05	6.601E+01
	6.061E-04	-7.651E-05	1.389E-13	5.175E+01	1.572E+03	2.185E+03	8.003E+04	1.000E+01	4.075E-22	6.719E+04
	4.876E-01	3.755E-10	1.188E+08	2.894E+06	6.767E+02	1.102E+03	0.	0.	1.052E+04	2.643E+04
							0.			
260.00	1.166E+09	1.115E+08	1.349E+09	2.311E+06	4.290E+06	1.979E+04	6.476E+05	6.088E+05	1.116E+04	3.237E+03
	9.230E+07	6.517E+06	1.689E+00	1.004E-19	8.184E-18	4.091E-03	3.387E+05	1.554E+05	1.832E+05	6.134E+01
	5.955E-04	-7.776E-05	9.618E-14	5.696E+01	1.638E+03	2.300E+03	7.556E+04	1.000E+01	2.122E-25	4.233E+04
	3.422E-01	7.694E-12	9.052E+07	1.783E+06	3.125E+02	8.508E+02	0.	0.	7.537E+03	2.007E+04
							0.			
280.00	7.850E+08	7.130E+07	1.063E+09	1.332E+06	3.999E+06	1.082E+04	6.865E+05	6.603E+05	6.210E+03	2.053E+03
	6.926E+07	4.770E+06	8.705E-01	4.950E-23	2.582E-20	9.246E-04	2.937E+05	1.541E+05	1.395E+05	5.278E+01

	4.495E-04	-7.744E-05	6.865E-14	6.166E+01	1.688E+03	2.395E+03	7.165E+04	1.000E+01	1.105E-28	2.751E+04
	2.501E-01	1.626E-13	6.817E+07	1.087E+06	1.487E+02	6.701E+02	0.	0.	5.155E+03	1.488E+04
							0.			
300.00	5.393E+08	4.654E+07	8.430E+08	7.305E+05	3.752E+06	6.068E+03	7.000E+05	6.822E+05	3.567E+03	1.281E+03
	5.179E+07	3.431E+06	4.488E-01	2.439E-26	8.342E-23	2.140E-04	2.523E+05	1.475E+05	1.047E+05	4.246E+01
	3.479E-04	-7.592E-05	5.016E-14	6.593E+01	1.726E+03	2.476E+03	6.819E+04	1.000E+01	5.758E-32	1.830E+04
	1.870E-01	3.517E-15	5.063E+07	6.536E+05	7.221E+01	5.355E+02	0.	0.	3.415E+03	1.085E+04
							0.			
320.00	3.754E+08	3.087E+07	6.857E+08	4.729E+05	3.536E+06	3.471E+03	6.334E+05	6.214E+05	2.183E+03	7.226E+02
	3.749E+07	2.555E+06	2.313E-01	1.202E-29	2.746E-25	5.047E-05	2.017E+05	1.257E+05	7.599E+04	2.961E+01
	2.655E-04	-7.350E-05	3.737E-14	6.984E+01	1.755E+03	2.545E+03	6.511E+04	1.000E+01	2.999E-35	1.241E+04
	1.425E-01	7.754E-17	3.710E+07	3.881E+05	3.554E+01	4.325E+02	0.	0.	2.129E+03	7.629E+03
							0.			
340.00	2.644E+08	2.072E+07	5.583E+08	2.684E+05	3.344E+06	2.015E+03	5.731E+05	5.650E+05	1.364E+03	4.154E+02
	2.710E+07	1.870E+06	1.193E-01	5.925E-33	9.184E-28	1.209E-05	1.630E+05	1.077E+05	5.533E+04	2.032E+01
	2.078E-04	-7.041E-05	2.827E-14	7.147E+01	1.777E+03	2.606E+03	6.234E+04	1.000E+01	1.562E-38	8.545E+03
	1.101E-01	1.736E-18	2.688E+07	2.279E+05	1.769E+01	3.521E+02	0.	0.	1.336E+03	5.405E+03
							0.			
360.00	1.878E+08	1.404E+07	4.574E+08	1.778E+05	3.171E+06	1.184E+03	5.186E+05	5.130E+05	8.687E+02	2.426E+02
	1.942E+07	1.369E+06	6.148E-02	2.920E-36	3.111E-30	2.934E-06	1.331E+05	9.271E+04	4.040E+04	1.377E+01
	1.641E-04	-6.687E-05	2.167E-14	7.686E+01	1.793E+03	2.659E+03	5.984E+04	1.000E+01	8.137E-42	5.961E+03
	8.613E-02	3.938E-20	1.929E+07	1.326E+05	8.886E+00	2.885E+02	0.	0.	8.423E+02	3.846E+03
							0.			
380.00	1.344E+08	9.584E+06	3.766E+08	1.106E+05	3.013E+06	7.023E+02	4.692E+05	4.654E+05	5.633E+02	1.437E+02
	1.382E+07	1.002E+06	3.169E-02	1.439E-39	1.066E-32	7.199E-07	1.097E+05	8.014E+04	2.956E+04	9.240E+00
	1.306E-04	-6.302E-05	1.679E-14	8.005E+01	1.806E+03	2.703E+03	5.756E+04	1.000E+01	4.239E-45	4.205E+03
	6.807E-02	9.034E-22	1.374E+07	7.666E+04	4.503E+00	2.375E+02	0.	0.	5.336E+02	2.742E+03
							0.			
400.00	9.666E+07	6.584E+06	3.113E+08	6.931E+04	2.868E+06	4.199E+02	4.246E+05	4.219E+05	3.714E+02	8.616E+01
	9.789E+06	7.333E+05	1.634E-02	7.092E-43	3.686E-35	1.784E-07	9.116E+04	6.949E+04	2.167E+04	6.156E+00
	1.047E-04	-5.901E-05	1.314E-14	8.308E+01	1.816E+03	2.751E+03	5.549E+04	1.000E+01	2.208E-4	2.996E+03
	5.427E-02	2.093E-23	9.745E+06	4.410E+04	2.301E+00	1.964E+02	0.	0.	3.394E+02	1.957E+03
							0.			
420.00	6.986E+07	4.547E+06	2.582E+08	4.370E+04	2.733E+06	2.527E+02	3.842E+05	3.82[illegible]E+05	2.489E+02	5.222E+01
	6.909E+06	5.367E+05	8.423E-03	3.495E-46	1.286E-37	4.458E-08	7.634E+04	6.042E+04	1.591E+04	4.080E+00
	8.443E-05	-5.493E-05	1.037E-14	8.596E+01	1.823E+03	2.792E+03	5.358E+04	1.000E+01	1.150E-51	2.152E+03
	4.359E-02	4.889E-25	6.883E+06	2.528E+04	1.185E+00	1.628E+02	0.	0.	2.166E+02	1.396E+03
							0.			
440.00	5.070E+07	3.154E+06	2.147E+08	2.770E+04	2.606E+06	1.530E+02	3.476E+05	3.463E+05	1.692E+02	3.196E+01
	4.864E+06	3.928E+05	4.342E-03	1.723E-49	4.521E-40	1.123E-08	6.436E+04	5.265E+04	1.171E+04	2.693E+00
	6.648E-05	-5.086E-05	8.249E-15	8.871E+01	1.829E+03	2.829E+03	5.182E+04	1.000E+01	5.990E-55	1.558E+03
	3.575E-02	1.151E-26	4.850E+06	1.445E+04	6.148E-01	1.354E+02	0.	0.	1.387E+02	9.957E+02
							0.			
460.00	3.692E+07	2.196E+06	1.789E+08	1.764E+04	2.488E+06	9.308E+01	3.145E+05	3.136E+05	1.166E+02	1.974E+01
	3.419E+06	2.875E+05	2.238E-03	8.490E-53	1.600E-42	2.846E-09	5.460E+04	4.597E+04	8.629E+03	1.773E+00
	5.583E-05	-4.691E-05	6.606E-15	9.134E+01	1.834E+03	2.864E+03	5.020E+04	1.000E+01	3.120E-58	1.136E+03
	2.867E-02	2.728E-28	3.411E+06	8.252E+03	3.211E-01	1.129E+02	0.	0.	8.907E+01	7.100E+02
							0.			
480.00	2.697E+07	1.534E+06	1.494E+08	1.128E+04	2.377E+06	5.689E+01	2.846E+05	2.840E+05	8.138E+01	1.229E+01
	2.401E+06	2.104E+05	1.154E-03	4.184E-56	5.700E-45	7.262E-10	4.659E+04	4.021E+04	6.372E+03	1.165E+00
	4.573E-05	-4.308E-05	5.323E-15	9.386E+01	1.837E+03	2.898E+03	4.869E+04	1.000E+01	1.625E-61	8.331E+02
	2.344E-02	6.506E-30	2.396E+06	4.706E+03	1.688E-01	9.425E+01	0.	0.	5.736E+01	5.063E+02
							0.			
500.00	1.975E+07	1.075E+06	1.250E+08	7.240E+03	2.272E+06	3.491E+01	2.575E+05	2.571E+05	5.740E+01	7.715E+00
	1.684E+06	1.540E+05	5.949E-04	2.062E-59	2.042E-47	1.863E-10	3.995E+04	3.52[illegible]E+04	4.714E+03	7.643E-01
	3.762E-05	-3.942E-05	4.313E-15	9.627E+01	1.840E+03	2.929E+03	4.728E+04	1.000E+01	8.465E-65	6.145E+02
	1.925E-02	1.560E-31	1.682E+06	2.682E+03	8.923E-02	7.885E+01	0.	0.	3.704E+01	3.611E+02
							0.			
520.00	1.450E+07	7.558E+05	1.047E+08	4.663E+03	2.173E+06	2.150E+01	2.330E+05	2.327E+05	4.087E+01	4.876E+00
	1.181E+06	1.127E+05	3.067E-04	1.016E-62	7.349E-50	4.805E-11	3.441E+04	3.091E+04	3.495E+03	5.011E-01

	3.130E-03	-3.578E-05	3.512E-15	7.758E+01	1.842E+03	2.960E+03	4.597E+04	1.000E+01	4.409E-68	4.555E+02
	1.553E-02	3.762E-33	1.173E+06	1.527E+03	4.742E-02	6.607E+01	0.	0.	2.398E+01	2.577E+02
							0.			
540.00	1.057E+07	5.325E+05	8.789E+07	3.013E+03	2.079E+06	1.327E+01	2.108E+05	2.106E+05	2.935E+01	3.103E+00
	8.276E+05	8.251E+04	1.581E-04	5.008E-66	2.658E-52	1.245E-11	2.976E+04	2.717E+04	2.597E+03	3.284E-01
	2.575E-05	-3.272E-05	2.874E-15	1.008E+02	1.843E+03	2.989E+03	4.474E+04	1.000E+01	2.297E-71	3.393E+02
	1.315E-02	9.110E-35	8.270E+05	8.695E+02	2.532E-02	5.544E+01	0.	0.	1.557E+01	1.840E+02
							0.			
560.00	7.873E+06	3.762E+05	7.385E+07	1.953E+03	1.990E+06	8.242E+00	1.908E+05	1.906E+05	2.123E+01	1.988E+00
	5.802E+05	6.039E+04	6.149E-05	2.468E-69	9.655E-55	3.239E-12	2.584E+04	2.391E+04	1.934E+03	2.152E-01
	2.141E-05	-2.970E-05	2.362E-15	1.029E+02	1.844E+03	3.017E+03	4.359E+04	1.000E+01	1.196E-74	2.538E+02
	1.093E-02	2.216E-36	5.797E+05	4.949E+02	1.356E-02	4.658E+01	0.	0.	1.014E+01	1.315E+02
							0.			
580.00	5.819E+06	2.664E+05	6.212E+07	1.269E+03	1.905E+06	5.127E+00	1.726E+05	1.725E+05	1.545E+01	1.281E+00
	4.065E+05	4.420E+04	4.201E-05	1.216E-72	3.520E-57	8.460E-13	2.252E+04	2.107E+04	1.443E+03	1.411E-01
	1.786E-05	-2.689E-05	1.946E-15	1.049E+02	1.845E+03	3.044E+03	4.251E+04	1.000E+01	6.231E-78	1.906E+02
	9.114E-03	5.410E-38	4.062E+05	2.617E+02	7.312E-03	3.918E+01	0.	0.	6.618E+00	9.411E+01
							0.			
600.00	4.310E+06	1.890E+05	5.232E+07	8.271E+02	1.825E+06	3.200E+00	1.562E+05	1.561E+05	1.131E+01	8.304E-01
	2.846E+05	3.235E+04	2.166E-05	5.995E-76	1.288E-59	2.218E-13	1.969E+04	1.861E+04	1.079E+03	9.255E-02
	1.495E-05	-2.431E-05	1.613E-15	1.069E+02	1.846E+03	3.071E+03	4.149E+04	1.000E+01	3.246E-81	1.436E+02
	7.623E-03	1.326E-39	2.347E+05	1.603E+02	3.951E-03	3.300E+01	0.	0.	4.334E+00	6.743E+01
							0.			
620.00	3.198E+06	1.344E+05	4.412E+07	5.405E+02	1.749E+06	2.002E+00	1.413E+05	1.413E+05	8.314E+00	5.415E-01
	1.995E+05	2.368E+04	1.116E-05	2.955E-79	4.730E-62	5.833E-14	1.727E+04	1.646E+04	8.087E+02	6.077E-02
	1.254E-05	-2.194E-05	1.340E-15	1.087E+02	1.847E+03	3.097E+03	4.053E+04	1.000E+01	1.691E-84	1.086E+02
	6.395E-03	3.260E-41	1.994E+05	9.120E+01	2.142E-03	2.783E+01	0.	0.	2.847E+00	4.837E+01
							0.			
640.00	2.377E+06	9.592E+04	3.724E+07	3.542E+02	1.676E+06	1.257E+00	1.279E+05	1.278E+05	6.139E+00	3.551E-01
	1.398E+05	1.733E+04	5.755E-06	1.456E-82	1.742E-64	1.539E-14	1.520E+04	1.459E+04	6.074E+02	3.995E-02
	1.055E-05	-1.978E-05	1.116E-15	1.105E+02	1.847E+03	3.122E+03	3.961E+04	1.000E+01	8.806E-88	8.236E+01
	5.380E-03	8.039E-43	1.397E+05	5.189E+01	1.165E-03	2.349E+01	0.	0.	1.877E+00	3.476E+01
							0.			
660.00	1.770E+06	6.843E+04	3.147E+07	2.326E+02	1.607E+06	7.911E-01	1.157E+05	1.157E+05	4.550E+00	2.342E-01
	9.792E+04	1.269E+04	2.967E-06	7.176E-86	6.435E-67	4.072E-15	1.342E+04	1.297E+04	4.572E+02	2.631E-02
	8.905E-06	-1.781E-05	9.327E-16	1.122E+02	1.847E+03	3.146E+03	3.875E+04	1.000E+01	4.587E-91	6.265E+01
	4.518E-03	1.988E-44	9.789E+04	2.953E+01	6.350E-04	1.985E+01	0.	0.	1.242E+00	2.501E+01
							0.			
680.00	1.321E+06	4.897E+04	2.662E+07	1.532E+02	1.541E+06	4.993E-01	1.047E+05	1.047E+05	3.383E+00	1.553E-01
	6.853E+04	9.285E+03	1.530E-06	3.537E-89	2.383E-69	1.080E-15	1.189E+04	1.155E+04	3.449E+02	1.736E-02
	7.532E-06	-1.601E-05	7.815E-16	1.139E+02	1.848E+03	3.170E+03	3.793E+04	1.000E+01	2.389E-94	4.778E+01
	3.838E-03	4.931E-46	6.656E+04	1.680E+01	3.471E-04	1.679E+01	0.	0.	8.246E-01	1.803E+01
							0.			
700.00	9.870E+05	3.511E+04	2.254E+07	1.011E+02	1.478E+06	3.160E-01	9.473E+04	9.472E+04	2.523E+00	1.036E-01
	4.805E+04	6.796E+03	7.885E-07	1.743E-92	8.847E-72	2.873E-16	1.057E+04	1.031E+04	2.607E+02	1.148E-02
	6.388E-06	-1.439E-05	6.564E-16	1.155E+02	1.848E+03	3.194E+03	3.715E+04	1.000E+01	1.244E-97	3.653E+01
	3.254E-03	1.226E-47	4.804E+04	9.558E+00	1.901E-04	1.422E+01	0.	0.	5.500E-01	1.301E+01
							0.			
720.00	7.339E+05	2.522E+04	1.910E+07	6.692E+01	1.418E+06	2.005E-01	8.572E+04	8.571E+04	1.887E+00	6.953E-02
	3.366E+04	4.974E+03	4.065E-07	8.590E-96	3.293E-74	7.658E-17	9.435E+03	9.238E+03	1.974E+02	7.610E-03
	5.430E-06	-1.292E-05	5.526E-16	1.170E+02	1.848E+03	3.217E+03	3.641E+04	1.000E+01	6.482-101	2.800E+01
	2.766E-03	3.055E-49	3.365E+04	5.438E+00	1.044E-04	1.205E+01	0.	0.	3.685E-01	9.409E+00
							0.			
740.00	5.540E+05	1.815E+04	1.621E+07	4.439E+01	1.361E+06	1.276E-01	7.756E+04	7.755E+04	1.414E+00	4.695E-02
	2.358E+04	3.641E+03	2.095E-07	4.233E-99	1.228E-76	2.046E-17	8.454E+03	8.304E+03	1.498E+02	5.062E-03
	4.628E-06	-1.159E-05	4.665E-16	1.185E+02	1.848E+03	3.240E+03	3.570E+04	1.000E+01	3.376-104	2.150E+01
	2.358E-03	7.631E-51	2.357E+04	3.094E+00	5.742E-05	1.022E+01	0.	0.	2.482E-01	6.815E+00
							0.			
760.00	4.161E+05	1.309E+04	1.376E+07	2.951E+01	1.306E+06	8.130E-02	7.016E+04	7.016E+04	1.063E+00	3.191E-02
	1.651E+04	2.665E+03	1.080E-07	2.086-102	4.590E-79	5.478E-18	7.608E+03	7.494E+03	1.139E+02	3.379E-03

	3.954E-06	-1.040E-05	3.943E-16	1.200E+02	1.848E+03	3.262E+03	3.502E+04	1.000E+01	1.759-107	1.655E+01
	2.014E-03	1.910E-52	1.651E+04	1.760E+00	3.164E-05	8.673E+00	0.	0.	1.680E-01	4.944E+00
							0.			
780.00	3.110E+05	9.457E+03	1.170E+07	1.367E+01	1.254E+06	5.202E-02	6.350E+04	6.350E+04	8.000E-01	2.183E-02
	1.157E+04	1.950E+03	5.569E-08	1.028-105	1.719E-81	1.470E-18	6.679E+03	6.792E+03	8.672E+01	2.265E-03
	3.317E-06	-9.317E-06	3.341E-16	1.215E+02	1.848E+03	3.284E+03	3.438E+04	1.000E+01	9.160-111	1.277E+01
	1.725E-03	4.790E-54	1.157E+04	1.001E+00	1.746E-05	7.377E+00	0.	0.	1.144E-01	3.593E+00
							0.			
800.00	2.359E+05	6.845E+03	9.950E+06	1.314E+01	1.204E+06	3.335E-02	5.746E+04	5.746E+04	6.035E-01	1.504E-02
	8.103E+03	1.427E+03	2.871E-08	5.068-109	6.452E-84	3.952E-19	6.251E+03	6.185E+03	6.617E+01	1.525E-03
	2.908E-06	-8.348E-06	2.837E-16	1.229E+02	1.848E+03	3.306E+03	3.376E+04	1.000E+01	4.771-114	9.866E+00
	1.481E-03	1.204E-55	8.103E+03	5.697E-01	9.652E-06	6.276E+00	0.	0.	7.844E-02	2.616E+00
							0.			
820.00	1.780E+05	4.963E+03	8.473E+06	8.794E+00	1.157E+06	2.143E-02	5.199E+04	5.199E+04	4.561E-01	1.044E-02
	5.676E+03	1.045E+03	1.460E-08	2.497-112	2.426E-86	1.064E-19	5.712E+03	5.662E+03	5.057E+01	1.032E-03
	2.504E-06	-7.476E-06	2.413E-16	1.244E+02	1.848E+03	3.327E+03	3.317E+04	1.000E+01	2.485-117	7.641E+00
	1.275E-03	3.031E-57	5.676E+03	3.241E-01	5.343E-06	5.344E+00	0.	0.	5.413E-02	1.907E+00
							0.			
840.00	1.346E+05	3.605E+03	7.221E+06	5.900E+00	1.111E+06	1.381E-02	4.704E+04	4.704E+04	3.454E-01	7.304E-03
	3.976E+03	7.647E+02	7.629E-09	1.231-115	9.140E-89	2.872E-20	5.251E+03	5.212E+03	3.871E+01	7.029E-04
	2.162E-06	-6.692E-06	2.057E-16	1.259E+02	1.848E+03	3.348E+03	3.260E+04	1.000E+01	1.294-120	5.928E+00
	1.101E-03	7.647E-59	3.976E+03	1.844E-01	2.961E-06	4.555E+00	0.	0.	3.763E-02	1.393E+00
							0.			
860.00	1.019E+05	2.623E+03	6.160E+06	3.967E+00	1.068E+06	8.918E-03	4.257E+04	4.257E+04	2.620E-01	5.152E-03
	2.785E+03	5.597E+02	3.933E-09	6.066-119	3.450E-91	7.766E-21	4.857E+03	4.827E+03	2.968E+01	4.816E-04
	1.871E-06	-5.989E-06	1.756E-16	1.274E+02	1.848E+03	3.369E+03	3.205E+04	1.000E+01	6.743-124	4.608E+00
	9.531E-04	1.933E-60	2.785E+03	1.049E-01	1.643E-06	3.885E+00	0.	0.	2.637E-02	1.019E+00
							0.			
880.00	7.724E+04	1.912E+03	5.259E+06	2.674E+00	1.027E+06	5.774E-03	3.852E+04	3.852E+04	1.991E-01	3.665E-03
	1.951E+03	4.097E+02	2.027E-09	2.990-122	1.304E-93	2.104E-21	4.523E+03	4.500E+03	2.280E+01	3.321E-04
	1.624E-06	-5.358E-06	1.502E-16	1.289E+02	1.848E+03	3.390E+03	3.153E+04	1.000E+01	3.512-127	3.588E+00
	8.273E-04	4.894E-62	1.951E+03	5.969E-02	9.129E-07	3.317E+00	0.	0.	1.863E-02	7.470E-01
							0.			
900.00	5.866E+04	1.396E+03	4.494E+06	1.806E+00	9.871E+05	3.747E-03	3.485E+04	3.485E+04	1.515E-01	2.630E-03
	1.367E+03	2.998E+02	1.045E-09	1.473-125	4.942E-96	5.709E-22	4.241E+03	4.223E+03	1.754E+01	2.307E-04
	1.414E-06	-4.791E-06	1.286E-16	1.304E+02	1.848E+03	3.410E+03	3.102E+04	1.000E+01	1.829-130	2.799E+00
	7.203E-04	1.241E-63	1.366E+03	3.396E-02	5.077E-07	2.835E+00	0.	0.	1.327E-02	5.483E-01
							0.			
920.00	4.461E+04	1.022E+03	3.844E+06	1.222E+00	9.492E+05	2.437E-03	3.153E+04	3.153E+04	1.155E-01	1.904E-03
	9.572E+02	2.195E+02	5.388E-10	7.261-129	1.876E-98	1.552E-22	4.005E+03	3.991E+03	1.351E+01	1.615E-04
	1.235E-06	-4.283E-06	1.106E-16	1.320E+02	1.848E+03	3.430E+03	3.054E+04	1.000E+01	9.529-134	2.188E+00
	6.289E-04	3.155E-65	9.572E+02	1.932E-02	2.826E-07	2.424E+00	0.	0.	9.542E-03	4.032E-01
							0.			
940.00	3.398E+04	7.485E+02	3.290E+06	8.290E-01	9.130E+05	1.589E-03	2.853E+04	2.853E+04	8.817E-02	1.391E-03
	6.705E+02	1.606E+02	2.778E-10	3.578-132	7.132-101	4.227E-23	3.809E+03	3.798E+03	1.042E+01	1.139E-04
	1.082E-06	-3.827E-06	9.510E-17	1.337E+02	1.849E+03	3.449E+03	3.007E+04	1.000E+01	4.963-137	1.713E+00
	5.509E-04	8.034E-67	6.705E+02	1.099E-02	1.575E-07	2.075E+00	0.	0.	6.921E-03	2.969E-01
							0.			
960.00	2.592E+04	5.494E+02	2.819E+06	5.635E-01	8.784E+05	1.039E-03	2.582E+04	2.582E+04	6.742E-02	1.026E-03
	4.697E+02	1.176E+02	1.432E-10	1.764-135	2.717-103	1.154E-23	3.648E+03	3.640E+03	8.053E+00	8.097E-05
	9.504E-07	-3.418E-06	8.197E-17	1.354E+02	1.849E+03	3.469E+03	2.962E+04	1.000E+01	2.585-140	1.344E+00
	4.840E-04	2.049E-68	4.697E+02	6.254E-03	8.783E-08	1.778E+00	0.	0.	5.066E-03	2.190E-01
							0.			
980.00	1.943E+04	4.040E+02	2.417E+06	3.836E-01	8.452E+05	6.804E-04	2.336E+04	2.336E+04	5.163E-02	7.630E-04
	3.290E+02	8.605E+01	7.381E-11	8.592-139	1.037-105	3.154E-24	3.519E+03	3.513E+03	6.231E+00	5.802E-05
	8.376E-07	-3.051E-06	7.078E-17	1.372E+02	1.849E+03	3.488E+03	2.919E+04	1.000E+01	1.347-143	1.056E+00
	4.267E-04	5.218E-70	3.290E+02	3.556E-03	4.902E-08	1.525E+00	0.	0.	3.741E-03	1.618E-01
							0.			
1000.00	1.515E+04	2.975E+02	2.074E+06	2.620E-01	8.135E+05	4.468E-04	2.114E+04	2.114E+04	3.959E-02	5.726E-04
	2.304E+02	6.296E+01	3.805E-11	4.284-142	3.966-108	8.641E-25	3.417E+03	3.412E+03	4.878E+00	4.191E-05

	7.410E-07	-2.772E-06	6.124E-17	1.391E+02	1.849E+03	3.507E+03	2.877E+04	1.000E+01	7.014-147	8.321E-01
	3.774E-04	1.341E-71	2.304E+02	2.024E-03	2.738E-08	1.308E+00	0.	0.	2.787E-03	1.198E-01
							0.			
1040.00	8.907E+03	1.622E+02	1.532E+06	1.226E-01	7.540E+05	1.939E-04	1.731E+04	1.731E+04	2.339E-02	3.304E-04
	1.131E+02	3.374E+01	1.011E-11	1.040-148	5.836-113	6.525E-26	3.278E+03	3.275E+03	2.911E+00	2.238E-05
	5.856E-07	-2.162E-06	4.612E-17	1.432E+02	1.849E+03	3.544E+03	2.797E+04	1.000E+01	1.903-153	5.193E-01
	2.983E-04	8.852E-75	1.131E+02	6.552E-04	8.562E-09	9.660E-01	0.	0.	1.587E-03	6.590E-02
							0.			
1080.00	5.266E+03	8.897E+01	1.134E+06	5.805E-02	6.995E+05	8.493E-05	1.417E+04	1.417E+04	1.389E-02	1.964E-04
	5.548E+01	1.807E+01	2.687E-12	2.527-155	8.662-118	4.970E-27	3.203E+03	3.201E+03	1.765E+00	1.232E-05
	4.694E-07	-1.713E-06	3.504E-17	1.479E+02	1.849E+03	3.581E+03	2.722E+04	1.000E+01	5.163-160	3.269E-01
	2.391E-04	5.892E-78	5.546E+01	2.121E-04	2.684E-09	7.155E-01	0.	0.	9.311E-04	3.649E-02
							0.			
1120.00	3.131E+03	4.913E+01	8.430E+05	2.766E-02	6.494E+05	3.752E-05	1.160E+04	1.160E+04	8.300E-03	1.198E-04
	2.722E+01	9.682E+00	7.142E-13	6.138-162	1.297-122	3.820E-28	3.166E+03	3.165E+03	1.075E+00	6.975E-06
	3.817E-07	-1.352E-06	2.686E-17	1.533E+02	1.849E+03	3.616E+03	2.652E+04	1.000E+01	1.401-166	2.076E-01
	1.944E-04	3.957E-81	2.722E+01	6.864E-05	8.432E-10	5.317E-01	0.	0.	5.610E-04	2.033E-02
							0.			
1160.00	1.872E+03	2.730E+01	6.284E+05	1.328E-02	6.034E+05	1.672E-05	9.498E+03	9.498E+03	4.986E-03	7.456E-05
	1.336E+01	5.187E+00	1.898E-13	1.491-168	1.962-127	2.965E-29	3.137E+03	3.137E+03	6.587E-01	4.074E-06
	3.149E-07	-1.062E-06	2.079E-17	1.594E+02	1.849E+03	3.651E+03	2.586E+04	1.000E+01	3.800-173	1.332E-01
	1.604E-04	2.684E-84	1.336E+01	2.222E-05	2.655E-10	3.963E-01	0.	0.	3.455E-04	1.140E-02
							0.			
1200.00	1.125E+03	1.526E+01	4.699E+05	6.428E-03	5.611E+05	7.518E-06	7.776E+03	7.776E+03	3.011E-03	4.719E-05
	6.554E+00	2.779E+00	5.044E-14	3.621-175	2.999-132	2.325E-30	3.089E+03	3.089E+03	4.056E-01	2.476E-06
	2.634E-07	-8.299E-07	1.627E-17	1.666E+02	1.849E+03	3.686E+03	2.524E+04	1.000E+01	1.031-179	8.633E-02
	1.342E-04	1.839E-87	6.554E+00	7.192E-06	8.373E-11	2.964E-01	0.	0.	2.166E-04	6.427E-03
							0.			

END OF TEST PROBLEM

TEST VALUES READ IN

NALTS = 182

I	ALTS(I),KM	I	ALTS(I),KM	I	ALTS(I),KM	I	ALTS(I),KM	I	ALTS(I),KM	I	ALTS(I),KM
1	0.00	2	1.00	3	2.00	4	3.00	5	4.00	6	5.00
7	6.00	8	7.00	9	8.00	10	9.00	11	10.00	12	11.00
13	12.00	14	13.00	15	14.00	16	15.00	17	16.00	18	17.00
19	18.00	20	19.00	21	20.00	22	21.00	23	22.00	24	23.00
25	24.00	26	25.00	27	26.00	28	27.00	29	28.00	30	29.00
31	30.00	32	31.00	33	32.00	34	33.00	35	34.00	36	35.00
37	36.00	38	37.00	39	38.00	40	39.00	41	40.00	42	41.00
43	42.00	44	43.00	45	44.00	46	45.00	47	46.00	48	47.00
49	48.00	50	49.00	51	50.00	52	51.00	53	52.00	54	53.00
55	54.00	56	55.00	57	56.00	58	57.00	59	58.00	60	59.00
61	60.00	62	61.00	63	62.00	64	63.00	65	64.00	66	65.00
67	66.00	68	67.00	69	68.00	70	69.00	71	70.00	72	71.00
73	72.00	74	73.00	75	74.00	76	75.00	77	76.00	78	77.00
79	78.00	80	79.00	81	80.00	82	81.00	83	82.00	84	83.00
85	84.00	86	85.00	87	86.00	88	87.00	89	88.00	90	89.00
91	90.00	92	91.00	93	92.00	94	93.00	95	94.00	96	95.00
97	96.00	98	97.00	99	98.00	100	99.00	101	100.00	102	101.00
103	102.00	104	103.00	105	104.00	106	105.00	107	106.00	108	107.00
109	108.00	110	109.00	111	110.00	112	111.00	113	112.00	114	113.00
115	114.00	116	115.00	117	116.00	118	117.00	119	118.00	120	119.00
121	119.99	122	120.00	123	121.00	124	122.00	125	123.00	126	124.00
127	125.00	128	130.00	129	135.00	130	140.00	131	145.00	132	150.00
133	160.00	134	170.00	135	180.00	136	190.00	137	200.00	138	220.00
139	240.00	140	260.00	141	280.00	142	300.00	143	320.00	144	340.00
145	360.00	146	380.00	147	400.00	148	420.00	149	440.00	150	460.00
151	480.00	152	500.00	153	520.00	154	540.00	155	560.00	156	580.00
157	600.00	158	620.00	159	640.00	160	660.00	161	680.00	162	700.00
163	720.00	164	740.00	165	760.00	166	780.00	167	800.00	168	820.00
169	840.00	170	860.00	171	880.00	172	900.00	173	920.00	174	940.00
175	960.00	176	980.00	177	1000.00	178	1040.00	179	1080.00	180	1120.00
181	1160.00	182	1200.00								

```
 IYRS =   79   IMONS =    7   IDAYS =    2
   ZT =  0.         HRS    GCO =   .5500E+02 DEG     GLO =   .2400E+03 DEG
NWFLAG=    0.00           METHOD=    0           TPFLAG=    0.00
```

INITIALIZATION CALL

```
 FROM SUBROUTINE WATER-  IX=  3     FVN=  .49863      FST=  .99726
TIF = 1330.012 DEG K,  TAU =  2.13691E-02 1/KM, FROM SUBROUTINE ATMOSU (FORMAT 8001)

 IYRS =   79   IMONS =    7   IDAYS =    2
   ZT =  0.         HRS    GCO =   .9599E+00 RAD     GLO =   .4189E+01 RAD

IDORN =   -1      UT =   .8000E+01     GAT =   .7743E+01    PLAT =   .6109E+00    PLON =   .4189E+01
```

HL = 23.94 HRS (LOCAL TIME AT GRID ORIGIN), SOLAR FLUX SHAR = 237.50 1.E-22 W/(M SQ HZ),
FROM PROGRAM DRVATM (FORMAT 2003)

ALT	N2 1/CC	O2 1/CC	O 1/CC	AR 1/CC	HE 1/CC	CO2 1/CC	E 1/CC	O+ 1/CC	NO+ 1/CC	QDEF 1/(CC SEC)
	N 1/CC	NO 1/CC	NO2 1/CC	O2(SDG) 1/CC	O3 1/CC	H2O 1/CC	E 1/CC	O+ 1/CC	N+ 1/CC	N+ 1/CC
	PRESSURE DYNES/CM**2	FEMSEQ	DENSITY GRAMS/CC	DEN SC HT KM	TEMP DEG K	E TEMP DEG K	H 1/CC	OH 1/CC	HO2 1/CC	CO 1/CC
	H2O 1/CC	CH4 1/CC	N (4S) 1/CC	N (2D) 1/CC	N (2P) 1/CC	O (1D) 1/CC	SAT. VP WATER	SAT. VP ICE	N2+ 1/CC	O2+ 1/CC
							REL. HUMID. PERCENT			
0.00	1.905E+19	5.153E+18	1.100E+00	2.198E+17	1.130E+15	7.815E+15	0.	0.	0.	1.815E+02
	5.456E+00	1.000E+00	3.604E+10	3.400E+00	6.297E+11	5.149E+17	0.	0.	0.	0.
	1.013E+06	0.	1.174E-03	8.100E+00	3.005E+02	3.005E+02	1.000E+00	1.734E+02	4.934E+01	3.088E+12
	7.579E+12	3.364E+13	5.456E+00	2.102E-11	2.102E-13	1.000E+00	3.642E+01	0.	0.	0.
							5.867E+01			
1.00	1.699E+19	4.590E+18	1.100E+00	1.960E+17	1.007E+15	6.970E+15	0.	0.	0.	1.588E+02
	6.300E+00	1.000E+00	3.203E+10	3.400E+00	5.808E+11	3.216E+17	0.	0.	0.	0.
	9.046E+05	-2.350E-06	1.047E-03	9.378E+00	3.008E+02	3.008E+02	1.000E+00	1.612E+02	8.174E+01	2.487E+12
	6.348E+12	3.000E+13	6.300E+00	2.526E-11	2.526E-13	1.000E+00	3.713E+01	0.	0.	0.
							3.597E+01			
2.00	1.536E+19	4.155E+18	1.100E+00	1.772E+17	9.108E+14	6.302E+15	0.	0.	0.	1.389E+02
	7.274E+00	1.000E+00	2.594E+10	3.400E+00	5.443E+11	2.008E+17	0.	0.	0.	0.
	8.070E+05	-8.263E-06	9.470E-04	1.044E+01	2.968E+02	2.968E+02	1.000E+00	1.564E+02	1.288E+02	2.168E+12
	5.451E+12	2.713E+13	7.274E+00	3.035E-11	3.035E-13	1.000E+00	2.928E+01	0.	0.	0.
							2.810E+01			
3.00	1.400E+19	3.788E+18	1.100E+00	1.616E+17	8.302E+14	5.744E+15	0.	0.	0.	1.216E+02
	8.399E+00	1.000E+00	1.978E+10	3.400E+00	5.174E+11	1.254E+17	0.	0.	0.	0.
	7.184E+05	-1.697E-05	8.633E-04	1.109E+01	2.899E+02	2.899E+02	1.000E+00	1.568E+02	1.947E+02	1.984E+12
	4.789E+12	2.473E+13	8.399E+00	3.648E-11	3.648E-13	1.000E+00	1.905E+01	0.	0.	0.
							2.634E+01			
4.00	1.281E+19	3.464E+18	1.100E+00	1.478E+17	7.594E+14	5.254E+15	0.	0.	0.	1.064E+02
	9.697E+00	1.000E+00	1.459E+10	3.400E+00	5.173E+11	7.831E+16	0.	0.	0.	0.
	6.376E+05	-2.791E-05	7.896E-04	1.125E+01	2.813E+02	2.813E+02	1.000E+00	1.600E+02	2.845E+02	1.858E+12
	4.288E+12	2.262E+13	9.697E+00	4.384E-11	4.384E-13	1.000E+00	1.081E+01	0.	0.	0.
							2.814E+01			
5.00	1.171E+19	3.167E+18	1.100E+00	1.351E+17	6.943E+14	4.804E+15	0.	0.	0.	9.307E+01
	1.120E+01	1.000E+00	1.063E+10	3.400E+00	5.407E+11	4.890E+16	0.	0.	0.	0.
	5.636E+05	-4.064E-05	7.219E-04	1.101E+01	2.719E+02	2.719E+02	1.000E+00	1.675E+02	4.038E+02	1.749E+12
	3.894E+12	2.068E+13	1.120E+01	5.268E-11	5.268E-13	1.000E+00	5.596E+00	5.525E+00	0.	0.
							3.281E+01			
6.00	1.067E+19	2.887E+18	1.100E+00	1.231E+17	6.327E+14	4.378E+15	0.	0.	0.	8.143E+01
	1.293E+01	1.000E+00	7.773E+09	3.400E+00	5.691E+11	2.141E+16	0.	0.	0.	0.
	4.961E+05	-5.484E-05	6.579E-04	1.051E+01	2.627E+02	2.627E+02	1.000E+00	1.76[illegible]E+02	5.598E+02	1.635E+12
	3.570E+12	1.884E+13	1.293E+01	6.331E-11	6.331E-13	1.000E+00	2.754E+00	2.484E+00	0.	0.
							2.819E+01			
7.00	9.675E+18	2.617E+18	1.100E+00	1.116E+17	5.737E+14	3.967E+15	0.	0.	0.	7.125E+01
	1.493E+01	1.000E+00	5.783E+09	3.400E+00	5.999E+11	9.330E+15	0.	0.	0.	0.
	4.347E+05	-7.033E-05	5.965E-04	9.910E+00	2.538E+02	2.538E+02	1.000E+00	1.465E+02	7.607E+02	1.503E+12
	3.288E+12	1.709E+13	1.493E+01	7.608E-11	7.608E-13	1.000E+00	1.333E+00	1.102E+00	0.	0.
							2.453E+01			
8.00	8.710E+18	2.358E+18	1.100E+00	1.006E+17	5.169E+14	3.577E+15	0.	0.	0.	6.234E+01
	1.723E+01	1.000E+00	4.416E+09	3.400E+00	6.228E+11	4.033E+15	0.	0.	0.	0.

	3.793E+05	-6.701E-05	5.375E-04	9.295E+00	2.458E+02	2.458E+02	1.000E+00	1.977E+02	1.016E+03	1.354E+12
	3.028E+12	1.540E+13	1.723E+01	9.143E-11	9.143E-13	1.000E+00	6.520E-01	4.979E-01	0.	0.
							2.102E+01			
9.00	7.801E+18	2.110E+18	1.100E+00	9.002E+16	4.676E+14	3.201E+15	0.	0.	0.	5.455E+01
	1.990E+01	1.000E+00	3.486E+09	3.400E+00	6.205E+11	1.737E+15	0.	0.	0.	0.
	3.295E+05	-1.049E-04	4.810E-04	8.723E+00	2.386E+02	2.386E+02	1.000E+00	2.095E+02	1.338E+03	1.192E+12
	2.777E+12	1.378E+13	1.990E+01	1.099E-10	1.099E-12	1.000E+00	3.298E-01	2.347E-01	0.	0.
							1.735E+01			
10.00	6.932E+18	1.875E+18	1.100E+00	7.998E+16	4.110E+14	2.844E+15	0.	0.	0.	4.773E+01
	2.298E+01	1.000E+00	2.857E+09	3.400E+00	6.391E+11	7.415E+14	0.	0.	0.	0.
	2.851E+05	-1.239E-04	4.274E-04	8.215E+00	2.324E+02	2.324E+02	1.000E+00	2.217E+02	1.740E+03	1.025E+12
	2.526E+12	1.224E+13	2.298E+01	1.320E-10	1.320E-12	1.000E+00	1.756E-01	1.175E-01	0.	0.
							1.355E+01			
11.00	6.116E+18	1.654E+18	1.100E+00	7.057E+16	3.627E+14	2.509E+15	0.	0.	0.	4.176E+01
	2.653E+01	1.000E+00	2.437E+09	3.400E+00	7.518E+11	3.144E+14	0.	0.	0.	0.
	2.458E+05	-1.442E-04	3.771E-04	7.778E+00	2.271E+02	2.271E+02	1.000E+00	2.342E+02	2.236E+03	8.626E+11
	2.274E+12	1.076E+13	2.653E+01	1.587E-10	1.587E-12	1.000E+00	9.971E-02	6.335E-02	0.	0.
							9.885E+00			
12.00	5.361E+18	1.450E+18	1.100E+00	6.186E+16	3.179E+14	2.199E+15	0.	0.	0.	3.654E+01
	3.063E+01	1.000E+00	2.165E+09	3.400E+00	9.436E+11	1.324E+14	0.	0.	0.	0.
	2.113E+05	-1.660E-04	3.305E-04	7.409E+00	2.227E+02	2.227E+02	1.000E+00	2.469E+02	2.843E+03	7.120E+11
	2.020E+12	9.284E+12	3.063E+01	1.907E-10	1.907E-12	1.000E+00	6.090E-02	3.707E-02	0.	0.
							6.684E+00			
13.00	4.670E+18	1.263E+18	1.100E+00	5.389E+16	2.769E+14	1.916E+15	0.	0.	0.	3.197E+01
	3.536E+01	1.000E+00	2.001E+09	3.400E+00	1.190E+12	5.543E+13	0.	0.	0.	0.
	1.811E+05	-1.892E-04	2.879E-04	7.101E+00	2.191E+02	2.191E+02	1.000E+00	2.599E+02	3.579E+03	5.782E+11
	1.769E+12	7.898E+12	3.536E+01	2.291E-10	2.291E-12	1.000E+00	4.023E-02	2.366E-02	0.	0.
							4.168E+00			
14.00	4.046E+18	1.094E+18	1.100E+00	4.668E+16	2.399E+14	1.660E+15	0.	0.	0.	2.797E+01
	4.083E+01	1.000E+00	1.920E+09	3.400E+00	1.486E+12	2.307E+13	0.	0.	0.	0.
	1.549E+05	-2.140E-04	2.494E-04	6.847E+00	2.163E+02	2.163E+02	1.000E+00	2.734E+02	4.463E+03	4.636E+11
	1.524E+12	6.644E+12	4.083E+01	2.753E-10	2.753E-12	1.000E+00	2.679E-02	1.649E-02	0.	0.
							2.393E+00			
15.00	3.488E+18	9.435E+17	1.100E+00	4.025E+16	2.068E+14	1.431E+15	0.	0.	0.	2.447E+01
	4.714E+01	1.000E+00	1.905E+09	3.400E+00	1.834E+12	1.746E+13	0.	0.	0.	0.
	1.323E+05	-2.406E-04	2.150E-04	6.640E+00	2.143E+02	2.143E+02	1.000E+00	2.879E+02	5.514E+03	3.683E+11
	1.291E+12	5.543E+12	4.714E+01	3.309E-10	3.309E-12	1.000E+00	2.233E-02	1.254E-02	0.	0.
							2.314E+00			
16.00	2.994E+18	8.100E+17	1.100E+00	3.455E+16	1.776E+14	1.228E+15	0.	0.	0.	2.141E+01
	5.442E+01	1.000E+00	1.949E+09	3.400E+00	2.239E+12	1.358E+13	0.	0.	0.	0.
	1.128E+05	-2.691E-04	1.846E-04	6.474E+00	2.128E+02	2.128E+02	1.000E+00	3.040E+02	6.749E+03	2.909E+11
	1.076E+12	4.598E+12	5.442E+01	3.976E-10	3.976E-12	1.000E+00	1.870E-02	1.036E-02	0.	0.
							2.134E+00			
17.00	2.562E+18	6.929E+17	1.100E+00	2.956E+16	1.519E+14	1.051E+15	0.	0.	0.	1.874E+01
	6.283E+01	1.000E+00	2.043E+09	3.400E+00	2.704E+12	1.081E+13	0.	0.	0.	0.
	9.613E+04	-2.997E-04	1.579E-04	6.342E+00	2.120E+02	2.120E+02	1.000E+00	3.222E+02	8.185E+03	2.291E+11
	8.834E+11	3.800E+12	6.283E+01	4.778E-10	4.778E-12	1.000E+00	1.685E-02	9.265E-03	0.	0.
							1.878E+00			
18.00	2.185E+18	5.911E+17	1.100E+00	2.521E+16	1.296E+14	8.964E+14	0.	0.	0.	1.639E+01
	7.255E+01	1.000E+00	2.186E+09	3.400E+00	3.217E+12	9.055E+12	0.	0.	0.	0.
	8.189E+04	-3.325E-04	1.347E-04	6.241E+00	2.117E+02	2.117E+02	1.000E+00	3.437E+02	9.838E+03	1.806E+11
	7.142E+11	3.134E+12	7.255E+01	5.741E-10	5.741E-12	1.000E+00	1.625E-02	8.908E-03	0.	0.
							1.629E+00			
19.00	1.860E+18	5.030E+17	1.100E+00	2.146E+16	1.103E+14	7.629E+14	0.	0.	0.	1.434E+01
	8.376E+01	1.000E+00	2.372E+09	3.400E+00	3.757E+12	8.011E+12	0.	0.	0.	0.
	6.976E+04	-3.675E-04	1.146E-04	6.166E+00	2.119E+02	2.119E+02	1.000E+00	3.695E+02	1.172E+04	1.427E+11
	5.697E+11	2.584E+12	8.376E+01	6.899E-10	6.899E-12	1.000E+00	1.666E-02	9.148E-03	0.	0.
							1.407E+00			
20.00	1.580E+18	4.274E+17	1.100E+00	1.823E+16	9.369E+13	6.482E+14	0.	0.	0.	1.255E+01
	9.670E+01	1.000E+00	2.599E+09	3.400E+00	4.280E+12	7.130E+12	0.	0.	0.	0.

	5.944E+04	-4.051E-04	9.741E-05	6.114E+00	2.126E+02	2.126E+02	1.000E+00	4.010E+02	1.383E+04	1.133E+11
	4.483E+11	2.133E+12	9.670E+01	8.290E-10	8.290E-12	1.000E+00	1.803E-02	9.958E-03	0.	0.
							1.161E+00			
21.00	1.341E+18	3.620E+17	1.100E+00	1.347E+16	7.352E+13	5.502E+14	0.	0.	0.	1.098E+01
	1.116E+02	1.000E+00	2.859E+09	3.400E+00	4.712E+12	6.240E+12	0.	0.	0.	0.
	5.069E+04	-4.452E-04	8.268E-05	6.083E+00	2.136E+02	2.136E+02	1.000E+00	4.402E+02	1.619E+04	9.062E+10
	3.501E+11	1.763E+12	1.116E+02	9.962E-10	9.962E-12	1.000E+00	2.045E-02	1.140E-02	0.	0.
							9.006E-01			
22.00	1.117E+18	3.077E+17	1.100E+00	1.312E+16	6.745E+13	4.667E+14	0.	0.	0.	9.608E+00
	1.289E+02	1.000E+00	3.145E+09	3.400E+00	4.937E+12	5.414E+12	0.	0.	0.	0.
	4.326E+04	-4.860E-04	7.013E-05	6.069E+00	2.149E+02	2.149E+02	1.000E+00	4.896E+02	1.878E+04	7.304E+10
	2.706E+11	1.461E+12	1.289E+02	1.197E-09	1.197E-11	1.000E+00	2.414E-02	1.364E-02	0.	0.
							6.654E-01			
23.00	9.647E+17	2.610E+17	1.100E+00	1.113E+16	5.720E+13	3.958E+14	0.	0.	0.	8.406E+00
	1.488E+02	1.000E+00	3.443E+09	3.400E+00	4.977E+12	4.673E+12	0.	0.	0.	0.
	3.697E+04	-5.336E-04	5.947E-05	6.071E+00	2.165E+02	2.165E+02	1.000E+00	5.524E+02	2.161E+04	5.939E+10
	2.076E+11	1.214E+12	1.488E+02	1.438E-09	1.438E-11	1.000E+00	2.946E-02	1.690E-02	0.	0.
							4.742E-01			
24.00	8.183E+17	2.213E+17	1.100E+00	9.442E+15	4.852E+13	3.357E+14	0.	0.	0.	7.355E+00
	1.718E+02	1.000E+00	3.736E+09	3.400E+00	4.951E+12	4.027E+12	0.	0.	0.	0.
	3.163E+04	-5.821E-04	5.045E-05	6.086E+00	2.184E+02	2.184E+02	1.000E+00	6.332E+02	2.466E+04	4.874E+10
	1.582E+11	1.011E+12	1.718E+02	1.728E-09	1.728E-11	1.000E+00	3.690E-02	2.155E-02	0.	0.
							3.290E-01			
25.00	6.946E+17	1.873E+17	1.100E+00	8.014E+15	4.118E+13	2.847E+14	0.	0.	0.	6.435E+00
	1.983E+02	1.000E+00	4.007E+09	3.400E+00	4.819E+12	3.460E+12	0.	0.	0.	0.
	2.710E+04	-6.335E-04	4.282E-05	6.114E+00	2.205E+02	2.205E+02	1.000E+00	7.379E+02	2.798E+04	4.039E+10
	1.199E+11	8.442E+11	1.983E+02	2.077E-09	2.077E-11	1.000E+00	4.717E-02	2.810E-02	0.	0.
							2.238E-01			
26.00	5.900E+17	1.596E+17	1.100E+00	6.608E+15	3.499E+13	2.421E+14	0.	0.	0.	5.631E+00
	2.290E+02	1.000E+00	4.235E+09	3.400E+00	4.555E+12	2.997E+12	0.	0.	0.	0.
	2.326E+04	-6.878E-04	3.636E-05	6.152E+00	2.227E+02	2.227E+02	1.000E+00	8.751E+02	3.152E+04	3.378E+10
	9.037E+10	7.067E+11	2.290E+02	2.496E-09	2.496E-11	1.000E+00	6.116E-02	3.724E-02	0.	0.
							1.502E-01			
27.00	5.018E+17	1.358E+17	1.100E+00	5.790E+15	2.976E+13	2.059E+14	0.	0.	0.	4.927E+00
	2.644E+02	1.000E+00	4.402E+09	3.400E+00	4.191E+12	2.573E+12	0.	0.	0.	0.
	1.999E+04	-7.452E-04	3.094E-05	6.200E+00	2.251E+02	2.251E+02	1.000E+00	1.057E+03	3.530E+04	2.851E+10
	6.773E+10	5.928E+11	2.644E+02	2.999E-09	2.999E-11	1.000E+00	8.004E-02	4.988E-02	0.	0.
							9.989E-02			
28.00	4.274E+17	1.156E+17	1.100E+00	4.931E+15	2.534E+13	1.753E+14	0.	0.	0.	4.311E+00
	3.052E+02	1.000E+00	4.493E+09	3.400E+00	3.772E+12	2.217E+12	0.	0.	0.	0.
	1.722E+04	-8.056E-04	2.635E-05	6.255E+00	2.276E+02	2.276E+02	1.000E+00	1.299E+03	3.933E+04	2.426E+10
	5.046E+10	4.979E+11	3.052E+02	3.603E-09	3.603E-11	1.000E+00	1.053E-01	6.722E-02	0.	0.
							6.618E-02			
29.00	3.645E+17	9.861E+16	1.100E+00	4.206E+15	2.161E+13	1.495E+14	0.	0.	0.	3.772E+00
	3.523E+02	1.000E+00	4.500E+09	3.400E+00	3.339E+12	1.912E+12	0.	0.	0.	0.
	1.445E+04	-8.671E-04	2.247E-05	6.317E+00	2.301E+02	2.301E+02	1.000E+00	1.627E+03	4.364E+04	2.081E+10
	3.734E+10	4.185E+11	3.523E+02	4.329E-09	4.329E-11	1.000E+00	1.396E-01	9.074E-02	0.	0.
							4.383E-02			
30.00	3.114E+17	8.424E+16	1.100E+00	3.593E+15	1.846E+13	1.278E+14	0.	0.	0.	3.300E+00
	4.057E+02	1.000E+00	4.421E+09	3.400E+00	2.919E+12	1.650E+12	0.	0.	0.	0.
	1.293E+04	-9.355E-04	1.920E-05	6.385E+00	2.327E+02	2.327E+02	1.000E+00	2.075E+03	4.826E+04	1.798E+10
	2.743E+10	3.513E+11	4.067E+02	5.202E-09	5.202E-11	1.000E+00	1.821E-01	1.223E-01	0.	0.
							2.911E-02			
31.00	2.655E+17	7.207E+16	1.100E+00	3.075E+15	1.580E+13	1.093E+14	0.	0.	0.	2.887E+00
	4.696E+02	1.000E+00	4.262E+09	3.400E+00	2.531E+12	1.425E+12	0.	0.	0.	0.
	1.110E+04	-1.005E-03	1.643E-05	6.457E+00	2.353E+02	2.353E+02	1.000E+00	2.694E+03	5.323E+04	1.562E+10
	2.000E+10	2.953E+11	4.696E+02	6.251E-09	6.251E-11	1.000E+00	2.382E-01	1.641E-01	0.	0.
							1.945E-02			
32.00	2.263E+17	6.140E+16	1.100E+00	2.636E+15	1.355E+13	9.373E+13	0.	0.	0.	2.526E+00
	5.421E+02	1.000E+00	4.034E+09	3.400E+00	2.180E+12	1.232E+12	0.	0.	0.	0.

	3.623E+03	-1.077E-03	1.403E-05	6.533E+00	2.380E+02	2.380E+02	1.000E+00	3.555E+03	5.864E+04	1.364E+10
	1.437E+10	2.478E+11	5.421E+02	7.511E-09	7.511E-11	1.000E+00	3.094E-01	2.187E-01	0.	0.
							1.309E-02			
33.00	1.962E+17	5.404E+16	1.100E+00	2.264E+15	1.163E+13	8.050E+13	0.	0.	0.	2.210E+00
	6.253E+02	1.000E+00	3.754E+09	3.400E+00	1.871E+12	1.067E+12	0.	0.	0.	0.
	8.355E+03	-1.153E-03	1.210E-05	6.612E+00	2.406E+02	2.406E+02	1.000E+00	4.767E+03	6.456E+04	1.197E+10
	1.040E+10	2.074E+11	6.258E+02	9.024E-09	9.024E-11	1.000E+00	3.985E-01	2.890E-01	0.	0.
							8.890E-03			
34.00	1.688E+17	4.567E+16	1.100E+00	1.948E+15	1.001E+13	6.927E+13	0.	0.	0.	1.934E+00
	7.224E+02	1.000E+00	3.441E+09	3.400E+00	1.600E+12	9.241E+11	0.	0.	0.	0.
	7.263E+03	-1.231E-03	1.041E-05	6.693E+00	2.431E+02	2.431E+02	1.000E+00	6.484E+03	7.110E+04	1.054E+10
	7.410E+09	1.730E+11	7.224E+02	1.084E-08	1.084E-10	1.000E+00	5.084E-01	3.781E-01	0.	0.
							6.101E-03			
35.00	1.455E+17	3.937E+16	1.100E+00	1.679E+15	8.629E+12	5.971E+13	0.	0.	0.	1.692E+00
	8.340E+02	1.000E+00	3.113E+09	3.400E+00	1.365E+12	8.014E+11	0.	0.	0.	0.
	6.327E+03	-1.312E-03	8.972E-06	6.774E+00	2.456E+02	2.456E+02	1.000E+00	8.937E+03	7.838E+04	9.310E+09
	5.276E+09	1.438E+11	8.340E+02	1.303E-08	1.303E-10	1.000E+00	6.418E-01	4.893E-01	0.	0.
							4.234E-03			
36.00	1.257E+17	3.400E+16	1.100E+00	1.450E+15	7.452E+12	5.156E+13	0.	0.	0.	1.481E+00
	9.628E+02	1.000E+00	2.786E+09	3.400E+00	1.161E+12	6.958E+11	0.	0.	0.	0.
	5.518E+03	-1.395E-03	7.748E-06	6.857E+00	2.481E+02	2.481E+02	1.000E+00	1.246E+04	8.657E+04	8.241E+09
	3.779E+09	1.190E+11	9.628E+02	1.565E-08	1.565E-10	1.000E+00	8.015E-01	6.259E-01	0.	0.
							2.973E-03			
37.00	1.087E+17	2.941E+16	1.100E+00	1.254E+15	6.446E+12	4.460E+13	0.	0.	0.	1.295E+00
	1.111E+03	1.000E+00	2.471E+09	3.400E+00	9.864E+11	6.047E+11	0.	0.	0.	0.
	4.819E+03	-1.482E-03	6.702E-06	6.939E+00	2.504E+02	2.504E+02	1.000E+00	1.754E+04	9.586E+04	7.309E+09
	2.623E+09	9.798E+10	1.111E+03	1.881E-08	1.881E-10	1.000E+00	9.897E-01	7.911E-01	0.	0.
							2.112E-03			
38.00	9.470E+16	2.548E+16	1.100E+00	1.087E+15	5.586E+12	3.865E+13	0.	0.	0.	1.133E+00
	1.283E+03	1.000E+00	2.178E+09	3.400E+00	8.357E+11	5.260E+11	0.	0.	0.	0.
	4.213E+03	-1.571E-03	5.808E-06	7.021E+00	2.527E+02	2.527E+02	1.000E+00	2.488E+04	1.065E+05	6.492E+09
	1.837E+09	8.025E+10	1.283E+03	2.260E-08	2.260E-10	1.000E+00	1.208E+00	9.878E-01	0.	0.
							1.519E-03			
39.00	8.176E+16	2.212E+16	1.100E+00	9.434E+14	4.848E+12	3.354E+13	0.	0.	0.	9.918E-01
	1.481E+03	1.000E+00	1.912E+09	3.400E+00	7.062E+11	4.581E+11	0.	0.	0.	0.
	3.689E+03	-1.662E-03	5.041E-06	7.102E+00	2.549E+02	2.549E+02	1.000E+00	3.549E+04	1.186E+05	5.775E+09
	1.281E+09	6.534E+10	1.481E+03	2.715E-08	2.715E-10	1.000E+00	1.458E+00	1.218E+00	0.	0.
							1.106E-03			
40.00	7.108E+16	1.923E+16	1.100E+00	8.202E+14	4.215E+12	2.916E+13	0.	0.	0.	8.677E-01
	1.710E+03	1.000E+00	1.675E+09	3.400E+00	5.949E+11	3.993E+11	0.	0.	0.	0.
	3.233E+03	-1.756E-03	4.382E-06	7.183E+00	2.570E+02	2.570E+02	1.000E+00	5.080E+04	1.327E+05	5.144E+09
	8.898E+08	5.283E+10	1.710E+03	3.262E-08	3.262E-10	1.000E+00	1.739E+00	1.483E+00	0.	0.
							8.146E-04			
41.00	6.189E+16	1.674E+16	1.100E+00	7.141E+14	3.670E+12	2.539E+13	0.	0.	0.	7.592E-01
	1.974E+03	1.000E+00	1.467E+09	3.400E+00	4.993E+11	3.484E+11	0.	0.	0.	0.
	2.837E+03	-1.852E-03	3.816E-06	7.262E+00	2.590E+02	2.590E+02	1.000E+00	7.279E+04	1.489E+05	4.588E+09
	6.154E+08	4.254E+10	1.974E+03	3.919E-08	3.919E-10	1.000E+00	2.051E+00	1.784E+00	0.	0.
							6.075E-04			
42.00	5.397E+16	1.460E+16	1.100E+00	6.227E+14	3.200E+12	2.214E+13	0.	0.	0.	6.643E-01
	2.278E+03	1.000E+00	1.286E+09	3.400E+00	4.175E+11	3.043E+11	0.	0.	0.	0.
	2.492E+03	-1.950E-03	3.327E-06	7.341E+00	2.609E+02	2.609E+02	1.000E+00	1.042E+05	1.677E+05	4.100E+09
	4.240E+08	3.400E+10	2.278E+03	4.709E-08	4.709E-10	1.000E+00	2.389E+00	2.117E+00	0.	0.
							4.586E-04			
43.00	4.713E+16	1.275E+16	1.100E+00	5.438E+14	2.795E+12	1.934E+13	0.	0.	0.	5.812E-01
	2.630E+03	1.000E+00	1.129E+09	3.400E+00	3.474E+11	2.659E+11	0.	0.	0.	0.
	2.191E+03	-2.051E-03	2.906E-06	7.419E+00	2.626E+02	2.626E+02	1.000E+00	1.486E+05	1.895E+05	3.672E+09
	2.911E+08	2.700E+10	2.630E+03	5.657E-08	5.657E-10	1.000E+00	2.751E+00	2.480E+00	0.	0.
							3.505E-04			
44.00	4.122E+16	1.115E+16	1.100E+00	4.756E+14	2.444E+12	1.691E+13	0.	0.	0.	5.086E-01
	3.036E+03	1.000E+00	9.943E+08	3.400E+00	2.876E+11	2.327E+11	0.	0.	0.	0.

	1.978E+03	-2.153E-03	2.541E-06	7.497E+00	2.643E+02	2.643E+02	1.000E+00	2.108E+05	2.146E+05	3.297E+09
	1.912E+08	2.132E+10	3.036E+03	6.797E-08	6.797E-10	1.000E+00	3.128E+00	2.866E+00	0.	0.
							2.714E-04			
45.00	3.609E+16	3.760E+15	1.100E+00	4.165E+14	2.140E+12	1.481E+13	0.	0.	0.	4.450E-01
	3.504E+03	1.000E+00	8.785E+08	3.400E+00	2.369E+11	2.018E+11	0.	0.	0.	0.
	1.678E+03	-2.257E-03	2.275E-06	7.574E+00	2.658E+02	2.658E+02	1.000E+00	2.965E+05	2.434E+05	2.969E+09
	1.357E+08	1.674E+10	3.504E+03	8.166E-08	8.166E-10	1.000E+00	3.511E+00	3.264E+00	0.	0.
							2.109E-04			
46.00	3.165E+16	5.552E+15	1.100E+00	3.652E+14	1.877E+12	1.290E+13	0.	0.	0.	3.893E-01
	4.045E+03	1.000E+00	7.787E+08	3.400E+00	1.939E+11	1.760E+11	0.	0.	0.	0.
	1.496E+03	-2.362E-03	1.951E-06	7.651E+00	2.671E+02	2.671E+02	1.000E+00	4.130E+05	2.764E+05	2.685E+09
	9.247E+07	1.307E+10	4.045E+03	9.811E-08	9.811E-10	1.000E+00	3.887E+00	3.661E+00	0.	0.
							1.670E-04			
47.00	2.779E+16	7.518E+15	1.100E+00	3.207E+14	1.648E+12	1.140E+13	0.	0.	0.	3.407E-01
	4.669E+03	1.000E+00	6.925E+08	3.400E+00	1.577E+11	1.535E+11	0.	0.	0.	0.
	1.319E+03	-2.468E-03	1.713E-06	7.727E+00	2.682E+02	2.682E+02	1.000E+00	5.682E+05	3.137E+05	2.439E+09
	6.275E+07	1.015E+10	4.669E+03	1.179E-07	1.179E-09	1.000E+00	4.242E+00	4.039E+00	0.	0.
							1.340E-04			
48.00	2.443E+16	6.609E+15	1.100E+00	2.819E+14	1.449E+12	1.002E+13	0.	0.	0.	2.981E-01
	5.399E+03	1.000E+00	6.177E+08	3.400E+00	1.275E+11	1.338E+11	0.	0.	0.	0.
	1.164E+03	-2.575E-03	1.506E-06	7.804E+00	2.692E+02	2.692E+02	1.000E+00	7.707E+05	3.554E+05	2.228E+09
	4.243E+07	7.852E+09	5.389E+03	1.416E-07	1.416E-09	1.000E+00	4.557E+00	4.380E+00	0.	0.
							1.091E-04			
49.00	2.151E+16	5.818E+15	1.100E+00	2.482E+14	1.275E+12	8.824E+12	0.	0.	0.	2.406E-01
	6.221E+03	1.000E+00	5.523E+08	3.400E+00	1.024E+11	1.165E+11	0.	0.	0.	0.
	1.028E+03	-2.683E-03	1.326E-06	7.880E+00	2.699E+02	2.699E+02	1.000E+00	1.029E+06	4.014E+05	2.048E+09
	2.854E+07	6.050E+09	6.221E+03	1.701E-07	1.701E-09	1.000E+00	4.814E+00	4.659E+00	0.	0.
							9.021E-05			
50.00	1.896E+16	5.128E+15	1.100E+00	2.187E+14	1.124E+12	7.777E+12	0.	0.	0.	2.282E-01
	7.190E+03	1.000E+00	4.947E+08	3.400E+00	8.167E+10	1.015E+11	0.	0.	0.	0.
	9.072E+02	-2.790E-03	1.169E-06	7.955E+00	2.704E+02	2.704E+02	1.000E+00	1.349E+06	4.509E+05	1.896E+09
	1.905E+07	4.648E+09	7.180E+03	2.044E-07	2.044E-09	1.000E+00	4.993E+00	4.856E+00	0.	0.
							7.588E-05			
51.00	1.673E+16	4.525E+15	1.100E+00	1.930E+14	9.918E+11	6.862E+12	0.	0.	0.	1.996E-01
	8.288E+03	3.214E+01	4.437E+08	3.400E+00	6.475E+10	8.833E+10	0.	0.	0.	0.
	8.012E+02	-2.896E-03	1.031E-06	8.030E+00	2.706E+02	2.706E+02	1.000E+00	1.736E+06	5.031E+05	1.768E+09
	1.255E+07	3.562E+09	8.288E+03	2.455E-07	2.455E-09	1.000E+00	5.077E+00	4.949E+00	0.	0.
							6.501E-05			
52.00	1.478E+16	3.997E+15	1.100E+00	1.705E+14	8.762E+11	6.062E+12	0.	0.	0.	1.747E-01
	9.566E+03	2.941E+02	3.979E+08	3.400E+00	5.102E+10	7.684E+10	0.	0.	0.	0.
	7.076E+02	-3.001E-03	9.110E-07	8.103E+00	2.706E+02	2.706E+02	1.000E+00	2.190E+06	5.565E+05	1.663E+09
	8.104E+06	2.725E+09	9.566E+03	2.950E-07	2.950E-09	1.000E+00	5.054E+00	4.923E+00	0.	0.
							5.680E-05			
53.00	1.307E+16	3.535E+15	1.100E+00	1.506E+14	7.748E+11	5.361E+12	0.	0.	0.	1.528E-01
	1.104E+04	1.364E+03	3.567E+08	3.400E+00	3.997E+10	6.681E+10	0.	0.	0.	0.
	6.249E+02	-3.105E-03	8.056E-07	8.172E+00	2.702E+02	2.702E+02	1.000E+00	2.703E+06	6.088E+05	1.579E+09
	5.077E+06	2.062E+09	1.104E+04	3.543E-07	3.543E-09	1.000E+00	4.916E+00	4.772E+00	0.	0.
							5.069E-05			
54.00	1.157E+16	3.127E+15	1.100E+00	1.335E+14	6.859E+11	4.746E+12	0.	0.	0.	1.337E-01
	1.274E+04	4.206E+03	3.192E+08	3.400E+00	3.114E+10	5.804E+10	0.	0.	0.	0.
	5.516E+02	-3.206E-03	7.132E-07	8.236E+00	2.695E+02	2.695E+02	1.000E+00	3.264E+06	6.576E+05	1.514E+09
	3.042E+06	1.591E+09	1.274E+04	4.257E-07	4.257E-09	1.000E+00	4.665E+00	4.497E+00	0.	0.
							4.629E-05			
55.00	1.025E+16	2.773E+15	1.100E+00	1.183E+14	6.078E+11	4.205E+12	0.	0.	0.	1.170E-01
	1.471E+04	9.952E+03	2.848E+08	3.400E+00	2.458E+10	5.038E+10	0.	0.	0.	0.
	4.870E+02	-3.303E-03	6.320E-07	8.299E+00	2.684E+02	2.684E+02	1.000E+00	3.854E+06	6.999E+05	1.465E+09
	1.710E+06	1.216E+09	1.471E+04	5.114E-07	5.114E-09	1.000E+00	4.311E+00	4.114E+00	0.	0.
							4.331E-05			
56.00	9.090E+15	2.459E+15	1.100E+00	1.049E+14	5.390E+11	3.729E+12	0.	0.	0.	1.024E-01
	1.696E+04	1.964E+04	2.416E+08	3.400E+00	2.146E+10	4.369E+10	0.	0.	0.	0.

	4.297E+02	-3.337E-03	5.605E-07	8.352E+00	2.670E+02	2.670E+02	1.000E+00	4.448E+06	7.327E+05	1.433E+09
	1.517E+06	3.301E+08	1.698E+04	6.143E-07	6.143E-09	1.000E+00	3.873E+00	3.645E+00	0.	0.
							4.159E-05			
57.00	8.067E+15	2.182E+15	1.100E+00	9.306E+13	4.784E+11	3.310E+12	0.	0.	0.	8.958E-02
	1.959E+04	3.405E+04	2.050E+08	3.400E+00	1.867E+10	3.786E+10	0.	0.	0.	0.
	3.788E+02	-3.487E-03	4.974E-07	8.396E+00	2.653E+02	2.653E+02	1.000E+00	5.015E+06	7.533E+05	1.417E+09
	1.346E+06	7.127E+08	1.959E+04	7.373E-07	7.373E-09	1.000E+00	3.378E+00	3.124E+00	0.	0.
							4.104E-05			
58.00	7.163E+15	1.936E+15	1.100E+00	8.265E+13	4.247E+11	2.939E+12	0.	0.	0.	7.837E-02
	2.262E+04	5.362E+04	1.739E+08	3.400E+00	1.655E+10	3.277E+10	0.	0.	0.	0.
	3.336E+02	-3.572E-03	4.416E-07	8.429E+00	2.631E+02	2.631E+02	1.000E+00	5.536E+06	7.594E+05	1.415E+09
	1.195E+06	5.472E+08	2.262E+04	8.865E-07	8.865E-09	1.000E+00	2.855E+00	2.586E+00	0.	0.
							4.168E-05			
59.00	6.363E+15	1.721E+15	1.100E+00	7.342E+13	3.773E+11	2.610E+12	0.	0.	0.	6.857E-02
	2.610E+04	7.848E+04	1.475E+08	3.400E+00	1.517E+10	2.832E+10	0.	0.	0.	0.
	2.935E+02	-3.652E-03	3.923E-07	8.449E+00	2.606E+02	2.606E+02	1.000E+00	5.975E+06	7.499E+05	1.429E+09
	1.061E+06	4.212E+08	2.610E+04	1.065E-06	1.065E-08	1.000E+00	2.337E+00	2.065E+00	0.	0.
							4.361E-05			
60.00	5.653E+15	1.529E+15	1.100E+00	6.523E+13	3.352E+11	2.319E+12	0.	0.	0.	6.000E-02
	3.012E+04	1.085E+05	1.252E+08	3.400E+00	1.443E+10	2.445E+10	0.	0.	0.	0.
	2.579E+02	-3.726E-03	3.485E-07	8.453E+00	2.577E+02	2.577E+02	1.000E+00	6.315E+06	7.252E+05	1.456E+09
	9.426E+05	3.251E+08	3.012E+04	1.279E-06	1.279E-08	1.000E+00	1.849E+00	1.589E+00	0.	0.
							4.708E-05			
61.00	5.022E+15	1.358E+15	4.149E+00	5.795E+13	2.978E+11	2.060E+12	0.	0.	0.	5.775E-02
	3.477E+04	1.260E+05	1.062E+03	3.400E+00	1.418E+10	2.108E+10	0.	0.	0.	0.
	2.263E+02	-3.794E-03	3.096E-07	8.440E+00	2.545E+02	2.545E+02	1.000E+00	6.540E+06	6.867E+05	1.499E+09
	8.373E+05	2.517E+08	3.477E+04	1.537E-06	1.537E-08	1.000E+00	1.414E+00	1.178E+00	0.	0.
							5.238E-05			
62.00	4.460E+15	1.206E+15	1.565E+01	5.146E+13	2.645E+11	1.830E+12	0.	0.	0.	5.558E-02
	4.012E+04	1.462E+05	9.008E+07	3.400E+00	1.426E+10	1.815E+10	0.	0.	0.	0.
	1.982E+02	-3.856E-03	2.750E-07	8.409E+00	2.510E+02	2.510E+02	1.000E+00	6.648E+06	6.373E+05	1.557E+09
	7.436E+05	1.954E+08	4.012E+04	1.846E-06	1.846E-08	1.000E+00	1.045E+00	8.405E-01	0.	0.
							6.019E-05			
63.00	3.958E+15	1.071E+15	5.904E+01	4.567E+13	2.347E+11	1.624E+12	0.	0.	0.	5.349E-02
	4.631E+04	1.696E+05	7.642E+07	3.400E+00	1.445E+10	1.560E+10	0.	0.	0.	0.
	1.732E+02	-3.912E-03	2.441E-07	8.357E+00	2.473E+02	2.473E+02	1.000E+00	6.640E+06	5.804E+05	1.630E+09
	6.600E+05	1.522E+08	4.631E+04	2.217E-06	2.217E-08	1.000E+00	7.459E-01	5.779E-01	0.	0.
							7.138E-05			
64.00	3.510E+15	9.496E+14	2.227E+02	4.050E+13	2.081E+11	1.440E+12	0.	0.	0.	5.148E-02
	5.344E+04	1.965E+05	6.483E+07	3.400E+00	1.451E+10	1.338E+10	0.	0.	0.	0.
	1.511E+02	-3.963E-03	2.164E-07	8.286E+00	2.432E+02	2.432E+02	1.000E+00	6.528E+06	5.203E+05	1.719E+09
	5.852E+05	1.189E+08	5.344E+04	2.663E-06	2.663E-08	1.000E+00	5.145E-01	3.831E-01	0.	0.
							8.732E-05			
65.00	3.109E+15	8.411E+14	8.401E+02	3.588E+13	1.844E+11	1.276E+12	0.	0.	0.	4.955E-02
	6.167E+04	2.275E+05	5.500E+07	3.400E+00	1.419E+10	1.145E+10	0.	0.	0.	0.
	1.315E+02	-4.008E-03	1.917E-07	8.195E+00	2.390E+02	2.390E+02	1.000E+00	6.328E+06	4.606E+05	1.824E+09
	5.184E+05	9.318E+07	6.167E+04	3.199E-06	3.199E-08	1.000E+00	3.432E-01	2.452E-01	0.	0.
							1.101E-04			
66.00	2.750E+15	7.439E+14	3.169E+03	3.173E+13	1.631E+11	1.128E+12	0.	0.	0.	4.769E-02
	7.118E+04	2.631E+05	3.447E+07	3.400E+00	1.328E+10	9.781E+09	0.	0.	0.	0.
	1.142E+02	-4.047E-03	1.695E-07	8.085E+00	2.346E+02	2.346E+02	1.000E+00	6.058E+06	6.381E+05	1.945E+09
	4.584E+05	7.318E+07	7.118E+04	3.842E-06	3.842E-08	1.000E+00	2.218E-01	1.518E-01	0.	0.
							1.429E-04			
67.00	2.424E+15	6.567E+14	1.195E+04	2.801E+13	1.439E+11	9.959E+11	0.	0.	0.	4.590E-02
	8.218E+04	3.040E+05	2.160E+07	3.400E+00	1.175E+10	8.335E+09	0.	0.	0.	0.
	9.890E+01	-4.032E-03	1.497E-07	7.957E+00	2.302E+02	2.302E+02	1.000E+00	5.739E+06	8.841E+05	2.082E+09
	4.047E+05	5.739E+07	8.214E+04	4.615E-06	4.615E-08	1.000E+00	1.391E-01	9.108E-02	0.	0.
							1.904E-04			
68.00	2.133E+15	5.783E+14	4.509E+04	2.467E+13	1.268E+11	8.773E+11	0.	0.	0.	4.418E-02
	9.479E+04	3.510E+05	1.354E+07	3.400E+00	9.728E+09	7.085E+09	0.	0.	0.	0.

	3.540E+01	-4.111E-03	1.313E-07	7.614E+00	2.256E+02	2.256E+02	1.000E+00	5.387E+06	1.275E+06	2.234E+09
	3.565E+05	4.540E+07	9.479E+04	5.543E-06	5.543E-08	1.000E+00	8.485E-02	5.315E-02	0.	0.
							2.601E-04			
69.00	1.879E+15	5.083E+14	1.701E+05	2.168E+13	1.114E+11	7.709E+11	0.	0.	0.	4.252E-02
	1.094E+05	4.649E+05	8.485E+06	3.400E+00	7.527E+09	6.005E+09	0.	0.	0.	0.
	7.353E+01	-4.140E-03	1.159E-07	7.656E+00	2.210E+02	2.210E+02	1.000E+00	5.024E+06	1.697E+06	2.399E+09
	3.113E+05	3.582E+07	1.094E+05	6.658E-06	6.658E-08	1.000E+00	5.050E-02	3.026E-02	0.	0.
							3.629E-04			
70.00	1.647E+15	4.455E+14	6.416E+05	1.900E+13	9.765E+10	6.750E+11	0.	0.	0.	4.092E-02
	1.262E+05	4.667E+05	5.317E+06	3.100E+00	5.477E+09	5.076E+09	0.	0.	0.	0.
	6.311E+01	-4.165E-03	1.015E-07	7.491E+00	2.165E+02	2.165E+02	1.000E+00	4.658E+06	2.351E+06	2.575E+09
	2.745E+05	2.626E+07	1.262E+05	7.996E-06	7.996E-08	1.000E+00	2.943E-02	1.688E-02	0.	0.
							5.155E-04			
71.00	1.439E+15	3.892E+14	2.420E+06	1.660E+13	8.531E+10	5.903E+11	0.	0.	0.	3.939E-02
	1.457E+05	5.376E+05	3.332E+06	9.513E+00	3.876E+09	4.276E+09	0.	0.	0.	0.
	5.400E+01	-4.187E-03	8.870E-08	7.318E+00	2.120E+02	2.120E+02	1.000E+00	4.297E+06	3.257E+06	2.759E+09
	2.398E+05	2.233E+07	1.457E+05	9.604E-06	9.604E-08	1.000E+00	1.686E-02	9.267E-03	0.	0.
							7.425E-04			
72.00	1.253E+15	3.383E+14	9.129E+06	1.446E+13	7.429E+10	5.140E+11	0.	0.	0.	3.791E-02
	1.681E+05	6.193E+05	2.088E+06	2.062E+01	2.735E+09	3.590E+09	0.	0.	0.	0.
	4.605E+01	-4.209E-03	7.724E-08	7.140E+00	2.076E+02	2.076E+02	1.000E+00	3.953E+06	4.513E+06	2.946E+09
	2.089E+05	1.761E+07	1.681E+05	1.153E-05	1.153E-07	1.000E+00	9.536E-03	5.031E-03	0.	0.
							1.079E-03			
73.00	1.087E+15	2.941E+14	3.444E+07	1.254E+13	6.446E+10	4.460E+11	0.	0.	0.	3.649E-02
	1.940E+05	7.132E+05	1.309E+06	7.448E+01	1.922E+09	3.003E+09	0.	0.	0.	0.
	3.914E+01	-4.230E-03	6.703E-08	6.960E+00	2.034E+02	2.034E+02	1.000E+00	3.625E+06	6.252E+06	3.130E+09
	1.812E+05	1.388E+07	1.940E+05	1.385E-05	1.385E-07	1.000E+00	5.353E-03	2.716E-03	0.	0.
							1.575E-03			
74.00	9.393E+14	2.542E+14	1.299E+08	1.084E+13	5.573E+10	3.856E+11	0.	0.	0.	3.512E-02
	2.238E+05	8.216E+05	8.203E+05	2.084E+02	1.346E+09	2.502E+09	0.	0.	0.	0.
	3.316E+01	-4.251E-03	5.795E-08	6.781E+00	1.993E+02	1.993E+02	1.000E+00	3.313E+06	8.662E+06	3.306E+09
	1.567E+05	1.091E+07	2.238E+05	1.664E-05	1.664E-07	1.000E+00	2.999E-03	1.466E-03	0.	0.
							2.296E-03			
75.00	8.094E+14	2.187E+14	4.900E+08	9.340E+12	4.799E+10	3.321E+11	0.	0.	0.	3.380E-02
	2.583E+05	9.470E+05	5.141E+05	5.831E+02	9.391E+08	2.075E+09	0.	0.	0.	0.
	2.800E+01	-4.274E-03	4.990E-08	6.604E+00	1.955E+02	1.955E+02	5.000E+02	3.016E+06	1.200E+07	3.466E+09
	1.349E+05	8.555E+06	2.583E+05	1.998E-05	1.998E-07	1.000E+00	1.686E-03	7.961E-04	0.	0.
							3.322E-03			
76.00	6.943E+14	1.878E+14	2.267E+09	8.011E+12	4.117E+10	2.848E+11	0.	0.	0.	3.253E-02
	2.980E+05	1.092E+06	3.222E+05	1.632E+03	5.246E+08	1.713E+09	0.	0.	0.	0.
	2.357E+01	-4.296E-03	4.281E-08	6.433E+00	1.918E+02	1.918E+02	3.497E+04	2.731E+06	1.147E+07	3.602E+09
	1.157E+05	6.689E+06	2.980E+05	2.400E-05	2.400E-07	1.000E+00	9.565E-04	4.376E-04	0.	0.
							4.743E-03			
77.00	5.931E+14	1.604E+14	6.095E+09	6.844E+12	3.517E+10	2.433E+11	0.	0.	0.	3.131E-02
	3.416E+05	1.261E+06	2.019E+05	4.565E+03	2.430E+08	1.407E+09	0.	0.	0.	0.
	1.978E+01	-4.325E-03	3.657E-08	6.268E+00	1.884E+02	1.884E+02	3.695E+05	2.453E+06	1.097E+07	3.707E+09
	9.847E+04	5.211E+06	3.438E+05	2.882E-05	2.882E-07	1.000E+00	5.513E-04	2.450E-04	0.	0.
							6.637E-03			
78.00	5.046E+14	1.365E+14	1.217E+10	5.823E+12	2.992E+10	2.070E+11	0.	0.	0.	3.013E-02
	3.967E+05	1.457E+06	1.265E+05	1.277E+04	1.234E+08	1.149E+09	0.	0.	0.	0.
	1.655E+01	-4.356E-03	3.111E-08	6.111E+00	1.852E+02	1.852E+02	1.655E+06	2.179E+06	1.049E+07	3.774E+09
	8.412E+04	4.045E+06	3.967E+05	3.461E-05	3.461E-07	1.000E+00	3.248E-04	1.406E-04	0.	0.
							9.046E-03			
79.00	4.276E+14	1.156E+14	2.027E+10	4.934E+12	2.535E+10	1.754E+11	0.	0.	0.	2.900E-02
	4.578E+05	1.686E+06	7.930E+04	3.574E+04	8.074E+07	9.326E+08	0.	0.	0.	0.
	1.380E+01	-4.391E-03	2.636E-08	5.964E+00	1.823E+02	1.823E+02	4.673E+06	1.904E+06	1.003E+07	3.798E+09
	7.178E+04	3.126E+06	4.578E+05	4.156E-05	4.156E-07	1.000E+00	1.968E-04	8.321E-05	0.	0.
							1.193E-02			
80.00	3.609E+14	9.758E+13	3.000E+10	4.164E+12	2.140E+10	1.480E+11	0.	0.	0.	2.791E-02
	5.282E+05	1.951E+06	4.970E+04	1.000E+05	7.257E+07	7.520E+08	0.	0.	0.	0.

	1.148E+01	-4.430E-03	2.225E-08	5.825E+00	1.797E+02	1.797E+02	1.000E+07	1.620E+06	9.593E+06	3.776E+09
	6.015E+04	2.406E+06	5.282E+05	4.991E-05	4.991E-07	1.000E+00	1.234E-04	5.112E-05	0.	0.
							1.512E-02			
81.00	3.033E+14	3.202E+13	4.094E+10	3.500E+12	1.799E+10	1.245E+11	0.	0.	0.	2.686E-02
	6.094E+05	2.261E+06	3.115E+04	1.100E+06	8.841E+07	6.019E+08	0.	0.	0.	0.
	9.527E+00	-4.475E-03	1.870E-08	5.697E+00	1.774E+02	1.774E+02	1.789E+07	1.043E+06	3.652E+06	3.706E+09
	5.057E+04	1.844E+06	6.094E+05	5.994E-05	5.994E-07	1.000E+00	8.057E-05	3.278E-05	0.	0.
							1.830E-02			
82.00	2.540E+14	6.868E+13	5.269E+10	2.931E+12	1.506E+10	1.042E+11	0.	0.	0.	2.586E-02
	7.031E+05	2.622E+06	1.952E+04	6.231E+06	1.360E+08	4.780E+08	0.	0.	0.	0.
	7.886E+00	-4.527E-03	1.566E-08	5.580E+00	1.754E+02	1.754E+02	2.832E+07	6.676E+05	1.390E+06	3.589E+09
	4.235E+04	1.408E+06	7.031E+05	7.198E-05	7.198E-07	1.000E+00	5.506E-05	2.206E-05	0.	0.
							2.103E-02			
83.00	2.120E+14	5.730E+13	6.495E+10	2.446E+12	1.257E+10	8.697E+10	0.	0.	0.	2.489E-02
	8.112E+05	3.043E+06	1.710E+04	2.118E+07	2.368E+08	3.764E+08	0.	0.	0.	0.
	6.518E+00	-4.585E-03	1.307E-08	5.473E+00	1.737E+02	1.737E+02	4.107E+07	4.277E+05	5.292E+05	3.429E+09
	3.534E+04	1.070E+06	8.112E+05	8.644E-05	8.644E-07	1.000E+00	3.959E-05	1.567E-05	0.	0.
							2.280E-02			
84.00	1.763E+14	4.764E+13	7.745E+10	2.034E+12	1.045E+10	7.232E+10	0.	0.	0.	2.395E-02
	9.359E+05	3.534E+06	1.496E+04	4.907E+07	4.120E+08	2.936E+08	0.	0.	0.	0.
	5.378E+00	-4.651E-03	1.087E-08	5.377E+00	1.723E+02	1.723E+02	5.583E+07	2.740E+05	2.014E+05	3.232E+09
	2.939E+04	8.109E+05	9.359E+05	1.038E-04	1.038E-06	1.000E+00	0.	0.	0.	0.
							0.			
85.00	1.462E+14	3.948E+13	9.000E+10	1.686E+12	8.666E+09	5.996E+10	0.	0.	0.	2.305E-02
	1.080E+06	4.107E+06	1.308E+04	8.600E+07	6.331E+08	2.267E+08	0.	0.	0.	0.
	4.431E+00	-4.725E-03	9.011E-09	5.292E+00	1.712E+02	1.712E+02	7.225E+07	1.755E+05	7.668E+04	3.006E+09
	2.437E+04	6.126E+05	1.080E+06	1.246E-04	1.246E-06	1.000E+00	0.	0.	0.	0.
							0.			
86.00	1.208E+14	3.262E+13	1.070E+11	1.394E+12	7.164E+09	4.957E+10	0.	0.	0.	2.219E-02
	1.246E+06	4.183E+06	1.142E+04	1.237E+08	7.770E+08	1.732E+08	0.	0.	0.	0.
	3.647E+00	-4.809E-03	7.449E-09	5.218E+00	1.705E+02	1.705E+02	9.000E+07	1.124E+05	4.626E+04	2.759E+09
	2.015E+04	4.617E+05	1.246E+06	1.497E-04	1.497E-06	1.000E+00	0.	0.	0.	0.
							0.			
87.00	9.963E+13	2.698E+13	1.273E+11	1.150E+12	5.908E+09	4.087E+10	0.	0.	0.	2.135E-02
	1.417E+06	4.369E+06	9.972E+03	1.553E+08	7.191E+08	1.306E+08	0.	0.	0.	0.
	3.001E+00	-4.901E-03	6.142E-09	5.155E+00	1.701E+02	1.701E+02	8.325E+07	7.200E+04	2.791E+04	2.499E+09
	1.662E+04	3.475E+05	1.437E+06	1.797E-04	1.797E-06	1.000E+00	0.	0.	0.	0.
							0.			
88.00	8.198E+13	2.209E+13	1.514E+11	9.459E+11	4.861E+09	3.363E+10	0.	0.	0.	2.055E-02
	1.658E+06	4.686E+06	8.699E+03	1.783E+08	5.046E+08	9.761E+07	0.	0.	0.	0.
	2.468E+00	-5.005E-03	5.054E-09	5.102E+00	1.700E+02	1.700E+02	7.700E+07	4.612E+04	1.684E+04	2.236E+09
	1.367E+04	2.613E+05	1.658E+06	2.158E-04	2.158E-06	1.000E+00	0.	0.	0.	0.
							0.			
89.00	6.733E+13	1.812E+13	1.800E+11	7.769E+11	3.992E+09	2.762E+10	0.	0.	0.	1.978E-02
	1.913E+06	5.166E+06	7.587E+03	1.927E+08	2.932E+08	7.190E+07	0.	0.	0.	0.
	2.030E+00	-5.120E-03	4.151E-09	5.060E+00	1.702E+02	1.702E+02	7.122E+07	2.954E+04	1.016E+04	1.978E+09
	1.123E+04	1.966E+05	1.913E+06	2.591E-04	2.591E-06	1.000E+00	0.	0.	0.	0.
							0.			
90.00	5.572E+13	1.483E+13	2.141E+11	6.371E+11	3.274E+09	2.265E+10	1.353E+02	5.952E-08	1.344E+02	1.904E-02
	2.206E+06	5.862E+06	6.616E+03	2.000E+08	1.708E+08	5.226E+07	1.646E+02	4.824E-08	1.646E+02	3.301E-14
	1.671E+00	-5.246E-03	3.404E-09	5.028E+00	1.707E+02	1.707E+02	6.587E+07	1.892E+04	6.130E+03	1.731E+09
	9.219E+03	1.481E+05	2.206E+06	3.111E-04	3.111E-06	1.000E+00	0.	0.	2.185E-04	9.775E-01
							0.			
91.00	4.524E+13	1.212E+13	2.412E+11	5.220E+11	2.682E+09	1.856E+10	1.653E+02	1.493E-07	1.641E+02	2.832E-02
	2.545E+06	6.847E+06	5.770E+03	2.008E+08	1.094E+08	3.747E+07	2.013E+02	1.216E-07	2.013E+02	8.403E-14
	1.377E+00	-5.386E-03	2.789E-09	5.006E+00	1.716E+02	1.716E+02	6.093E+07	1.212E+04	3.698E+03	1.499E+09
	7.557E+03	1.118E+05	2.545E+06	3.735E-04	3.735E-06	1.000E+00	0.	0.	2.892E-04	1.245E+00
							0.			
92.00	3.704E+13	9.684E+12	2.702E+11	4.273E+11	2.196E+09	1.519E+10	2.019E+02	3.735E-07	2.004E+02	4.210E-02
	2.936E+06	8.227E+06	5.036E+03	1.953E+08	6.997E+07	2.649E+07	2.462E+02	3.058E-07	2.462E+02	2.137E-13

	1.135E+00	-5.533E-03	2.283E-09	4.994E+00	1.728E+02	1.728E+02	5.636E+07	7.764E+03	2.231E+03	1.286E+09
	6.191E+03	6.472E+04	2.936E+06	4.484E-04	4.484E-06	1.000E+00	0.	0.	3.849E-04	1.545E+00
							0.			
93.00	3.031E+13	6.050E+12	3.004E+11	3.498E+11	1.797E+09	1.244E+10	2.466E+02	9.286E-07	2.447E+02	6.254E-02
	3.387E+06	1.014E+07	4.396E+03	1.631E+08	4.476E+07	1.846E+07	3.014E+02	7.658E-07	3.014E+02	5.424E-13
	9.389E-01	-5.707E-03	1.869E-09	4.792E+00	1.743E+02	1.743E+02	6.213E+07	4.973E+03	1.346E+03	1.095E+09
	5.073E+03	6.449E+04	3.387E+06	5.384E-04	5.384E-06	1.000E+00	4.463E-05	1.774E-05	5.162E-04	1.871E+00
							9.954E-04			
94.00	2.481E+13	6.547E+12	3.308E+11	2.863E+11	1.471E+09	1.016E+10	3.012E+02	2.28[illegible]E-06	2.990E+02	9.282E-02
	3.907E+06	1.275E+07	3.846E+03	1.643E+08	2.863E+07	1.269E+07	3.691E+02	1.303E-06	3.691E+02	1.372E-12
	7.776E-01	-5.890E-03	1.530E-09	4.399E+00	1.761E+02	1.761E+02	4.821E+07	3.185E+03	8.122E+02	9.260E+08
	4.153E+03	4.936E+04	3.907E+06	6.463E-04	6.463E-06	1.000E+00	6.328E-05	2.550E-05	6.989E-04	2.222E+00
							4.876E-04			
95.00	2.032E+13	5.317E+12	3.601E+11	2.345E+11	1.205E+09	8.336E+09	3.679E+02	5.582E-06	3.653E+02	1.377E-01
	4.506E+06	1.621E+07	3.368E+03	1.400E+08	1.832E+07	8.602E+06	4.522E+02	4.692E-06	4.522E+02	3.455E-12
	6.455E-01	-6.090E-03	1.253E-09	5.016E+00	1.783E+02	1.783E+02	4.460E+07	2.040E+03	4.900E+02	7.783E+08
	3.411E+03	3.803E+04	4.506E+06	7.760E-04	7.760E-06	1.000E+00	9.412E-05	3.654E-05	9.574E-04	2.608E+00
							2.249E-04			
96.00	1.665E+13	4.312E+12	3.866E+11	1.922E+11	9.875E+08	6.833E+09	4.493E+02	1.343E-05	4.463E+02	2.040E-01
	5.198E+06	2.052E+07	2.955E+03	1.127E+08	1.174E+07	5.757E+06	5.543E+02	1.137E-05	5.543E+02	8.652E-12
	5.374E-01	-6.307E-03	1.027E-09	5.042E+00	1.807E+02	1.807E+02	4.125E+07	1.307E+03	2.956E+02	6.510E+08
	2.801E+03	2.950E+04	5.198E+06	9.316E-04	9.316E-06	1.000E+00	1.461E-04	6.096E-05	1.329E-03	3.067E+00
							9.828E-05			
97.00	1.367E+13	3.493E+12	4.087E+11	1.577E+11	8.104E+08	5.607E+09	5.488E+02	3.178E-05	5.451E+02	3.022E-01
	5.995E+06	2.531E+07	2.598E+03	8.547E+07	7.526E+06	3.808E+06	6.795E+02	2.718E-05	6.795E+02	2.153E-11
	4.488E-01	-6.543E-03	8.476E-10	5.077E+00	1.834E+02	1.834E+02	3.815E+07	8.371E+02	1.784E+02	5.426E+08
	2.305E+03	2.307E+04	5.995E+06	1.118E-03	1.118E-05	1.000E+00	2.355E-04	1.004E-04	1.874E-03	3.689E+00
							4.093E-05			
98.00	1.123E+13	2.826E+12	4.248E+11	1.296E+11	6.661E+08	4.609E+09	6.703E+02	7.386E-05	6.656E+02	4.471E-01
	6.915E+06	2.944E+07	2.249E+03	6.143E+07	4.834E+06	2.493E+06	8.332E+02	6.381E-05	8.332E+02	5.320E-11
	3.760E-01	-6.799E-03	6.926E-10	5.121E+00	1.863E+02	1.863E+02	3.529E+07	5.362E+02	1.076E+02	4.511E+08
	1.900E+03	1.818E+04	6.915E+06	1.343E-03	1.343E-05	1.000E+00	3.926E-04	1.715E-04	2.687E-03	4.675E+00
							1.634E-05			
99.00	9.250E+12	2.285E+12	4.336E+11	1.067E+11	5.485E+08	3.795E+09	8.187E+02	1.682E-04	8.122E+02	6.607E-01
	7.976E+06	3.088E+07	2.023E+03	4.242E+07	3.110E+06	1.617E+06	1.022E+03	1.468E-04	1.022E+03	1.305E-10
	3.161E-01	-7.075E-03	5.703E-10	5.174E+00	1.896E+02	1.896E+02	3.264E+07	3.435E+02	6.492E+01	3.745E+08
	1.570E+03	1.445E+04	7.976E+06	1.612E-03	1.612E-05	1.000E+00	6.742E-04	3.027E-04	3.920E-03	6.509E+00
							6.280E-06			
100.00	7.633E+12	1.848E+12	4.342E+11	8.807E+10	4.526E+08	3.131E+09	1.000E+03	3.744E-04	9.895E+02	9.748E-01
	9.199E+06	2.746E+07	1.793E+03	2.846E+07	2.006E+06	1.043E+06	1.253E+03	3.303E-04	1.253E+03	3.175E-10
	2.668E-01	-7.373E-03	4.706E-10	5.236E+00	1.932E+02	1.932E+02	3.019E+07	2.200E+02	3.917E+01	3.107E+08
	1.301E+03	1.157E+04	9.199E+06	1.935E-03	1.935E-05	1.000E+00	1.191E-03	5.514E-04	5.824E-03	1.049E+01
							2.316E-06			
101.00	6.314E+12	1.495E+12	4.264E+11	7.285E+10	3.744E+08	2.615E+09	1.006E+03	5.470E-04	9.893E+02	9.652E-01
	1.090E+07	2.527E+07	1.594E+03	1.972E+07	1.296E+06	6.693E+05	1.259E+03	4.876E-04	1.259E+03	5.299E-10
	2.261E-01	-7.694E-03	3.893E-10	5.306E+00	1.971E+02	1.971E+02	2.686E+07	1.725E+02	2.684E+01	2.579E+08
	1.090E+03	9.332E+03	1.090E+07	2.322E-03	2.322E-05	1.000E+00	2.161E-03	1.036E-03	5.925E-03	1.094E+01
							8.437E-07			
102.00	5.236E+12	1.211E+12	4.105E+11	6.042E+10	3.105E+08	2.207E+09	1.001E+03	7.808E-04	9.895E+02	9.559E-01
	1.290E+07	2.335E+07	1.421E+03	1.348E+07	8.402E+05	4.300E+05	1.267E+03	7.035E-04	1.267E+03	8.718E-10
	1.974E-01	-8.040E-03	3.228E-10	5.384E+00	2.014E+02	2.014E+02	2.390E+07	1.297E+02	1.839E+01	2.144E+08
	8.996E+02	7.574E+03	1.290E+07	2.786E-03	2.788E-05	1.000E+00	4.027E-03	2.006E-03	6.152E-03	1.132E+01
							2.969E-07			
103.00	4.355E+12	9.842E+11	3.878E+11	5.025E+10	2.582E+08	1.862E+09	1.002E+03	1.089E-03	9.903E+02	9.468E-01
	1.491E+07	2.167E+07	1.272E+03	9.209E+06	5.461E+05	2.766E+05	1.275E+03	9.914E-04	1.275E+03	1.416E-09
	1.644E-01	-8.411E-03	2.685E-10	5.470E+00	2.061E+02	2.061E+02	2.127E+07	9.442E+01	1.260E+01	1.785E+08
	7.512E+02	6.178E+03	1.491E+07	3.346E-03	3.346E-05	1.000E+00	7.713E-03	4.010E-03	6.516E-03	1.162E+01
							1.021E-07			
104.00	3.633E+12	8.028E+11	3.598E+11	4.192E+10	2.154E+08	1.562E+09	1.004E+03	1.482E-03	9.917E+02	9.380E-01
	1.723E+07	2.018E+07	1.142E+03	6.293E+06	3.560E+05	1.794E+05	1.285E+03	1.364E-03	1.285E+03	2.274E-09

	1.411E-01	-6.611E-03	2.240E-10	5.563E+00	2.112E+02	2.112E+02	[illegible]	6.756E+01	8.636E+06	1.491E+08
	6.290E+02	5.055E+03	1.723E+07	4.017E-03	4.017E-05	1.000E+00	1.517E-02	8.275E-03	7.033E-03	1.182E+01
							3.448E-08			
105.00	3.040E+12	6.541E+11	3.284E+11	3.508E+10	1.802E+08	1.300E+09	1.005E+03	1.972E-03	9.935E+02	9.293E-01
	1.976E+07	1.886E+07	1.029E+03	4.300E+06	2.328E+05	1.175E+05	1.296E+03	1.835E-03	1.296E+03	3.614E-09
	1.216E-01	-9.240E-03	1.874E-10	5.662E+00	2.168E+02	2.168E+02	1.685E+07	4.827E+01	5.917E+00	1.249E+08
	5.281E+02	4.140E+03	1.976E+07	4.821E-03	4.821E-05	1.000E+00	3.062E-02	1.762E-02	7.723E-03	1.194E+01
							1.149E-08			
106.00	2.552E+12	5.425E+11	2.955E+11	2.944E+10	1.513E+08	1.074E+09	1.006E+03	2.568E-03	9.959E+02	9.207E-01
	2.251E+07	1.769E+07	9.301E+02	2.938E+06	1.527E+05	7.814E+04	1.308E+03	2.415E-03	1.308E+03	5.607E-09
	1.053E-01	-9.700E-03	1.573E-10	5.766E+00	2.230E+02	2.230E+02	1.500E+07	3.500E+01	4.055E+00	1.050E+08
	4.446E+02	3.386E+03	2.251E+07	5.787E-03	5.787E-05	1.000E+00	6.326E-02	3.064E-02	8.609E-03	1.190E+01
							3.803E-09			
107.00	2.149E+12	4.499E+11	2.628E+11	2.480E+10	1.274E+08	8.812E+08	1.011E+03	3.282E-03	9.988E+02	9.122E-01
	2.548E+07	1.664E+07	8.435E+02	2.008E+06	1.005E+05	5.298E+04	1.324E+03	3.118E-03	1.322E+03	8.863E-09
	9.157E-02	-1.020E-02	1.325E-10	5.876E+00	2.298E+02	2.298E+02	1.335E+07	2.614E+01	2.778E+00	8.862E+07
	3.753E+02	2.759E+03	2.548E+07	6.945E-03	6.945E-05	1.000E+00	1.333E-01	8.698E-02	9.717E-03	1.193E+01
							1.260E-09			
108.00	1.816E+12	3.752E+11	2.318E+11	2.095E+10	1.077E+08	7.206E+08	1.014E+03	4.128E-03	1.002E+03	9.039E-01
	2.867E+07	1.570E+07	7.675E+02	1.372E+06	6.635E+04	3.678E+04	1.337E+03	3.960E-03	1.337E+03	1.360E-08
	8.001E-02	-1.073E-02	1.119E-10	5.989E+00	2.372E+02	2.372E+02	1.189E+07	2.033E+01	1.904E+00	7.510E+07
	3.177E+02	2.232E+03	2.867E+07	8.336E-03	8.336E-05	1.000E+00	2.655E-01	2.002E-01	1.107E-02	1.181E+01
							4.219E-10			
109.00	1.539E+12	3.145E+11	2.034E+11	1.776E+10	9.124E+07	5.883E+08	1.018E+03	5.132E-03	1.006E+03	8.956E-01
	3.210E+07	1.485E+07	7.004E+02	9.376E+05	4.394E+04	2.625E+04	1.353E+03	4.967E-03	1.353E+03	2.091E-08
	7.023E-02	-1.130E-02	9.487E-11	6.104E+00	2.452E+02	2.452E+02	1.058E+07	1.658E+01	1.305E+00	6.390E+07
	2.697E+02	1.788E+03	3.210E+07	1.000E-02	1.000E-04	1.000E+00	6.176E-01	4.609E-01	1.268E-02	1.163E+01
							1.439E-10			
110.00	1.308E+12	2.648E+11	1.783E+11	1.510E+10	7.757E+07	4.800E+08	1.022E+03	6.334E-03	1.011E+03	8.875E-01
	3.575E+07	1.409E+07	6.410E+02	6.407E+05	2.920E+04	1.932E+04	1.370E+03	6.188E-03	1.370E+03	3.165E-08
	6.193E-02	-1.193E-02	8.068E-11	6.221E+00	2.539E+02	2.539E+02	9.427E+06	1.418E+01	8.940E-01	5.459E+07
	2.297E+02	1.414E+03	3.575E+07	1.201E-02	1.201E-04	1.000E+00	1.344E+00	1.112E+00	1.456E-02	1.138E+01
							5.041E-11			
111.00	1.116E+12	2.235E+11	1.566E+11	1.287E+10	6.616E+07	3.917E+08	1.027E+03	7.796E-03	1.016E+03	8.796E-01
	3.963E+07	1.339E+07	5.881E+02	4.378E+05	1.946E+04	1.470E+04	1.390E+03	7.661E-03	1.390E+03	4.739E-08
	5.487E-02	-1.260E-02	6.879E-11	6.388E+00	2.634E+02	2.634E+02	8.397E+06	1.265E+01	6.126E-01	4.602E+07
	1.962E+02	1.102E+03	3.963E+07	1.441E-02	1.441E-04	1.000E+00	2.925E+00	2.657E+00	1.670E-02	1.108E+01
							1.828E-11			
112.00	9.543E+11	1.890E+11	1.384E+11	1.101E+10	5.658E+07	3.194E+08	1.032E+03	9.611E-03	1.021E+03	8.719E-01
	4.373E+07	1.276E+07	5.409E+02	2.992E+05	1.306E+04	1.157E+04	1.410E+03	9.504E-03	1.410E+03	7.017E-08
	4.884E-02	-1.334E-02	5.883E-11	6.454E+00	2.737E+02	2.737E+02	7.481E+06	1.168E+01	4.197E-01	4.030E+07
	1.681E+02	8.437E+02	4.373E+07	1.729E-02	1.729E-04	1.000E+00	6.341E+00	0.	1.905E-02	1.078E+01
							6.894E-12			
113.00	8.186E+11	1.598E+11	1.233E+11	9.445E+09	4.854E+07	2.600E+08	1.038E+03	1.192E-02	1.027E+03	8.644E-01
	4.807E+07	1.219E+07	4.985E+02	2.044E+05	8.717E+03	9.413E+03	1.432E+03	1.179E-02	1.432E+03	1.027E-07
	4.367E-02	-1.414E-02	5.047E-11	6.568E+00	2.847E+02	2.847E+02	6.667E+06	1.106E+01	2.876E-01	3.481E+07
	1.445E+02	6.347E+02	4.807E+07	2.075E-02	2.075E-04	1.000E+00	1.362E+01	0.	2.158E-02	1.036E+01
							2.716E-12			
114.00	7.042E+11	1.350E+11	1.109E+11	8.175E+09	4.175E+07	2.108E+08	1.044E+03	1.489E-02	1.034E+03	8.571E-01
	5.264E+07	1.166E+07	4.603E+02	1.397E+05	5.860E+03	7.668E+03	1.456E+03	1.463E-02	1.456E+03	1.485E-07
	3.924E-02	-1.501E-02	4.341E-11	6.681E+00	2.966E+02	2.966E+02	5.943E+06	1.067E+01	1.971E-01	3.017E+07
	1.248E+02	4.693E+02	5.264E+07	2.490E-02	2.490E-04	1.000E+00	2.808E+01	0.	2.421E-02	9.956E+00
							1.119E-12			
115.00	6.076E+11	1.139E+11	1.008E+11	7.011E+09	3.603E+07	1.700E+08	1.050E+03	1.877E-02	1.041E+03	8.502E-01
	5.743E+07	1.117E+07	4.257E+02	9.546E+04	3.351E+03	6.765E+03	1.480E+03	1.830E-02	1.480E+03	2.121E-07
	3.542E-02	-1.590E-02	3.746E-11	6.793E+00	3.093E+02	3.093E+02	5.299E+06	1.042E+01	1.351E-01	2.623E+07
	1.078E+02	3.419E+02	5.743E+07	2.988E-02	2.988E-04	1.000E+00	6.004E+01	0.	2.690E-02	9.530E+00
							4.812E-13			
116.00	5.260E+11	9.607E+10	9.246E+10	6.070E+09	3.119E+07	1.362E+08	1.057E+03	2.380E-02	1.048E+03	8.430E-01
	6.244E+07	1.073E+07	3.941E+02	6.573E+04	2.673E+03	5.877E+03	1.507E+03	2.301E-02	1.507E+03	2.993E-07

	3.212E-02	-1.699E-02	3.243E-11	6.904E+00	3.229E+02	3.229E+02	4.726E+06	1.027E+01	9.254E-02	2.288E+07
	9.369E+01	2.467E+02	6.244E+07	3.586E-02	3.586E-04	1.000E+00	1.216E+02	0.	2.967E-02	9.096E+00
							2.154E-13			
117.00	4.573E+11	6.114E+10	8.512E+10	5.276E+09	2.711E+07	1.085E+08	1.065E+03	3.013E-02	1.056E+03	8.380E-01
	6.767E+07	1.032E+07	3.653E+02	4.457E+04	1.816E+03	5.093E+03	1.534E+03	2.888E-02	1.534E+03	4.176E-07
	2.926E-02	-1.809E-02	2.819E-11	7.013E+00	3.370E+02	3.370E+02	4.217E+06	1.017E+01	6.341E-02	2.003E+07
	6.175E+01	1.778E+02	6.767E+07	4.303E-02	4.303E-04	1.000E+00	2.381E+02	0.	3.262E-02	8.666E+00
							9.954E-14			
118.00	3.996E+11	6.907E+10	7.806E+10	4.611E+09	2.369E+07	8.634E+07	1.073E+03	3.756E-02	1.065E+03	8.332E-01
	7.310E+07	9.936E+06	3.389E+02	3.046E+04	1.240E+03	4.315E+03	1.563E+03	3.567E-02	1.563E+03	5.770E-07
	2.677E-02	-1.924E-02	2.464E-11	7.122E+00	3.517E+02	3.517E+02	3.764E+06	1.011E+01	4.345E-02	1.762E+07
	7.168E+01	1.297E+02	7.310E+07	5.163E-02	5.163E-04	1.000E+00	4.459E+02	0.	3.604E-02	8.257E+00
							4.698E-14			
119.00	3.517E+11	5.993E+10	7.044E+10	4.058E+09	2.086E+07	6.913E+07	1.082E+03	4.503E-02	1.074E+03	8.298E-01
	7.874E+07	9.583E+06	3.146E+02	2.081E+04	8.531E+02	3.476E+03	1.591E+03	4.240E-02	1.591E+03	7.913E-07
	2.458E-02	-2.040E-02	2.169E-11	7.229E+00	3.663E+02	3.663E+02	3.361E+06	1.007E+01	2.977E-02	1.560E+07
	6.320E+01	9.750E+01	7.874E+07	6.195E-02	6.195E-04	1.000E+00	7.882E+02	0.	4.049E-02	7.894E+00
							2.230E-14			
119.99	3.131E+11	5.392E+10	6.156E+10	3.613E+09	1.857E+07	5.660E+07	1.091E+03	5.017E-02	1.083E+03	8.287E-01
	8.451E+07	9.257E+06	2.924E+02	1.428E+04	5.949E+02	2.580E+03	1.620E+03	4.695E-02	1.620E+03	1.078E-06
	2.267E-02	-2.146E-02	1.930E-11	7.333E+00	3.799E+02	3.799E+02	3.006E+06	1.004E+01	2.048E-02	1.396E+07
	5.619E+01	7.764E+01	8.451E+07	7.413E-02	7.382E-04	1.000E+00	0.	0.	4.702E-02	7.686E+00
							0.			
120.00	3.128E+11	5.388E+10	6.146E+10	3.609E+09	1.855E+07	5.650E+07	1.091E+03	5.020E-02	1.083E+03	8.287E-01
	8.457E+07	9.254E+06	2.922E+02	1.422E+04	5.929E+02	2.571E+03	1.620E+03	4.698E-02	1.620E+03	1.081E-06
	2.260E-02	-1.141E-05	1.929E-11	7.334E+00	3.800E+02	3.800E+02	3.002E+06	1.004E+01	2.040E-02	1.395E+07
	5.612E+01	7.752E+01	8.457E+07	7.432E-02	7.391E-04	1.000E+00	0.	0.	4.710E-02	7.684E+00
							0.			
121.00	2.738E+11	4.662E+10	5.572E+10	3.051E+09	1.777E+07	4.721E+07	1.101E+03	6.105E-02	1.093E+03	8.223E-01
	9.058E+07	8.948E+06	2.714E+02	9.719E+03	4.060E+02	2.127E+03	1.656E+03	5.653E-02	1.656E+03	1.472E-06
	2.095E-02	-1.222E-05	1.690E-11	7.797E+00	4.001E+02	4.001E+02	2.684E+06	1.003E+01	1.398E-02	1.227E+07
	4.929E+01	5.696E+01	9.058E+07	8.917E-02	8.335E-04	1.000E+00	0.	0.	5.267E-02	7.267E+00
							0.			
122.00	2.415E+11	4.067E+10	5.081E+10	2.604E+09	1.708E+07	3.983E+07	1.111E+03	7.358E-02	1.104E+03	8.180E-01
	9.675E+07	8.662E+06	2.523E+02	6.641E+03	2.801E+02	1.773E+03	1.692E+03	6.745E-02	1.692E+03	1.975E-06
	1.945E-02	-1.302E-05	1.492E-11	8.258E+00	4.198E+02	4.198E+02	2.400E+06	1.002E+01	9.580E-03	1.087E+07
	4.362E+01	4.217E+01	9.675E+07	1.070E-01	9.408E-04	1.000E+00	0.	0.	5.862E-02	6.962E+00
							0.			
123.00	2.144E+11	3.573E+10	4.657E+10	2.240E+09	1.645E+07	3.390E+07	1.122E+03	8.798E-02	1.115E+03	8.158E-01
	1.031E+08	8.394E+06	2.345E+02	4.538E+03	1.945E+02	1.488E+03	1.728E+03	7.987E-02	1.728E+03	2.615E-06
	1.812E-02	-1.381E-05	1.326E-11	8.719E+00	4.390E+02	4.390E+02	2.148E+06	1.001E+01	6.564E-03	9.687E+06
	3.887E+01	3.143E+01	1.031E+08	1.284E-01	1.063E-03	1.000E+00	0.	0.	6.496E-02	6.687E+00
							0.			
124.00	1.915E+11	3.160E+10	4.288E+10	1.941E+09	1.588E+07	2.908E+07	1.133E+03	1.045E-01	1.127E+03	8.153E-01
	1.095E+08	8.142E+06	2.181E+02	3.101E+03	1.360E+02	1.256E+03	1.764E+03	9.396E-02	1.764E+03	3.420E-06
	1.694E-02	-1.459E-05	1.186E-11	9.178E+00	4.578E+02	4.578E+02	1.923E+06	1.001E+01	4.498E-03	8.677E+06
	3.483E+01	2.357E+01	1.095E+08	1.540E-01	1.202E-03	1.000E+00	0.	0.	7.173E-02	6.440E+00
							0.			
125.00	1.720E+11	2.810E+10	3.965E+10	1.694E+09	1.536E+07	2.512E+07	1.145E+03	1.232E-01	1.139E+03	8.166E-01
	1.160E+08	7.906E+06	2.029E+02	2.119E+03	9.552E+01	1.066E+03	1.800E+03	1.099E-01	1.800E+03	4.424E-06
	1.588E-02	-1.536E-05	1.066E-11	9.635E+00	4.762E+02	4.762E+02	1.724E+06	1.000E+01	3.082E-03	7.811E+06
	3.139E+01	1.777E+01	1.160E+08	1.847E-01	1.361E-03	1.000E+00	0.	0.	7.895E-02	6.220E+00
							0.			
130.00	1.072E+11	1.677E+10	2.819E+10	9.269E+08	1.330E+07	1.315E+07	1.215E+03	2.620E-01	1.209E+03	8.459E-01
	1.491E+08	6.907E+06	1.438E+02	3.158E+02	1.747E+01	5.019E+02	1.992E+03	2.244E-01	1.991E+03	1.394E-05
	1.190E-02	-1.906E-05	6.691E-12	1.190E+01	5.626E+02	5.626E+02	1.012E+06	1.000E+01	4.656E-04	4.928E+06
	1.991E+01	4.626E+00	1.491E+08	4.173E-01	2.331E-03	1.000E+00	0.	0.	1.229E-01	5.454E+00
							0.			
135.00	7.241E+10	1.091E+10	2.131E+10	5.593E+08	1.186E+07	7.638E+06	1.302E+03	5.050E-01	1.296E+03	9.111E-01
	1.793E+08	6.131E+06	1.081E+02	4.705E+01	3.463E+00	2.561E+02	2.205E+03	4.230E-01	2.204E+03	3.658E-05

	9.297E-03	-2.245E-05	4.552E-12	1.411E+01	6.401E+02	6.401E+02	6.143E+05	1.000E+01	7.035E-05	3.435E+06
	1.367E+01	1.305E+00	1.793E+08	8.656E-01	3.741E-03	1.000E+00	0.	0.	1.439E-01	5.156E+00
							0.			
140.00	5.165E+10	7.527E+09	1.681E+10	3.611E+08	1.078E+07	4.766E+06	1.409E+03	9.150E-01	1.403E+03	1.014E+00
	2.014E+08	5.506E+06	8.997E+01	7.010E+00	7.259E-01	1.382E+02	2.449E+03	7.678E-01	2.448E+03	8.318E-05
	7.482E-03	-2.551E-05	3.274E-12	1.627E+01	7.096E+02	7.096E+02	3.921E+05	1.000E+01	1.063E-05	2.526E+06
	9.926E+00	3.894E-01	2.014E+08	1.634E+00	5.567E-03	1.000E+00	0.	0.	2.692E-01	5.282E+00
							0.			
145.00	3.836E+10	5.422E+09	1.368E+10	2.446E+08	9.938E+06	3.133E+06	1.540E+03	1.611E+00	1.533E+03	1.160E+00
	2.116E+08	4.986E+06	8.210E+01	1.044E+00	1.585E-01	7.764E+01	2.733E+03	1.332E+00	2.732E+03	1.684E-04
	6.152E-03	-2.825E-05	2.452E-12	1.337E+01	7.721E+02	7.721E+02	2.674E+05	1.000E+01	1.605E-06	1.768E+06
	7.502E+00	1.210E-01	2.116E+08	2.780E+00	7.585E-03	1.000E+00	0.	0.	3.896E-01	5.897E+00
							0.			
150.00	2.976E+10	4.035E+09	1.139E+10	1.723E+08	9.264E+06	2.143E+06	1.699E+03	2.781E+00	1.689E+03	1.362E+00
	2.100E+08	4.542E+06	7.403E+01	1.556E-01	3.567E-02	4.500E+01	3.067E+03	2.241E+00	3.065E+03	3.117E-04
	5.142E-03	-3.066E-05	1.894E-12	2.040E+01	8.282E+02	8.282E+02	1.969E+05	1.000E+01	2.425E-07	1.396E+06
	5.845E+00	3.877E-02	2.100E+08	4.228E+00	9.382E-03	1.000E+00	0.	0.	5.613E-01	7.110E+00
							0.			
160.00	1.838E+10	2.400E+09	6.321E+09	9.255E+07	8.242E+06	1.093E+06	2.124E+03	8.045E+00	2.103E+03	2.008E+00
	1.948E+08	3.813E+06	4.638E+01	3.455E-03	1.935E-03	1.617E+01	3.935E+03	6.063E+00	3.929E+03	9.468E-04
	3.724E-03	-3.457E-05	1.210E-12	2.425E+01	9.238E+02	9.238E+02	1.332E+05	1.000E+01	5.535E-09	8.520E+05
	3.795E+00	4.260E-03	1.948E+08	7.018E+00	1.070E-02	1.000E+00	0.	0.	1.167E+00	1.168E+01
							0.			
170.00	1.224E+10	1.527E+09	6.375E+09	5.366E+07	7.497E+06	6.043E+05	2.743E+03	2.291E+01	2.695E+03	3.194E+00
	1.576E+08	3.231E+06	3.330E+01	7.669E-05	1.119E-04	6.194E+00	5.170E+03	1.624E+01	5.154E+03	2.408E-03
	2.793E-03	-3.741E-05	8.237E-13	2.780E+01	1.001E+03	1.001E+03	1.106E+05	1.000E+01	1.263E-10	5.534E+05
	2.626E+00	4.989E-04	1.578E+08	8.113E+00	8.887E-03	1.000E+00	0.	0.	2.457E+00	2.348E+01
							0.			
180.00	6.513E+09	1.017E+09	5.047E+09	3.279E+07	6.924E+06	3.534E+05	3.647E+03	6.508E+01	3.527E+03	5.399E+00
	1.274E+08	2.750E+06	2.391E+01	1.703E-06	6.764E-06	2.481E+00	6.939E+03	4.367E+01	6.895E+03	5.975E-03
	2.146E-03	-3.934E-05	5.864E-13	3.106E+01	1.063E+03	1.063E+03	1.009E+05	1.000E+01	2.883E-12	3.759E+05
	1.900E+00	6.111E-05	1.274E+08	7.792E+00	6.360E-03	1.000E+00	0.	0.	5.267E+00	5.027E+01
							0.			
190.00	6.103E+09	6.998E+08	4.092E+09	2.081E+07	6.464E+06	2.151E+05	4.971E+03	1.843E+02	4.662E+03	9.524E+00
	1.026E+08	2.347E+06	1.717E+01	3.780E-08	4.224E-07	1.027E+00	9.461E+03	1.178E+02	9.343E+03	1.454E-02
	1.679E-03	-4.050E-05	4.312E-13	3.403E+01	1.114E+03	1.114E+03	9.539E+04	1.000E+01	6.580E-14	2.630E+05
	1.420E+00	7.732E-06	1.026E+08	7.309E+00	4.586E-03	1.000E+00	0.	0.	1.142E+01	1.124E+02
							0.			
200.00	4.476E+09	4.936E+08	3.375E+09	1.358E+07	6.083E+06	1.349E+05	6.913E+03	5.143E+02	6.119E+03	1.713E+01
	8.240E+07	2.005E+06	1.233E+01	8.391E-10	2.704E-08	4.356E-01	1.300E+04	3.151E+02	1.268E+04	3.441E-02
	1.333E-03	-4.103E-05	3.251E-13	3.673E+01	1.154E+03	1.154E+03	9.144E+04	1.000E+01	1.502E-15	1.897E+05
	1.087E+00	1.003E-06	8.240E+07	6.342E+00	3.140E-03	1.000E+00	0.	0.	2.463E+01	2.557E+02
							0.			
220.00	2.525E+09	2.585E+08	2.382E+09	6.132E+06	5.478E+06	5.649E+04	1.394E+04	3.449E+03	9.193E+03	5.148E+01
	5.295E+07	1.466E+06	6.354E+00	4.135E-13	1.170E-10	8.270E-02	2.383E+04	1.970E+03	2.186E+04	1.620E-01
	8.678E-04	-4.066E-05	1.949E-13	4.143E+01	1.214E+03	1.214E+03	8.520E+04	1.000E+01	7.823E-19	1.035E+05
	6.729E-01	1.780E-08	5.295E+07	3.310E+00	1.088E-03	1.000E+00	0.	0.	1.008E+02	1.196E+03
							0.			
240.00	1.486E+09	1.417E+08	1.736E+09	2.918E+06	5.005E+06	2.501E+04	2.870E+04	1.547E+04	9.318E+03	1.109E+02
	3.402E+07	1.073E+06	3.276E+00	2.038E-16	5.323E-13	1.652E-02	3.847E+04	8.364E+03	3.010E+04	5.006E-01
	5.834E-04	-3.834E-05	1.230E-13	4.540E+01	1.253E+03	1.253E+03	8.003E+04	1.000E+01	4.075E-22	5.947E+04
	4.382E-01	3.324E-10	3.402E+07	1.727E+00	4.039E-04	1.000E+00	0.	0.	2.790E+02	3.633E+03
							0.			
260.00	8.994E+08	7.998E+07	1.291E+09	1.436E+06	4.614E+06	1.148E+04	5.786E+04	4.506E+04	6.181E+03	1.627E+02
	2.200E+07	7.651E+05	1.689E+00	1.004E-19	2.512E-15	3.423E-03	5.491E+04	2.331E+04	3.159E+04	9.999E-01
	4.018E-04	-3.640E-05	8.046E-14	4.683E+01	1.279E+03	1.279E+03	7.556E+04	1.000E+01	2.122E-25	3.542E+04
	2.957E-01	6.437E-12	2.200E+07	9.073E-01	1.590E-04	1.000E+00	0.	0.	4.975E+02	6.118E+03
							0.			
280.00	5.529E+08	4.603E+07	9.726E+08	7.230E+05	4.279E+06	5.395E+03	1.097E+05	9.953E+04	3.235E+03	1.877E+02
	1.439E+07	5.747E+05	8.705E-01	4.950E-23	1.216E-17	7.285E-04	7.624E+04	4.962E+04	2.660E+04	1.520E+00

	2.622E-04	-3.331E-05	5.409E-14	5.180E+01	1.296E+03	1.296E+03	7.165E+04	1.000E+01	1.105E-26	2.167E+04
	2.049E-01	1.261E-13	1.439E+07	4.019E-01	6.596E-05	1.000E+00	0.	0.	6.485E+02	6.264E+03
							0.			
300.00	3.415E+08	2.646E+07	7.398E+08	3.697E+05	3.984E+06	2.579E+03	1.843E+05	1.814E+05	1.551E+03	1.838E+02
	9.534E+06	4.206E+05	4.486E-01	2.439E-26	6.036E-20	1.585E-04	1.065E+05	6.764E+04	1.881E+04	1.926E+00
	2.014E-04	-3.014E-05	3.716E-14	5.469E+01	1.308E+03	1.303E+03	6.619E+04	1.000E+01	5.758E-32	1.355E+04
	1.450E-01	2.605E-15	9.534E+06	2.594E-01	2.865E-05	1.000E+00	0.	0.	6.549E+02	4.674E+03
							0.			
320.00	2.167E+08	1.582E+07	5.662E+08	1.913E+05	3.719E+06	1.249E+03	2.838E+05	2.795E+05	7.427E+02	1.557E+02
	6.399E+06	3.079E+05	2.313E-01	1.204E-29	3.046E-22	3.511E-05	1.432E+05	1.313E+05	1.191E+04	2.086E+00
	1.457E-04	-2.686E-05	2.600E-14	5.731E+01	1.315E+03	1.315E+03	6.511E+04	1.000E+01	2.999E-35	8.633E+03
	1.043E-01	5.394E-17	6.399E+06	1.414E-01	1.295E-05	1.000E+00	0.	0.	5.256E+02	3.010E+03
							0.			
340.00	1.372E+08	9.392E+06	4.354E+08	9.983E+04	3.478E+06	6.102E+02	3.667E+05	3.641E+05	3.752E+02	1.138E+02
	4.344E+06	2.253E+05	1.193E-01	5.925E-33	1.561E-24	7.901E-06	1.741E+05	1.669E+05	7.190E+03	1.930E+00
	1.067E-04	-2.367E-05	1.348E-14	5.981E+01	1.320E+03	1.320E+03	6.234E+04	1.000E+01	1.562E-38	5.585E+03
	7.612E-02	1.135E-18	4.344E+06	7.795E-02	6.050E-06	1.000E+00	0.	0.	3.513E+02	1.836E+03
							0.			
360.00	8.733E+07	5.608E+06	3.361E+08	5.246E+04	3.257E+06	3.005E+02	4.000E+05	3.985E+05	2.046E+02	7.118E+01
	2.975E+06	1.649E+05	6.148E-02	2.920E-36	8.113E-27	1.802E-06	1.829E+05	1.786E+05	4.286E+03	1.512E+00
	7.898E-05	-2.065E-05	1.331E-14	6.219E+01	1.323E+03	1.323E+03	5.984E+04	1.000E+01	8.137E-42	3.663E+03
	5.619E-02	2.420E-20	2.975E+06	4.335E-02	2.905E-06	1.000E+00	0.	0.	2.073E+02	1.102E+03
							0.			
380.00	5.583E+07	3.365E+06	2.601E+08	2.775E+04	3.053E+06	1.490E+02	3.619E+05	3.610E+05	1.195E+02	3.742E+01
	2.051E+06	1.207E+05	3.169E-02	1.439E-39	4.267E-29	4.162E-07	1.611E+05	1.585E+05	2.563E+03	9.858E-01
	5.899E-05	-1.786E-05	9.708E-15	6.447E+01	1.325E+03	1.325E+03	5.756E+04	1.000E+01	4.239E-45	2.431E+03
	4.190E-02	5.223E-22	2.051E+06	2.428E-02	1.426E-06	1.000E+00	0.	0.	1.125E+02	6.592E+02
							0.			
400.00	3.583E+07	2.028E+06	2.018E+08	1.475E+04	2.864E+06	7.425E+01	3.275E+05	3.270E+05	7.146E+01	1.996E+01
	1.421E+06	8.636E+04	1.634E-02	7.092E-43	2.269E-31	9.713E-08	1.425E+05	1.409E+05	1.547E+03	6.463E-01
	4.443E-05	-1.533E-05	7.156E-15	6.065E+01	1.327E+03	1.327E+03	5.549E+04	1.000E+01	2.208E-48	1.631E+03
	3.152E-02	1.140E-23	1.421E+06	1.366E-02	7.129E-07	1.000E+00	0.	0.	6.184E+01	3.960E+02
							0.			
420.00	2.307E+07	1.227E+06	1.569E+08	7.876E+03	2.688E+06	3.720E+01	2.963E+05	2.960E+05	4.356E+01	1.079E+01
	9.676E+05	6.463E+04	8.423E-03	3.495E-46	1.218E-33	2.289E-08	1.265E+05	1.255E+05	9.422E+02	4.261E-01
	3.371E-05	-1.307E-05	5.325E-15	6.871E+01	1.328E+03	1.328E+03	5.358E+04	1.000E+01	1.150E-51	1.105E+03
	2.390E-02	2.510E-25	9.676E+05	7.714E-03	3.616E-07	1.000E+00	0.	0.	3.318E+01	2.388E+02
							0.			
440.00	1.490E+07	7.446E+05	1.222E+08	4.224E+03	2.525E+06	1.873E+01	2.681E+05	2.679E+05	2.698E+01	5.910E+00
	6.884E+05	4.734E+04	4.342E-03	1.723E-49	6.592E-36	5.439E-09	1.126E+05	1.120E+05	5.792E+02	2.824E-01
	2.575E-05	-1.108E-05	3.997E-15	7.066E+01	1.329E+03	1.329E+03	5.182E+04	1.000E+01	5.990E-55	7.549E+02
	1.825E-02	5.576E-27	6.884E+05	4.366E-03	1.857E-07	1.000E+00	0.	0.	1.807E+01	1.446E+02
							0.			
460.00	9.655E+06	4.535E+05	9.536E+07	2.274E+03	2.373E+06	9.470E+00	2.426E+05	2.425E+05	1.694E+01	3.279E+00
	4.805E+05	3.465E+04	2.238E-03	8.490E-53	3.596E-38	1.302E-09	1.007E+05	1.003E+05	3.591E+02	1.883E-01
	1.979E-05	-9.352E-06	3.022E-15	7.250E+01	1.329E+03	1.329E+03	5.020E+04	1.000E+01	3.120E-58	5.197E+02
	1.402E-02	1.248E-28	4.805E+05	2.475E-03	9.632E-08	1.000E+00	0.	0.	9.877E+00	8.789E+01
							0.			
480.00	6.272E+06	2.771E+05	7.453E+07	1.230E+03	2.231E+06	4.809E+00	2.195E+05	2.195E+05	1.075E+01	1.844E+00
	3.358E+05	2.536E+04	1.154E-03	4.184E-56	1.975E-40	3.140E-10	9.041E+04	9.019E+04	2.244E+02	1.263E-01
	1.523E-05	-7.859E-06	2.301E-15	7.422E+01	1.329E+03	1.329E+03	4.869E+04	1.000E+01	1.625E-61	3.602E+02
	1.083E-02	2.813E-30	3.358E+05	1.405E-03	5.039E-08	1.000E+00	0.	0.	5.423E+00	5.360E+01
							0.			
500.00	4.095E+06	1.698E+05	5.834E+07	6.672E+02	2.098E+06	2.452E+00	1.986E+05	1.986E+05	6.885E+00	1.051E+00
	2.346E+05	1.856E+04	5.949E-04	2.062E-59	1.091E-42	7.610E-11	8.163E+04	8.148E+04	1.413E+02	8.544E-02
	1.187E-05	-6.582E-06	1.763E-15	7.583E+01	1.330E+03	1.330E+03	4.728E+04	1.000E+01	8.465E-65	2.512E+02
	8.408E-03	6.378E-32	2.348E+05	7.981E-04	2.656E-08	1.000E+00	0.	0.	2.997E+00	3.280E+01
							0.			
520.00	2.668E+06	1.044E+05	4.573E+07	3.634E+02	1.974E+06	1.250E+00	1.797E+05	1.797E+05	4.440E+00	6.078E-01
	1.643E+05	1.359E+04	3.067E-04	1.016E-62	6.061E-45	1.857E-11	7.419E+04	7.410E+04	8.959E+01	5.835E-02

	9.267E-06	-5.497E-06	1.358E-15	7.715E+01	1.330E+03	1.330E+03	4.597E+04	1.000E+01	4.409E-68	1.761E+02
	6.561E-03	1.454E-33	1.643E+05	4.530E-04	1.408E-08	1.000E+00	0.	0.	1.671E+00	2.013E+01
							0.			
540.00	1.746E+06	6.432E+04	3.590E+07	1.986E+02	1.658E+06	6.454E-01	1.626E+05	1.626E+05	2.681E+00	3.574E-01
	1.150E+05	9.945E+03	1.581E-04	5.008E-66	3.384E-47	4.552E-12	6.800E+04	6.795E+04	5.715E+01	4.032E-02
	7.265E-06	-4.580E-06	1.051E-15	7.677E+01	1.330E+03	1.330E+03	4.474E+04	1.000E+01	2.297E-71	1.241E+02
	5.144E-03	3.331E-35	1.150E+05	2.579E-04	7.509E-09	1.000E+00	0.	0.	9.418E-01	1.240E+01
							0.			
560.00	1.146E+06	3.976E+04	2.623E+07	1.089E+02	1.749E+06	3.331E-01	1.472E+05	1.471E+05	1.878E+00	2.141E-01
	8.053E+04	7.279E+03	8.149E-05	2.468E-69	1.897E-49	1.121E-12	6.297E+04	6.293E+04	3.667E+01	2.827E-02
	5.722E-06	-3.809E-06	8.170E-16	8.012E+01	1.330E+03	1.330E+03	4.359E+04	1.000E+01	1.196E-74	8.780E+01
	4.051E-03	7.666E-37	8.053E+04	1.466E-04	4.023E-09	1.000E+00	0.	0.	5.385E-01	7.658E+00
							0.			
580.00	7.541E+05	2.465E+04	2.222E+07	5.997E+01	1.648E+06	1.725E-01	1.331E+05	1.331E+05	1.230E+00	1.310E-01
	5.639E+04	5.328E+03	4.201E-05	1.216E-72	1.068E-51	2.770E-13	5.902E+04	5.899E+04	2.366E+01	2.016E-02
	4.526E-06	-3.163E-06	6.378E-16	8.140E+01	1.330E+03	1.330E+03	4.251E+04	1.000E+01	6.231E-78	6.239E+01
	3.204E-03	1.771E-38	5.639E+04	8.340E-05	2.165E-09	1.000E+00	0.	0.	3.133E-01	4.744E+00
							0.			
600.00	4.974E+05	1.532E+04	1.752E+07	3.313E+01	1.553E+06	8.973E-02	1.205E+05	1.205E+05	8.083E-01	6.209E-02
	3.949E+04	3.900E+03	2.166E-05	5.395E-76	6.038E-54	6.872E-14	5.605E+04	5.603E+04	1.534E+01	1.467E-02
	3.597E-06	-2.623E-06	4.998E-16	8.264E+01	1.330E+03	1.330E+03	4.149E+04	1.000E+01	3.246E-81	4.450E+01
	2.546E-03	4.108E-40	3.949E+04	4.744E-05	1.169E-09	1.000E+00	0.	0.	1.861E-01	2.948E+00
							0.			
620.00	3.288E+05	9.550E+03	1.383E+07	1.836E+01	1.463E+06	4.683E-02	1.090E+05	1.090E+05	5.330E-01	5.283E-02
	2.766E+04	2.855E+03	1.116E-05	2.955E-79	3.425E-56	1.711E-14	5.395E+04	5.394E+04	9.992E+00	1.091E-02
	2.871E-06	-2.172E-06	3.930E-16	8.386E+01	1.330E+03	1.330E+03	4.053E+04	1.000E+01	1.691E-84	3.186E+01
	2.032E-03	4.564E-42	2.766E+04	2.699E-05	6.338E-10	1.000E+00	0.	0.	1.132E-01	1.837E+00
							0.			
640.00	2.179E+05	5.969E+03	1.094E+07	1.021E+01	1.380E+06	2.454E-02	9.864E+04	9.864E+04	3.526E-01	3.498E-02
	1.937E+04	2.089E+03	5.755E-06	1.456E-82	1.950E-58	4.276E-15	5.256E+04	5.255E+04	6.538E+00	8.303E-03
	2.303E-06	-1.797E-06	3.102E-16	8.506E+01	1.330E+03	1.330E+03	3.961E+04	1.000E+01	8.806E-88	2.289E+01
	1.630E-03	2.234E-43	1.937E+04	1.535E-05	3.445E-10	1.000E+00	0.	0.	7.075E-02	1.148E+00
							0.			
660.00	1.447E+05	3.740E+03	8.658E+06	5.697E+00	1.302E+06	1.290E-02	8.925E+04	8.925E+04	2.339E-01	2.385E-02
	1.357E+04	1.529E+03	2.967E-06	7.176E-86	1.113E-60	1.072E-15	5.164E+04	5.163E+04	4.296E+00	6.455E-03
	1.856E-06	-1.466E-06	2.456E-16	8.627E+01	1.330E+03	1.330E+03	3.875E+04	1.000E+01	4.587E-91	1.650E+01
	1.314E-03	5.236E-45	1.357E+04	6.733E-06	1.876E-10	1.000E+00	0.	0.	4.545E-02	7.193E-01
							0.			
680.00	9.636E+04	2.350E+03	6.863E+06	3.190E+00	1.228E+06	6.810E-03	8.076E+04	8.076E+04	1.556E-01	1.675E-02
	9.505E+03	1.117E+03	1.530E-06	3.537E-89	6.379E-63	2.697E-16	5.090E+04	5.090E+04	2.834E+00	5.114E-03
	1.504E-06	-1.227E-06	1.951E-16	8.751E+01	1.330E+03	1.330E+03	3.793E+04	1.000E+01	2.389E-94	1.193E+01
	1.064E-03	1.231E-46	9.505E+03	4.969E-06	1.027E-10	1.000E+00	0.	0.	3.003E-02	4.520E-01
							0.			
700.00	6.430E+04	1.481E+03	5.447E+06	1.792E+00	1.159E+06	3.607E-03	7.307E+04	7.307E+04	1.038E-01	1.208E-02
	6.658E+03	8.193E+02	7.885E-07	1.743E-92	3.667E-65	6.805E-17	5.005E+04	5.004E+04	1.877E+00	4.115E-03
	1.225E-06	-1.013E-06	1.555E-16	8.879E+01	1.330E+03	1.330E+03	3.715E+04	1.000E+01	1.244E-97	8.654E+00
	8.672E-04	2.904E-48	6.658E+03	2.827E-06	5.624E-11	1.000E+00	0.	0.	2.037E-02	2.848E-01
							0.			
720.00	4.301E+04	9.353E+02	4.329E+06	1.010E+00	1.094E+06	1.918E-03	6.612E+04	6.612E+04	6.940E-02	8.936E-03
	4.663E+03	5.997E+02	4.065E-07	8.590E-96	2.115E-67	1.723E-17	4.885E+04	4.885E+04	1.248E+00	3.353E-03
	1.004E-06	-8.351E-07	1.243E-16	9.014E+01	1.330E+03	1.330E+03	3.641E+04	1.000E+01	6.482-101	6.299E+00
	7.107E-04	6.874E-50	4.663E+03	1.608E-06	3.087E-11	1.000E+00	0.	0.	1.415E-02	1.800E-01
							0.			
740.00	2.893E+04	5.923E+02	3.445E+06	5.708E-01	1.034E+06	1.023E-03	5.983E+04	5.983E+04	4.651E-02	6.751E-03
	3.267E+03	4.389E+02	2.095E-07	4.233E-99	1.224E-69	4.378E-18	4.719E+04	4.719E+04	8.325E-01	2.762E-03
	8.278E-07	-6.878E-07	9.977E-17	9.158E+01	1.330E+03	1.330E+03	3.570E+04	1.000E+01	3.376-104	4.601E+00
	5.860E-04	1.633E-51	3.267E+03	9.149E-07	1.698E-11	1.000E+00	0.	0.	1.004E-02	1.140E-01
							0.			
760.00	1.937E+04	3.760E+02	2.745E+06	3.237E-01	9.765E+05	5.477E-04	5.413E+04	5.413E+04	3.125E-02	5.192E-03
	2.288E+03	3.213E+02	1.080E-07	2.086-102	7.110E-72	1.116E-18	4.507E+04	4.507E+04	5.573E-01	2.297E-03

	6.870E-07	-3.657E-07	8.034E-17	9.314E+01	1.330E+03	1.330E+03	3.502E+04	1.000E+01	1.759-107	3.373E+00
	4.863E-04	3.871E-33	2.288E+03	5.205E-07	9.356E-12	1.000E+00	0.	0.	7.251E-03	7.242E-02
							0.			
780.00	1.304E+04	2.394E+02	2.196E+06	1.842E-01	9.228E+05	2.942E-04	4.898E+04	4.898E+04	2.105E-02	4.051E-03
	1.603E+03	2.352E+02	5.569E-08	1.020-105	4.145E-74	2.857E-19	4.259E+04	4.259E+04	3.743E-01	1.929E-03
	5.741E-07	-4.647E-07	6.494E-17	9.483E+01	1.330E+03	1.330E+03	3.438E+04	1.000E+01	9.160-111	2.481E+00
	4.063E-04	9.310E-55	1.603E+03	2.961E-07	5.164E-12	1.000E+00	0.	0.	5.311E-03	4.612E-02
							0.			
800.00	8.802E+03	1.527E+02	1.750E+06	1.051E-01	8.724E+05	1.586E-04	4.432E+04	4.432E+04	1.421E-02	3.197E-03
	1.173E+03	1.721E+02	2.871E-08	5.068-109	2.426E-76	7.340E-20	3.987E+04	3.987E+04	2.522E-01	1.634E-03
	4.631E-07	-3.810E-07	5.270E-17	9.669E+01	1.330E+03	1.330E+03	3.376E+04	1.000E+01	4.771-114	1.833E+00
	3.420E-04	2.236E-56	1.123E+03	1.685E-07	2.854E-12	1.000E+00	0.	0.	3.935E-03	2.945E-02
							0.			
820.00	5.953E+03	9.771E+01	1.399E+06	6.016E-02	8.250E+05	8.581E-05	4.010E+04	4.010E+04	9.613E-03	2.545E-03
	7.864E+02	1.260E+02	1.480E-08	2.497-112	1.426E-78	1.894E-20	3.704E+04	3.704E+04	1.705E-01	1.396E-03
	4.096E-07	-3.119E-07	4.294E-17	9.876E+01	1.330E+03	1.330E+03	3.317E+04	1.000E+01	2.485-117	1.360E+00
	2.899E-04	5.394E-58	7.864E+02	9.585E-08	1.580E-12	1.000E+00	0.	0.	2.942E-03	1.885E-02
							0.			
840.00	4.035E+03	6.267E+01	1.121E+06	3.156E-02	7.804E+05	4.658E-05	3.629E+04	3.629E+04	6.519E-03	2.040E-03
	5.509E+02	9.221E+01	7.629E-09	1.231-115	8.419E-81	4.909E-21	3.419E+04	3.419E+04	1.156E-01	1.201E-03
	3.498E-07	-2.547E-07	3.515E-17	1.011E+02	1.330E+03	1.330E+03	3.260E+04	1.000E+01	1.294-120	1.013E+00
	2.476E-04	1.307E-59	5.509E+02	5.453E-08	8.757E-13	1.000E+00	0.	0.	2.215E-03	1.210E-02
							0.			
860.00	2.741E+03	4.029E+01	8.985E+05	1.991E-02	7.385E+05	2.537E-05	3.283E+04	3.283E+04	4.431E-03	1.644E-03
	3.859E+02	6.749E+01	3.933E-09	6.066-119	4.994E-83	1.278E-21	3.141E+04	3.141E+04	7.864E-02	1.039E-03
	3.011E-07	-2.074E-07	2.891E-17	1.036E+02	1.330E+03	1.330E+03	3.205E+04	1.000E+01	6.743-124	7.585E-01
	2.131E-04	3.181E-61	3.859E+02	3.102E-08	4.859E-13	1.000E+00	0.	0.	1.677E-03	7.789E-03
							0.			
880.00	1.866E+03	2.596E+01	7.213E+05	1.151E-02	6.990E+05	1.386E-05	2.971E+04	2.971E+04	3.019E-03	1.330E-03
	2.703E+02	4.940E+01	2.027E-09	2.990-122	2.978E-85	3.346E-22	2.875E+04	2.875E+04	5.365E-02	9.030E-04
	2.612E-07	-1.685E-07	2.390E-17	1.065E+02	1.330E+03	1.330E+03	3.153E+04	1.000E+01	3.512-127	5.707E-01
	1.849E-04	7.784E-63	2.703E+02	1.765E-08	2.700E-13	1.000E+00	0.	0.	1.275E-03	5.025E-03
							0.			
900.00	1.273E+03	1.677E+01	5.798E+05	6.668E-03	6.618E+05	7.602E-06	2.688E+04	2.688E+04	2.062E-03	1.079E-03
	1.893E+02	3.616E+01	1.045E-09	1.473-125	1.785E-87	8.806E-23	2.624E+04	2.624E+04	3.672E-02	7.878E-04
	2.282E-07	-1.364E-07	1.986E-17	1.098E+02	1.330E+03	1.330E+03	3.102E+04	1.000E+01	1.829-130	4.318E-01
	1.615E-04	1.915E-64	1.893E+02	1.004E-08	1.501E-13	1.000E+00	0.	0.	9.731E-04	3.251E-03
							0.			
920.00	8.700E+02	1.086E+01	4.666E+05	3.876E-03	6.268E+05	4.182E-06	2.432E+04	2.432E+04	1.411E-03	8.770E-04
	1.326E+02	2.647E+01	5.388E-10	7.261-129	1.076E-89	2.331E-23	2.390E+04	2.390E+04	2.521E-02	6.890E-04
	2.009E-07	-1.100E-07	1.660E-17	1.134E+02	1.330E+03	1.330E+03	3.054E+04	1.000E+01	9.529-134	3.286E-01
	1.422E-04	4.738E-66	1.326E+02	5.713E-09	8.358E-14	1.000E+00	0.	0.	7.445E-04	2.108E-03
							0.			
940.00	5.960E+02	7.050E+00	3.759E+05	2.260E-03	5.938E+05	2.308E-06	2.201E+04	2.201E+04	9.680E-04	7.141E-04
	9.290E+01	1.937E+01	2.778E-10	3.578-132	6.578E-92	6.206E-24	2.173E+04	2.173E+04	1.736E-02	6.038E-04
	1.782E-07	-8.843E-08	1.396E-17	1.176E+02	1.330E+03	1.330E+03	3.007E+04	1.000E+01	4.963-137	2.515E-01
	1.261E-04	1.179E-67	9.290E+01	3.250E-09	4.657E-14	1.000E+00	0.	0.	5.709E-04	1.371E-03
							0.			
960.00	4.091E+02	4.587E+00	3.032E+05	1.322E-03	5.627E+05	1.278E-06	1.991E+04	1.991E+04	6.656E-04	5.823E-04
	6.507E+01	1.418E+01	1.432E-10	1.764-135	3.984E-94	1.663E-24	1.974E+04	1.974E+04	1.199E-02	5.300E-04
	1.591E-07	-7.077E-08	1.181E-17	1.222E+02	1.330E+03	1.330E+03	2.962E+04	1.000E+01	2.585-140	1.937E-01
	1.176E-04	2.954E-69	6.507E+01	1.849E-09	2.597E-14	1.000E+00	0.	0.	4.386E-04	8.934E-04
							0.			
980.00	2.814E+02	2.992E+00	2.449E+05	7.750E-04	5.334E+05	7.099E-07	1.802E+04	1.802E+04	4.588E-04	4.752E-04
	4.558E+01	1.038E+01	7.381E-11	8.592-139	2.448E-96	4.485E-25	1.791E+04	1.791E+04	8.313E-03	4.660E-04
	1.410E-07	-5.638E-08	1.006E-17	1.273E+02	1.330E+03	1.330E+03	2.919E+04	1.000E+01	1.347-143	1.502E-01
	1.012E-04	7.448E-71	4.558E+01	1.052E-09	1.450E-14	1.000E+00	0.	0.	3.374E-04	5.838E-04
							0.			
1000.00	1.919E+02	1.950E+00	1.980E+05	4.556E-04	5.058E+05	3.956E-07	1.630E+04	1.630E+04	3.170E-04	3.881E-04
	3.173E+01	7.597E+00	3.805E-11	4.284-142	1.514E-98	1.218E-25	1.624E+04	1.624E+04	5.781E-03	4.105E-04

	1.293E-07	-4.472E-08	8.630E-18	1.331E+02	1.330E+03	1.330E+03	2.677E+04	1.000E+01	7.014-147	1.173E-01
	9.150E-05	1.891E-72	3.193E+01	5.986E-10	8.097E-15	1.000E+00	0.	0.	2.600E-04	3.825E-04
							0.			
1040.00	9.267E+01	3.414E-01	1.293E+05	1.591E-04	4.552E+05	1.240E-07	1.335E+04	1.335E+04	1.524E-04	2.592E-04
	1.567E+01	4.070E+00	1.011E-11	1.040-148	5.914-103	9.167E-27	1.333E+04	1.333E+04	2.823E-03	3.214E-04
	1.074E-07	-2.772E-08	6.480E-18	1.466E+02	1.330E+03	1.330E+03	2.797E+04	1.000E+01	1.903-153	7.295E-02
	7.605E-05	1.244E-75	1.567E+01	1.937E-10	2.532E-15	1.000E+00	0.	0.	1.549E-04	1.654E-04
							0.			
1080.00	4.465E+01	3.653E-01	8.557E+04	5.613E-05	4.101E+05	3.937E-08	1.093E+04	1.093E+04	7.401E-05	1.734E-04
	7.647E+00	2.180E+00	2.687E-12	2.527-155	2.374-107	7.093E-28	1.093E+04	1.093E+04	1.398E-03	2.576E-04
	9.102E-08	-1.680E-08	5.001E-18	1.629E+02	1.330E+03	1.330E+03	2.722E+04	1.000E+01	5.163-160	4.665E-02
	6.443E-05	8.409E-79	7.687E+00	6.271E-11	7.936E-16	1.000E+00	0.	0.	9.266E-05	7.228E-05
							0.			
1120.00	2.168E+01	1.600E-01	5.663E+04	2.003E-05	3.698E+05	1.265E-08	8.948E+03	8.948E+03	3.631E-05	1.160E-04
	3.772E+00	1.168E+00	7.142E-13	6.138-162	9.791-112	5.636E-29	8.954E+03	8.954E+03	7.029E-04	2.159E-04
	7.831E-08	-1.006E-08	3.964E-18	1.821E+02	1.330E+03	1.330E+03	2.652E+04	1.000E+01	1.401-166	3.064E-02
	5.543E-05	5.839E-82	3.772E+00	2.030E-11	2.494E-16	1.000E+00	0.	0.	5.564E-05	3.190E-05
							0.			
1160.00	1.060E+01	7.072E-02	3.765E+04	7.226E-06	3.339E+05	4.115E-09	7.326E+03	7.326E+03	1.801E-05	7.769E-05
	1.851E+00	6.256E-01	1.898E-13	1.491-168	4.138-116	4.591E-30	7.334E+03	7.334E+03	3.595E-04	1.953E-04
	6.823E-08	-5.906E-09	3.220E-18	2.038E+02	1.330E+03	1.330E+03	2.586E+04	1.000E+01	3.800-173	2.063E-02
	4.830E-05	4.156E-85	1.851E+00	6.570E-12	7.850E-17	1.000E+00	0.	0.	3.353E-05	1.423E-05
							0.			
1200.00	5.227E+00	3.152E-02	2.514E+04	2.635E-06	3.018E+05	1.354E-09	5.998E+03	5.998E+03	9.030E-06	5.204E-05
	9.040E-01	3.353E-01	5.044E-14	3.621-175	1.788-120	3.822E-31	6.005E+03	6.005E+03	1.877E-04	1.964E-04
	6.004E-08	-3.418E-09	2.674E-18	2.275E+02	1.330E+03	1.330E+03	2.524E+04	1.000E+01	1.031-179	1.419E-02
	4.250E-05	3.024E-88	9.080E-01	2.127E-12	2.476E-17	1.000E+00	0.	0.	2.027E-05	6.411E-06
							0.			

END OF TEST PROBLEM

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