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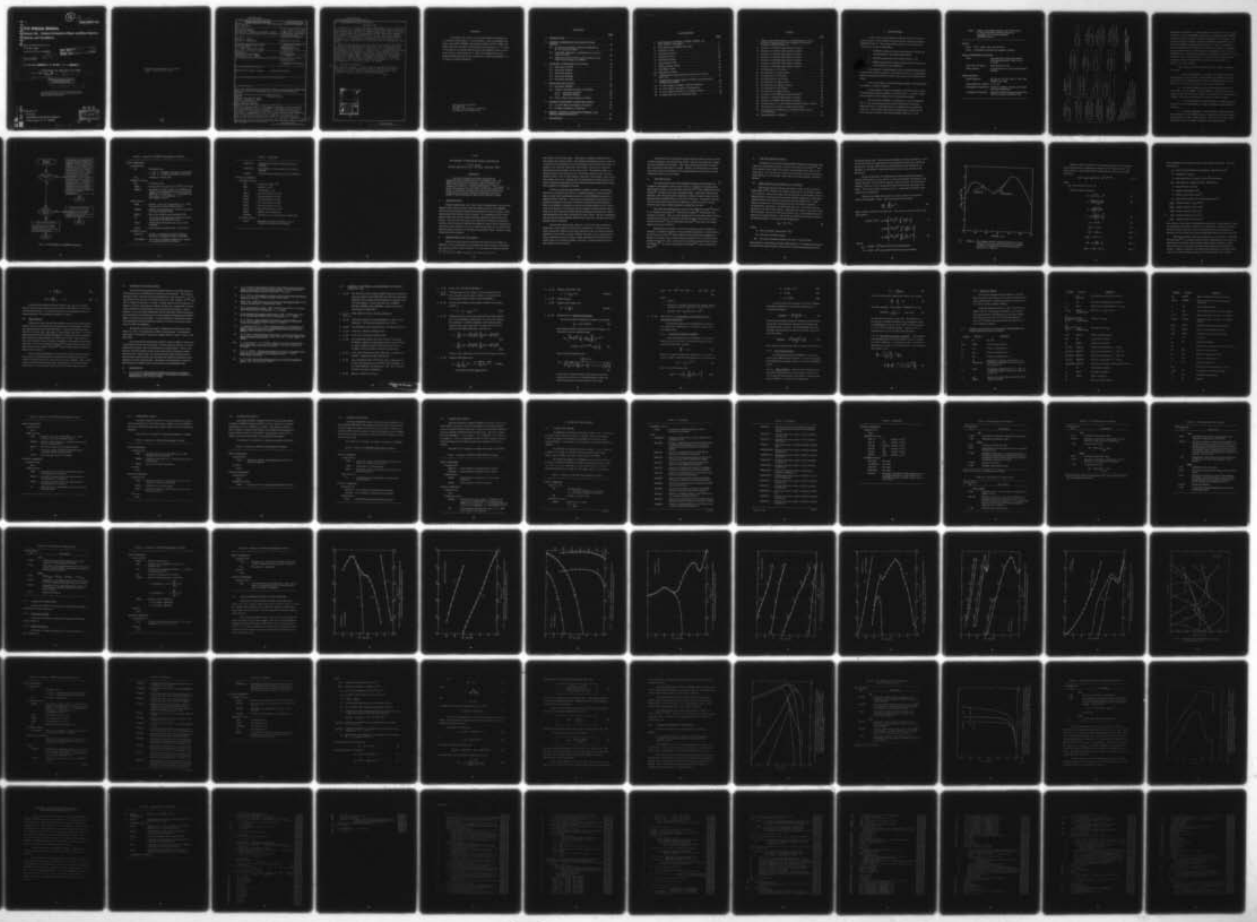

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A preliminary model of the ambient atmosphere and ionosphere has been adopted for use in ROSCOE. The model provides at all altitudes all the needed properties of the neutral atmosphere, including a dependence on the solar cycle and the local (apparent) time for altitudes above 120 km. Analytic fit-functions to Myer's minor-species data base provide all the minor neutral species (O, CO_2, N, NO, H_2O, $O_2(^1\Delta g)$, O3, and NO_2) required by → next Page

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18. SUPPLEMENTARY NOTES (Continued)

EDITORS' NOTE

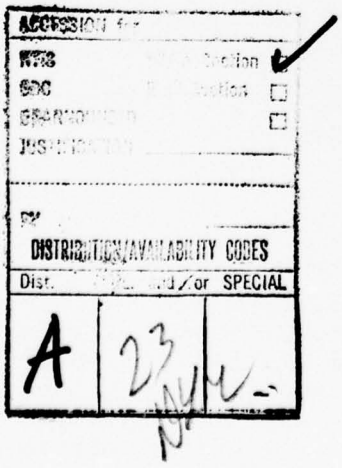
Volumes 13 to 17 were originally published by SAI to describe the atmospheric, geomagnetic, and high-altitude energy deposition and neutral heave models for ROSCOE. This whole section of code, when associated with an appropriate DRIVER subroutine, operated as a package that ran independently of the rest of the ROSCOE structure. Provision was also made, within this high-altitude package, for two completely independent descriptions of atmospheric heave, each with its own description of atmospheric chemistry.

When GRC incorporated this section of code within the ROSCOE framework, some modifications were necessary, which means that some of the descriptions in Volumes 13 to 17 are inappropriate to ROSCOE as it now exists. In particular, the NRL heave routines (deck NRLHYD) and associated chemistry (deck NRLCHM) are not presently used in ROSCOE. Three other subroutines are different: subroutines ATMOSU, EIF, and XTCOEF correspond to the ROSCOE subroutines ATMOS, EXPINT, and WDXP respectively. With these exceptions, the subroutines described in Volumes 13 to 17 correspond exactly to those currently in ROSCOE.

20. ABSTRACT (Continued)

cont.

the chemistry module. Interim electron density profiles and effective ion production rates serve as the basis for the ionospheric model. Herein are presented derivations, flow diagrams, Fortran listings, and test problems.



PREFACE

We thank R. W. Lowen for numerous helpful discussions and for pointing out the utility of — and providing — his early-ROSCOE versions of the AFWL WORRY-code routines JULIAN, SOLCY, ORB, and ZSOL which form the basis of the versions presented here; C. A. Smith for assistance in preparing Revision 02 of the ATMOSU program and an early version of this report; B. F. Myers for supplying the minor-species density-profiles used as a data base in Subroutine SPCMIN; and J. Wang for helpful suggestions.

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1. INTRODUCTION

In this volume we describe the model for the major and minor neutral species in the ambient atmosphere and the ambient ionosphere [ROSCOE Model 1]. The overall model consists of 11 subroutines of which three are major subroutines:

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

b. SPCMIN provides the minor neutral species, and

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

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

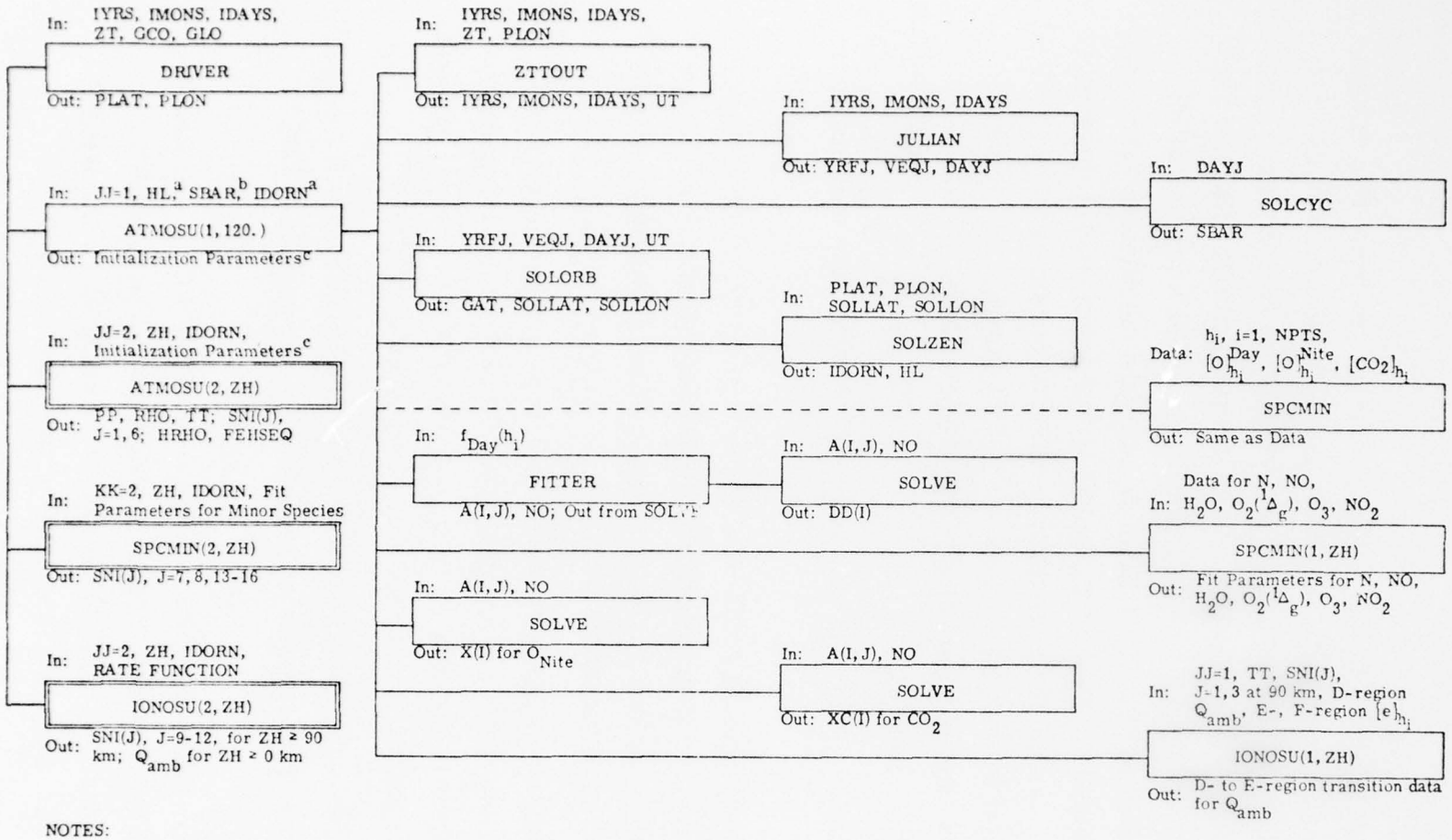
The overall inputs, some intermediate outputs, and final outputs for Model 1 are given in Table 1.

A flow diagram of the 11 subroutines, with their driver routine for development and test problem, is given in Fig. 1. A brief, simplified description of the working of the 11 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

Table 1. Inputs, Intermediate Outputs, and Final Outputs for Major and Minor Neutral Species and Ionosphere for Ambient Conditions (ROSCOE Model 1)

INPUTS	
Time:	Year, month, day, and zone time
Place:	Geographic colatitude and longitude; altitude
SOME INTERMEDIATE OUTPUTS	
Time:	Universal time, Julian day number, local (apparent) time, index for day or night
Solar-Cycle Property:	Solar flux at 10.7 cm
Minor Species:	Fit parameters for day and night density profiles
FINAL OUTPUTS	
Neutral Species:	N_2, O_2, O, Ar, He, CO_2, N, NO, NO_2, $O_2(^1\Delta_g)$, O_3, H_2O
Ionized Species ($\geq$ 90 km):	e, O^+, M^+
Atmospheric Properties:	Pressure, density, density scale height, and (gas) temperature
Ionospheric Properties:	Electron (and N_2 vibration) temperature, effective ion-pair production rate



NOTES:

[a] Provided by SOLZEN.

[b] Provided by SOLCYC.

[c] Initialization parameters include:

(1) DD(I) for f_{Day}.
(2) PP, RHO, TT, HRHO, and SNI(6) at 120 km.
(3) Fourier coefficients for τ and T_∞.
(4) Coefficients for HRHO formula in 110- to 120-km interval.
(5) Coefficients for O_{Nite} profile.
(6) Coefficients for CO_2 profile in 100- to 120-km transition region.
(7) $[N_2(230\ km)] \equiv$ S1Z2N for N-profile initialization.
(8) Atmospheric profiles at 90-km for IONOSU initialization.

Fig. 1. Flow Diagram of ATMOSU, SPCMIN, IONOSU, and Their Auxiliary Subroutines.

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 (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. After an initialization call from ATMOSU to SPCMIN(1, ZH), daytime and nighttime fit parameters are determined for O and CO_2 and an initialization call is made to IONOSU(1, ZH). During the initialization of SPCMIN, six calls to FITTER and seven (direct) calls to SOLVE are made to determine the fit coefficients for the day and night profiles of the minor species NO, N, $O_2(^1\Delta_g)$, O_3, H_2O, and NO_2.

The working of the above-mentioned 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), 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).

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, computes IDORN and HL, inputs to ATMOSU through ATMOUP Common.

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 the six minor species (SNI(I), I=7, 8, 13-16). On subsequent calls to IONOSU(2, ZH), ATMOUP Common is used to return the number densities of the three charged species (SNI(I), I=9-11) 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).

2. AMBIENT ATMOSPHERE AND MAJOR NEUTRAL SPECIES

The main subroutine for the ambient atmosphere and the major neutral species is ATMOSU. It is based on the subroutine ATMOS developed by R. W. Lowen [Lo-73a]. For the convenience of the reader we have reproduced Lo-73a here as Section 2.1. Comments, revisions, and extensions to Lo-73a are given in Section 2.2. To facilitate finding the location in Lo-73a to which a comment or change in Section 2.2 applies, we have added an encircled letter (keyed to Section 2.2) at the appropriate location in the margin of the reproduced paper. The correspondence between symbols in Lo-73a (and in the revisions and extensions) and their Fortran names in ATMOSU is given in Section 2.3.

See Fig. 2 for a simplified flow diagram of ATMOSU and Table 2 for a summary of inputs and outputs for ATMOSU.

2.1 AN AMBIENT ATMOSPHERE MODEL FOR ROSCOE

(On pages **15-27**)

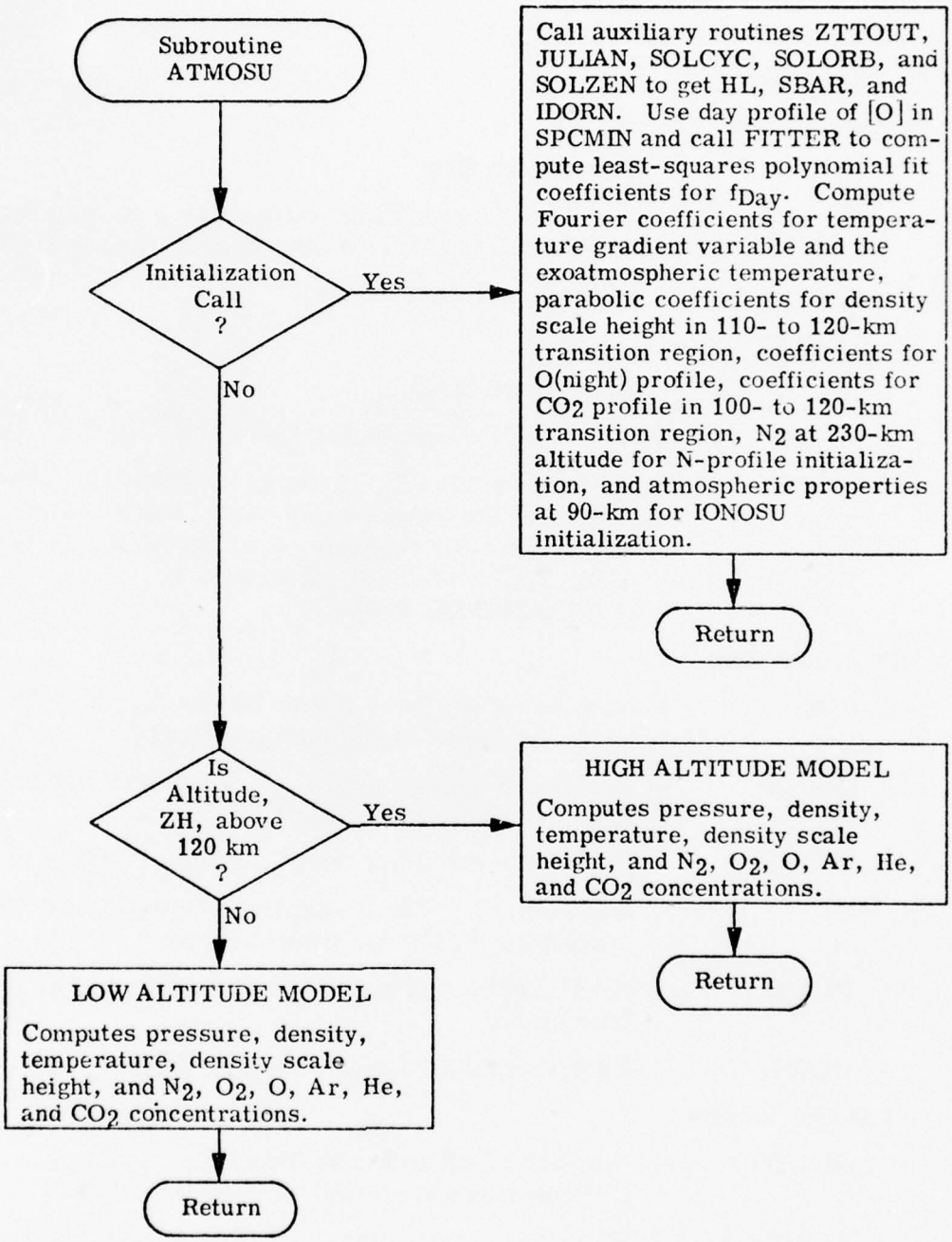


Fig. 2. Flow Diagram of ATMOSU Subroutine.

Table 2. Summary of ATMOSU Input/Output Variables.

INPUT VARIABLES

Argument List

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

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).

ALTODN Common

NALTOD	-	Number of altitudes at which the daytime O-values are specified as data in SPCMIN.
ALTKM(47)	-	The array of altitudes at which minor species are specified as data in SPCMIN.

Table 2. (Continued).

ODAY(27)	- The daytime O-values 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.

OUTPUT VARIABLES

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

ALTODN Common

S1Z2N	- N_2 density at 230-km altitude for use in N-density initialization in SPCMIN

Lo-73a

AN AMBIENT ATMOSPHERE MODEL FOR ROSCOE

R. W. Lowen
Science Applications, Inc., La Jolla, California 92037

ABSTRACT

An initial computerized model of the ambient atmosphere has been developed for the ROSCOE code. The model reproduces within a few per cent all the data of the CIRA 65 atmospheres, extended smoothly to sea level in conformity with the U. S. Standard Atmosphere. The routine is fast and requires only 120 cards, yet has a sound physical basis, so that many continuous derivatives are provided and so that there is reason to believe the technique can be extended to newer atmospheric data as they become available. (a)*

1. INTRODUCTION

Science Applications, Inc. (SAI), has the responsibility for the development of the next-generation radar and optical systems code ROSCOE, with the General Research Corporation handling the systems aspects, under sponsorship of the Defense Nuclear Agency. It is intended that this development shall draw upon the phenomenology experience of the entire community. SAI must therefore take every opportunity to keep the community familiar with the status of ROSCOE development, and to solicit contributions, comments, and criticisms. Here we report on the status of one of the first phenomenology modules to be available in preliminary form, namely a model of the ambient atmosphere.

2. REQUIREMENTS OF THE MODEL

There are certain general requirements placed on all models for ROSCOE, such as high speed, low storage need, high accuracy, generality, high physics content, and smoothness. It is not always possible to achieve

*See Section 2.2 (p. 29ff) containing notes describing revisions.

all of these, but they are goals. Then there are specific requirements of the ambient atmosphere model. The ambient atmosphere routine is required to provide certain properties of the atmosphere when entered with values of altitude (≥ 0), latitude, local time, day number, and year (or equivalent parameter describing phase in the solar cycle). The desired outputs are species densities and temperatures, and various quantities that are determined by these, such as mass density, pressure, scale height, mean molecular weight, and so on. Outputs that are specifically excluded because they will be considered separately are the ambient ionosphere and ambient winds. Also excluded is tropospheric weather.

As for the general requirements on speed, accuracy, and storage, the first is not likely to be severe; it would be difficult to write an atmosphere routine that contributed seriously to overall ROSCOE running time, although called frequently. The accuracy requirement is first of all to reproduce atmospheric properties within their experimental uncertainties. This is not difficult, and turns out not to be the determining factor; rather, if the code purports to reproduce some atmosphere model in general use, it must do so with sufficient fidelity that the discrepancies produce no significant differences from other codings of the same model. We have interpreted this to mean that discrepancies should be no more than a few per cent in any quantity that is important.

The storage requirement, however, is a serious one, and all but eliminates certain kinds of models from consideration. Because atmospheric properties depend not only upon altitude but also (in various altitude regimes) on time of day, season, latitude, and solar cycle, and because so many output quantities are wanted, simple interpolation from tabular data would require very extensive tables (of course, not all would have to be in the machine at any one time).

The requirement of generality means primarily that we want to choose an adequate form for the preliminary model, although the details may change as newer data become available. This can be achieved provided the model has a sufficiently high physics content. Finally, the requirement of smoothness means that it is desirable for the output quantities to possess as many continuous derivatives as possible.

3. THE DATA BASE

It is expected that new CIRA (COSPAR International Reference Atmosphere) atmospheres will be issued shortly. Champion is preparing the high-altitude models, using the ideas of Jacchia's[1, 2] static diffusion models. Groves[3] is preparing the lower-altitude models. When these data become available, they will presumably represent a sufficient improvement over the data presently available that one will want to use them. At present, however, one can only proceed with what is in hand now, and try to select a model structure that can be readily adjusted to accept the new data. (b)

The older atmospheric data come from the CIRA 65 models[4] and the U. S. Standard Atmosphere[5], with the later models[6] of latitudinal and seasonal variations. Data on minor species are not provided in these sources, and generally have to be collected from the literature and collated; recent reviews by Strobel[7] and by Shimazaki and Laird[8] have been very helpful and provide many references.

Besides these data sets, the literature contains some examples of attempts at simplified modeling of high-altitude atmospheres. Deriving from an observation by Bates[9] that the equations describing an atmosphere in diffusive separation can be solved exactly analytically for a certain form of temperature profile, these models have been fitted to satellite data by Stein and Walker[10], to Jacchia atmospheres by Walker[11], and to CIRA 65 by Nisbet[12].

4. THE PRELIMINARY MODEL

A structure for the Ambient Atmosphere Model has been chosen that rests on a sound physical basis, that fits the currently-available[4, 5] data well, and that seems likely to be able to accommodate newer data as they come along. It is convenient to divide the discussion into three sub-topics, Major Species at Low Altitude, Major Species at High Altitude, and Minor Species.

4.1 Major Species at Low Altitude ($0 \leq z \leq 120$ km)

For the preliminary ambient atmosphere model we have elected to follow CIRA 65[4] in dividing the altitude regime into a low-altitude regime, $0 \leq z \leq 120$ km, wherein the major and inert species are thoroughly mixed so that fractional concentrations are (almost) altitude-independent, and a high-altitude regime where diffusive separation prevails (120 km $\leq z$). Under these circumstances, the pertinent physics at low altitude comprises (a) hydrostatic equilibrium, (b) the perfect gas law, (c) the law of partial pressures, and (d) perfect mixing. Assumption (d) begins to fail above about 80 km altitude, because of solar dissociation of O_2, and somewhat higher because of increasing diffusion. The model can still be preserved by using as the defining quantity "molecular-scale temperature,"

$$T_M \equiv M_* T/M \ , \tag{1}$$

where

T = the true kinetic temperature (^oK),

M = the mean molecular weight,

M_* = the mean molecular weight at sea level = 28.96 g/mole.

This quantity is specified in both the CIRA 65 and U. S. Standard Atmospheres as a piecewise-linear profile, which permits the remaining equations to be

integrated analytically. There are two difficulties with this procedure. First, it does not satisfy our preference for an atmospheric model with continuous derivatives. Second, CIRA 65 is not defined below 30 km altitude; U. S. Standard is, but differs, although the two are fairly close near 40 or 50 kilometers.

To get around these two difficulties we have arbitrarily selected a profile of the quantity g/T_M, where g is the gravitational acceleration, that agrees with Ref. (5) below 30 km altitude, agrees with Ref. (4) above 50 km altitude, and more or less agrees with both between 30 km and 50 km altitudes. The chosen profile is shown in Fig. 1, along with the profiles defining the two atmospheres.

We have next fitted this profile as a least-squares polynomial in terms of the altitude, z(km). An eleventh-degree polynomial,

$$\frac{g}{T_M} = \sum_{k=0}^{11} g_k z^k \quad , \tag{2}$$

fits to within a fraction of one per cent. The governing equations then yield the pressure,

$$p \text{ (dynes/cm}^2) = p_o \exp\left[- \frac{M \quad 10^5}{R} \int_0^z \frac{g(z')}{T(z')} dz' \right] \tag{c}$$

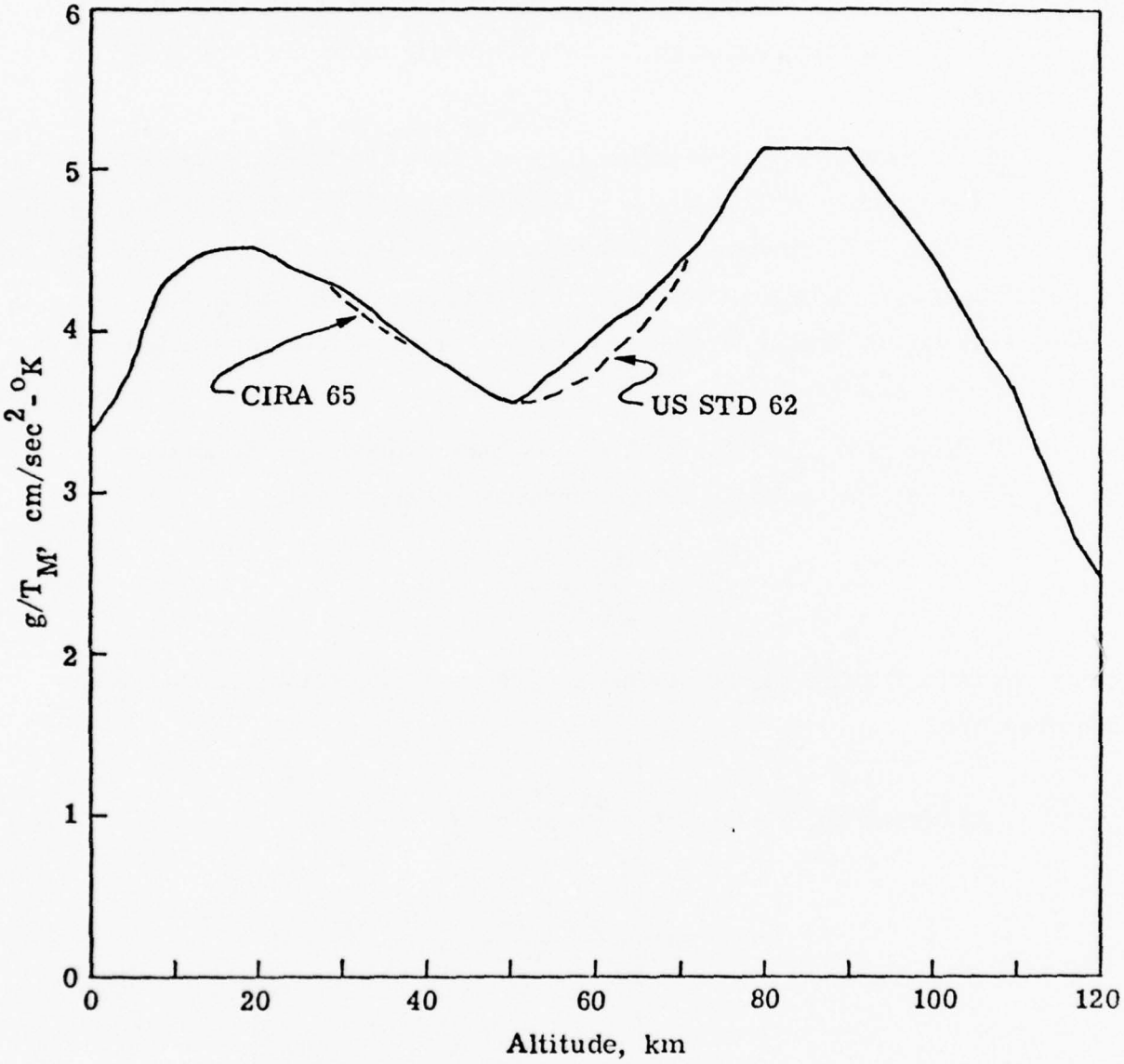
$$= p_o \exp\left[- \frac{M_* \quad 10^5}{R} \int_0^z \frac{g(z')}{T_M(z')} dz' \right]$$

$$= p_o \exp\left[- \frac{M_* \quad 10^5}{R} \sum_{k=0}^{11} \frac{g_k}{(k+1)} z^{k+1} \right] \quad , \tag{3}$$

where

$p_o = 1.01325 \times 10^6$ dynes/cm^2 (sea-level pressure),

$R = 8.3143 \times 10^7$ erg/g-mole-^oK (universal gas constant).



(d) Figure 1. The Altitude Profile of Gravitational Acceleration Divided by Molecular-Scale Temperature Adopted to Define the Preliminary Ambient Atmosphere Model for $z \leq 120$ km.

Because of biasing problems in this fitting procedure, the fit (3) does not provide an entirely adequate fit, especially at the important "join" altitude of 120 km. This can be fixed by multiplying the result (3) by a small correction,

$$p(x) = p_3(z) \exp[9.4144 \times 10^{-8} z^{2.833}] , \quad (4)$$ (e)

where

p_3 = the value given by Eq. (3).

With the auxiliary equations

$$g = g_o R_e^2/(R_e + z)^2 , \quad (5)$$

$$\rho = \left(\frac{M_*}{R}\right)\left(\frac{g}{T_M}\right)\left(\frac{p}{g}\right) , \quad (6)$$

$$T = \left(\frac{M}{M_*}\right)\left(\frac{T_M}{g}\right) g ,$$

$$n = (\rho L)\Big/\left[\left(\frac{M}{M_*}\right) M_*\right] , \quad (7)$$

$$n_* = \rho L/M_* , \quad (8)$$

$$[N_2] = 0.78\, n_* , \quad (9)$$

$$[A] = 0.009\, n_* , \quad (10)$$ (f) (g)

$$[O_2] = 1.211\, n_* - n , \quad (11)$$

$$[O] = 2n_*\left(\frac{M_*}{M} - 1\right) , \quad (12)$$ (h)

$$[He] = 4.625 \times 10^{-5}\, n_* , \quad (13)$$ (i)

this completes the low-altitude model, once M/M_* is specified. Here the symbols are:

g_o = sea-level gravitational acceleration = 980.621 cm/sec^2

L = Avogadro's number,

g = the acceleration of gravity (cm/sec^2) at altitude z,

R_e = the radius of a spherical earth = 6367.65 km,

ρ = mass density (g/cm^3),

T = kinetic temperature (^{o}K),

n = total number density (cm^{-3}),

n_* = total number density if no dissociation (cm^{-3}),

$[N_2]$ = number density of N_2 (cm^{-3}),

$[O_2]$ = number density of O_2 (cm^{-3}),

[O] = number density of O (cm^{-3}),

(j) [A] = number density of A (cm^{-3}),

[He] = number density of He (cm^{-3}).

Note, please, that helium is included here among the "major species," where it clearly does not belong, because (a) it is necessary to provide a value at the join altitude of 120 km, and (b) its physics in the low atmosphere is probably more like that of the major species than like that of the minor ones.

The other problem facing the model has to do with M/M_*. The CIRA 65 description[4] is too vague to permit one to understand how the model was generated in the difficult region between 80 and 120 km altitudes, where solar dissociation of O_2 begins and where the importance of diffusion increases. Results consistent with CIRA 65 are obtained if one follows a procedure of (a) first calculating $[O_2]$ as at lower altitudes, and (b) then

dissociating some of the $[O_2]$, so that M/M_* decreases. This gives the equations

$$[O_2] + \frac{1}{2}[O] = 0.211\, n_* \tag{14}$$

$$[N_2] + [A] + [O_2] + [O] = n \ , \tag{15}$$

from which Eqs. (11) and (12) follow. Our model is completed by a fit to M/M_* of the form

$$M/M_* = 1/(1 + f) \ , \tag{16}$$

where f is the quantity given by the eighth-degree polynomial fit

$$f = \exp\left\{\sum_{k=0}^{8} f_k\, z^k\right\} \ ; \tag{17}$$ (k)

the data actually fitted were values of $M_*[O]/2L\rho$, with [O] taken from Ref. (4) above 80 km, from Ref. (8) for $40 \le z \le 80$ km, and artificially made to go to zero at $z = 0$. (l)

4.2 Major Species at High Altitude (120 km ≤ z)

For the preliminary high-altitude model of the ambient atmosphere we have elected to adopt the Stein and Walker model[10] as adapted by Nisbet[12] to CIRA 65. (m) Nisbet has given Fourier-series fits to the local-time variation of exospheric temperature and to the temperature gradient at 120 km altitude, with coefficients that depend on the value of the 10.7 cm solar flux. (n) Using these, and with starting values at $z = 120$ km provided by the low-altitude model, one has the analytic solutions for species densities,

$$n_i(z) = n_i(120)\, \exp\left\{-\tau\gamma_i\zeta\right\} \left\{\frac{(1 - a)}{(1 - a\, e^{-\tau\zeta})}\right\}^{1+\alpha_i+\gamma_i} \ , \tag{18}$$

where

(o)
$$\zeta = \frac{(z - 120)\, R_e^2}{(R_e + z)\,(R_e + 120)} \text{ (geopotential altitude)*} , \tag{19}$$

(p)
$$\gamma_i = m_i\, g/\tau k\, T_\infty , \tag{20}$$

α_i = thermal-diffusion coefficient

= -0.4 for He, 0.0 for all other species considered,

$$a = (T_\infty - T_{120})/T_\infty , \tag{21}$$

T_∞ = exospheric temperature (^oK) ,

T_{120} = temperature at 120-km altitude (^oK) ,

$n_i(120)$ = density of i^{th} species at 120-km altitude (cm^{-3}) ,

k = Boltzmann's constant ($erg/^oK$) ,

$$\tau = (T_\infty - T_{120})^{-1}\, (dT/dz)_{z=120} , \tag{22}$$

m_i = mass of the i^{th} species (g/particle) .

From the results of (18)-(22), any other quantity of interest can be found, e.g., from the auxiliary equations

$$\rho = \sum_i n_i\, m_i , \tag{23}$$

(q)
*An incorrect equation for ζ is given in both Refs. (10) and (11).

$$p = kT \sum_i n_i \ , \tag{24}$$

$$M = \rho \Big/ \sum_i n_i \ , \qquad \text{etc.} \tag{25}$$ (r)

In the current model we have provided for N_2, O_2, O, A, and He. Because H has been neglected, the mass density given will be too low at extremely high altitudes. It is believed that this is an unimportant defect for present purposes; H can readily be added if it matters.

4.3 Minor Species

Besides the major species that contribute most to the overall number density, there are a number of minor species that are important to IR emission and transmission and other processes. These may include O_3, CO_2, OH, NO, CO, NO_2, N_2O, H_2O, HO_2, H, CH_4, HNO_3, and others. The basic experimental data on the altitude distribution of these species are sketchy at best; theoretical understanding can hardly be any better. Their distributions are believed to be governed by a combination of transport and chemical processes. The most elaborate calculations[8] consider only vertical transport, and have been sharply criticized[7] for both their boundary conditions and for their numerics.

In view of these difficulties, it was decided to defer modeling of the minor species until development of the chemistry and IR models has proceeded to the point where it is more clear just what is needed. Then a model will be provided using what data exist. Unfortunately, this model will undoubtedly have a weaker basis in physics than the major species models.

(s)

(t)

5. SUMMARY AND CONCLUSIONS

The preliminary ambient atmosphere model as described above has been programmed in FORTRAN for exercise and evaluation. The program has been used to calculate entire atmospheres for local times of 0, 4, 8, 12, 16, 20 hours and solar 10.7-cm flux values of 75, 150, and 225 $\times 10^{-22}$ watts/m^2 c/s (CIRA 65 Models 2, 5, and 8). Casual inspection shows that the results are correct everywhere to within a few per cent, except that in regions where a species is unimportant it may be given less accurately. Unfortunately, a very thorough comparison with the data-base models would have to be automated, and would involve a vast amount of keypunching atmosphere tables, so this has been foregone. It is also difficult to illustrate comparisons graphically when the quantities agree to a few per cent while varying over 17 orders of magnitude.

No special care has been taken to optimize this version for speed, since it is to be re-programmed at GRC for that purpose. Nevertheless, the current version gives results for a single altitude in about 1 msec on the CDC 7600.

It is clear that the preliminary model is still incomplete; lacking are (a) latitudinal and seasonal variations, (b) minor species models, (c) multi-temperature models, and (d) consideration of excited states. Work on (a) has been deferred pending receipt of the newer CIRA atmosphere models, expected soon. Work on (b), (c), and (d) has been deferred until work on the chemistry and IR models has proceeded far enough to establish a better definition of model requirements. Meanwhile, the preliminary model has been delivered to permit early running of the overall ROSCOE Code.

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2.2 COMMENTS, REVISIONS, AND EXTENSIONS TO LOWEN'S PAPER [Lo-73a]

a. **p. 15** The 120 cards in the original ATMOS (noted in the abstract) have increased to about 300 in Revision 09 of the Subroutine ATMOSU with an additional 300 substantive comment cards. The total number of cards in the deck (for ATMOSU, SPCMIN, IONOSU, their DRIVER, and their associated subroutines) is about 2318.

b. **p. 17** para. 2 CIRA-1972 [CI-72] has now been published.

c. **p. 19** In the first of Eqs. (3), M should appear as $M(z')$ in the integrand. The remaining equations are correct.

d. **p. 20** The analytic fit to the profile in Fig. 1 is given by Eq. (2).

e. **p. 21** In Eq. (4), read p(z) instead of p(x).

f. **p. 21** In Eq. (10), read [Ar] instead of [A].

g. **p. 21** The coefficient 0.009 in Eq. (10) is close to the value, 0.008615, required to reproduce the value given by CI-65 for [Ar] at 120 km, and it is also close to the value, 0.00934, given by US-62 for sea level composition.

h. **p. 21** In Eq. (12), note that the factor $[(M_*/M) - 1]$ equals the quantity f appearing in Eqs. (16) and (17).

i. **p. 21** The coefficient 4.625×10^{-5} in Eq. (13) is required to reproduce the value given by CI-65 for [He] at 120 km, but it is quite different from the value, 5.24×10^{-6}, given by US-62 for sea level composition.

j. **p. 22** Read Ar instead of A (twice).

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k. p. 23 In Eq. (17), note that $M_*[O]/2L\rho = f$.

l. p. 23 para. 1 The [O]-values for $40 \leq z(km) \leq 80$ were taken from the noon, summer curve in Fig. 5 of Ref. 8. (Provision for day and night values of [O] is made in ATMOSU.)

m. p. 23 The Stein and Walker model assumes that the temperature profile is

$$T = T_\infty - (T_\infty - T_{120})\, e^{-\tau\zeta}. \tag{17a}$$

n. p. 23 Nisbet's Fourier-series fits to the local-time (HL) dependence of the exospheric temperature T_∞ and to the temperature gradient τ at 120-km altitude, with coefficients that depend on the value of the 10.7-cm solar flux (F) associated with the CIRA-1965 tables, are given by

$$T_\infty = \sum_{i=0}^{5} C_i(F) \cos\left(\frac{2\pi\, i\, HL}{24}\right) + \sum_{i=1}^{5} S_i(F) \sin\left(\frac{2\pi\, i\, HL}{24}\right) \tag{18a}$$

$$\tau = \sum_{i=0}^{5} A_i(F) \cos\left(\frac{2\pi\, i\, HL}{24}\right) + \sum_{i=1}^{5} B_i(F) \sin\left(\frac{2\pi\, i\, HL}{24}\right) \tag{18b}$$

Values of the coefficients are given in the computer program.

o. p. 24 Equation (19) should read

$$\zeta = \frac{1}{g_{120}} \int_{120}^{z} g\, dz' = \frac{(z - 120)(R_e + 120)}{R_e + z} \tag{19-Rev}$$

= geopotential altitude <u>above</u> 120 km.

p. p. 24 Equation (20) should read

$$\gamma_i = m_i \, g_{120} / \tau \, k \, T_\infty \qquad \text{(20-Rev)}$$

q. p. 24 Delete footnote.

r. p. 25 Equation (25) should read

$$M = L\rho / \sum_i n_i \qquad \text{(25-Rev)}$$

s. p. 25 Add Section 4.4, Density Scale Height.

By starting with the definition of density scale height,

$$H_\rho \equiv \rho(z)/(-d\rho/dz) \ , \qquad (26)$$

and using the analytic expressions given in the paper, one finds that for the low-altitude model

$$H_\rho = \left[\frac{M_* \times 10^5}{R} \frac{g}{T_M} - \frac{1}{g/T_M} \sum_{k=1}^{11} g_k \, k \, z^{k-1} - 2.66710 \times 10^{-7} \, z^{1.833} - \frac{2}{R_e + z} \right] \qquad (27)$$

and for the high-altitude model

$$H_\rho = \frac{\sum_i n_i(z) \, m_i}{\tau \left(\frac{R_e + 120 - \zeta}{R_e + z} \right) \sum_i n_i(z) \, m_i \left[\gamma_i + (1 + \alpha_i + \gamma_i) \frac{a e^{-\tau\zeta}}{1 - a e^{-\tau\zeta}} \right]} \ . \qquad (28)$$

To provide a continuous density scale height across the boundary between the low- and high-altitude models, the following parabolic transition function can be used,

$$H_\rho(z) = a(z - 110)^2 + b(z - 110) + c \,, \qquad 110 \le z(\text{km}) \le 120 \tag{29}$$

where

$c = H_\rho(110)$

b = derivative of density scale height at 110-km altitude, taken to be given by $[H_\rho(110.5) - H_\rho(109.5)]/1.0$.

$a = [H_\rho(120) - 10b - H_\rho(110)]/(120 - 110)^2$.

t. p. 25 Add Section 4.5, An Evaluation of the Departure from Hydrostatic Equilibrium.

The possible departure of the ROSCOE atmosphere from hydrostatic equilibrium is of interest, and we report our findings here.

4.5.1 Low-Altitude Model in ATMOSU

In the low-altitude portion of ATMOSU, the pressure, given by Eq. (3) of Lo-73a, is (initially) obtained by integrating the hydrostatic equation,

$$\frac{dp}{dz} = -\rho g \,. \tag{30}$$

However, owing to limitations in fitting g/T, a correction factor is used to obtain the final expression for the pressure,

$$p(Z) = p_3(Z)\, e^{A Z^b} \,, \tag{31}$$

where Z is in kilometers and

$$p_3(Z) = p_o \exp\left[- c \sum_{k=0}^{11} \frac{g_k}{k+1} Z^{k+1} \right] \tag{32a}$$

$$A = 9.4144 \times 10^{-8} \tag{32b}$$

$$b = 2.833 \tag{32c}$$

$$c = M_{\star}\, 10^{5}/R \quad . \tag{32d}$$

To numerically test the extent to which the ATMOSU atmosphere departs from hydrostatic equilibrium, we evaluated the quantity

$$\text{FEHSEQ} \equiv \frac{-\,10^{-5}\, dp/dZ}{\rho g} - 1 \quad , \tag{33}$$

which is the fractional amount by which the acceleration at a point due to the pressure gradient fails to balance the acceleration due to gravity. By differentiating Eqs. (31) and (32a) and using Eqs. (2) and (6) of Lo-73a, one can rewrite Eq. (33) as

$$\text{FEHSEQ} = \frac{-\,10^{-5}\, A\, b\, Z^{b-1}}{g/T_M} \frac{R}{M_{\star}} \quad . \tag{34}$$

The results of evaluating Eq. (34) are given in Section 4.5.3.

4.5.2 High-Altitude Models

The high-altitude model in ATMOSU is closely related to the CIRA-65 model [CI-65]. So, before examining the ATMOSU high-altitude model, we consider the CIRA-65 model.

4.5.2.1 CIRA-65 Model. One can test the departure of the CIRA-65 atmosphere from hydrostatic equilibrium by first noting that the pressure scale height, a quantity tabulated in CIRA-65, is defined by the expression

$$H_p \equiv \frac{p}{(-\, dp/dz)} \,, \tag{35}$$

so that, if hydrostatic equilibrium obtains, the relation

$$-\frac{dp}{dz} = \frac{p}{H_p} = \rho g \tag{36}$$

should be satisfied. The quantity FEHSEQ in Eq. (31),

$$\text{FEHSEQ} \equiv \frac{p}{H_p \rho\, g} - 1 \qquad \text{(cgs units)} \,, \tag{37}$$

has the same meaning as in Eq. (33). An evaluation of Eq. (37) for the CIRA-65 Model-5 8-hr atmosphere shows that FEHSEQ varies from -9.96×10^{-4} at 120-km altitude to -6.53×10^{-3} at 800-km altitude. These errors are probably due to errors in numerical integration.

4.5.2.2 High-Altitude Model in ATMOSU. The ATMOSU high-altitude model is the Stein-Walker model as adapted by Nisbet to CIRA-65. To evaluate Eq. (33), one needs an expression for dp/dZ, which one can show, after considerable algebra, to be

$$\frac{dp}{dZ} = \frac{g\, \tau\, k\, T_\infty}{g_{120}} \left\{ a\, e^{-\tau\zeta} \sum_i n_i - \frac{T}{T_\infty} \sum_i n_i \left(\gamma_i + \frac{(1 + \alpha_i + \gamma_i)\, a\, e^{-\tau\zeta}}{1 - a\, e^{-\tau\zeta}} \right) \right\} . \tag{38}$$

4.5.3 Numerical Results

For the low-altitude model in ATMOSU, one finds that the pressure derivative is too small to maintain hydrostatic equilibrium by a fractional amount that ranges from 0 at 0 km to 0.020 at 120-km altitude.

In the high-altitude model, for HL = 11.66 hrs and SBAR = 157.57, the pressure derivative is too small to maintain hydrostatic equilibrium by a fractional amount that increases from 9.0×10^{-6} at 120-km altitude to 1.0×10^{-4} at 320-km altitude and then decreases to 1.8×10^{-5} at 800-km altitude.

2.3 SYMBOLS IN LOWEN'S PAPER AND ITS EXTENSIONS AND THEIR FORTRAN NAMES IN ATMOSU

Symbol	Fortran	Definition
a	SA	Eq. (21).
[Ar]	SNI(4)	Argon number density.
A_i	A(I)	Fourier coefficient for τ.
B_i	B(I)	Fourier coefficient for τ.
C_i	C(I)	Fourier coefficient for T_∞.
f	SF SFDAF(ZH)	$M_*[O]/2L\rho$; see Eqs. (16) and (17). In ATMOSU, SFDAF(ZH) is used for the daytime profile of f.
f_k	DD(I)	Coefficient in polynomial fit to f, Eq. (17). In ATMOSU, DD(I) is used for the daytime profile of f.
F	FF SBAR	The 10.7-cm solar flux associated with the CIRA-1965 tables.

Symbol	Fortran	Definition
g	GG GAF(ZH)	Acceleration of gravity at altitude z.
g_o	GZ	Sea-level gravitational acceleration.
g_k	AA(I)	Coefficient in polynomial fit to g/T_M.
g/T_M	GDTM GDTMAF(ZH)	Ratio of g to T_M, Eq. (2).
$\int_0^z \frac{g(z')}{T_M(z')} dz'$	GDTMI GTMIAF(ZH)	Integral of g/T_M.
$\sum_1^{11} g_k k z^{k-1}$	GKKZ GKKZAF(ZH)	Derivative of g/T_M.
[He]	SNI(5)	Helium number density.
HL	HL	Local time, in hours.
H_ρ	HRHO	Density scale height.
$H_\rho(110)$	HRO110	Density scale height at z = 110 km.
$H_\rho(110.5)$	HR1105	Density scale height at z = 110.5 km.
$H_\rho(109.5)$	HR1095	Density scale height at z = 109.5 km.
$H_\rho(120)$	HRO120	Density scale height at z = 120 km.
$dH_\rho(110)/dz$	DDZ110	Derivative of density scale height at 110 km.
k	SK	Boltzmann's constant.
L	BIGA	Avogadro's number.
m_i	SMI(I)	Mass of species i.
M		Mean molecular weight.

Symbol	Fortran	Definition
M_*	BIGMS	Mean molecular weight at sea level.
M/M_*	BMBMS	Ratio of M to M_* for day (noontime) conditions.
n	SN	Total number density.
n_*	SNS	Total number density if no dissociation.
$n_i(z)$	SNI(I)	Number density of species i at altitude z.
$n_i(120)$	SNIZ(I)	Number density of species i at 120-km altitude.
$[N_2]$	SNI(I)	Molecular nitrogen number density.
[O]	SNI(3)	Atomic oxygen number density.
$[O_2]$	SNI(2)	Molecular oxygen number density.
p	PP	Pressure.
p_0	PZ	Sea-level pressure.
p_3		Basic factor in pressure, given by Eq. (3).
R	RR	Universal gas constant.
R_e	RE	Radius of a spherical earth.
S_i	S(I)	Fourier coefficient for T_∞.
T	TT	Kinetic temperature.
T_M		Molecular-scale temperature, Eq. (1).
T_{120}	TZ	Temperature at 120-km altitude.
T_∞	TIF	Exospheric temperature.
z	ZH	Altitude.

Symbol	Fortran	Definition
α_i	ALP(I)	Thermal-diffusion coefficient.
γ_i	GAM GAMT*SMI(I)	Eq. (20).
ζ	ZZ	Geopotential altitude (above 120 km).
π	PI	3.141592653590.
ρ	RHO	Mass density.
$d\rho/dz$	DRODZN	Spatial derivative of ρ.
τ	TAU	Variable controlling the temperature gradient at 120-km altitude, Eq. (22).

3. AUXILIARY SUBROUTINES FOR ATMOSU

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-hr 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 current ROSCOE code.

3.1 SUBROUTINE ZTTOUT

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.

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

Table 3. Summary of ZTTOUT Input/Output Variables.

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)

3.2 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.

See Table 4 for a summary of inputs and outputs for JULIAN.

Table 4. Summary of JULIAN Input/Output Variables.

INPUT VARIABLES

Argument List

- IYRS - Number of the year in the 1900's (e.g., 1974 becomes 74) at Greenwich
- IMONS - Number of the month (e.g., February becomes 2) at Greenwich
- IDAYS - Day of the month at Greenwich

Common

None

OUTPUT VARIABLES

Argument List

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

Common

None

3.3 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 5 for a summary of inputs and outputs for SOLCYC.

Table 5. Summary of SOLCYC Input/Output Variables.

INPUT VARIABLES

Argument List

DAYJ - Julian day number (a half integer) at 0 hrs 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)]

3.4 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).

See Table 6 for a summary of inputs and outputs for SOLORB.

Table 6. Summary of SOLORB Input/Output Variables.

INPUT VARIABLES

Argument List

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

3.5 SUBROUTINE SOLZEN

Subroutine SOLZEN computes COSCHI, the cosine of the solar zenith angle 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 7 for a summary of inputs and outputs for SOLZEN.

Table 7. Summary of SOLZEN Input/Output Variables.

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)

4. MINOR NEUTRAL SPECIES

4.1 SUBROUTINE SPCMIN

The ROSCOE high-altitude chemistry module [Vol. 11] requires the minor neutral species O, CO_2, N, and NO. Analytic-fit profiles for day and night at all altitudes are provided for O and CO_2 in Subroutine ATMOSU. The profiles for N and NO are provided in Subroutine SPCMIN.

The ROSCOE low-altitude chemistry module [Vol. 11] requires in addition to O, CO_2, N, and NO, the minor neutral species H_2O, $O_2(^1\Delta_g)$, O_3, and NO_2, which are also provided by SPCMIN.

The inputs and outputs for SPCMIN are summarized in Table 8. The nature of the functions used for fitting the adopted data-base values [Vol. 14b] at noon or midnight in various altitude ranges is given in Tables 9 through 16 for O, CO_2, N, NO, H_2O, $O_2(^1\Delta_g)$, O_3, and NO_2.

Table 8. Summary of SPCMIN Input/Output Variables.

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

(cont'd)

Table 8. (Continued).

ALTODN Common

S1Z2N	-	N_2 density at 230-km altitude for use in N-density initialization.

DATA

ALTKM(47)	-	Altitudes at which minor species densities are specified as data
NALTOD	-	Number of altitudes between 0 and 130 km used to establish the arithmetic function used for daytime O densities between 0- and 120-km altitude.
NALTND	-	Number of altitudes between 40 and 230 km used to fit the daytime N densities.
NDEGND	-	Degree of the polynomial used to fit daytime N densities between 40- and 230-km altitude.
NALTNN	-	Number of altitudes between 85 and 230 km used to fit the nighttime N densities.
NDEGNN	-	Degree of the polynomial used to fit nighttime N densities between 85- and 230-km altitude.
NALTNO	-	Number of altitudes between 0 and 120 km used to fit the daytime NO densities.
NDEGNO	-	Degree of the polynomial used to fit daytime NO densities between 0- and 120-km altitude.
NKMH2O	-	Number of altitudes between 0 and 120 km used to fit H_2O densities.
NDGH2O	-	Degree of the polynomial used to fit the H_2O densities between 0- and 120-km altitude.
NALTO2	-	Number of altitudes between 0 and 50 km used to fit daytime $O_2(^1\Delta_g)$ densities.
NDGO2D	-	Degree of the polynomial used to fit the daytime $O_2(^1\Delta_g)$ densities between 0- and 50-km altitude.
NKMNO2	-	Number of altitudes between 0 and 160 km used to fit the daytime NO_2 densities.

(cont'd)

Table 8. (Continued).

NDGNO2	- Degree of the polynomial used to fit the daytime NO_2 densities between 0- and 160-km altitude.
ODAY(27)	- Noontime data-base values of [O] at altitudes 0(5)130 km*
ONITE(18)	- Midnight data-base values of [O] at altitudes 0(5)85 km *
CO2(25)	- Data-base values of $[CO_2]$ at altitudes 0(5)120 km *
ANODAY(25)	- Noontime data-base values of [NO] at altitudes 0(5)120 km *
ANONIT(18)	- Midnight data-base values of [NO] at altitudes 0(5)85 km*
ANDAY(47)	- Noontime data-base values of [N] at altitudes 0(5)230 km *
ANNITE(47)	- Midnight data-base values of [N] at altitudes 0(5)230 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(27)	- Noontime data-base values of $[O_3]$ at altitudes 0(5)130 km*
O3NIT(27)	- Midnight data-base values of $[O_3]$ at altitudes 0(5)130 km*
H2ODN(25)	- Data-base values of $[H_2O]$ at altitudes 0(5)120 km*
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*

(cont'd)

*See Vol. 14b.

Table 8. (Continued).

OUTPUT VARIABLES

Argument List

None

ATMOUP Common

SNI(7)	-	N	density, $1/cm^3$
SNI(8)	-	NO	density, $1/cm^3$
SNI(13)	-	$O_2(^1\Delta_g)$	density, $1/cm^3$
SNI(14)	-	O_3	density, $1/cm^3$
SNI(15)	-	NO_2	density, $1/cm^3$
SNI(16)	-	H_2O	density, $1/cm^3$

ALTODN Common

NALTOD	-	See input
ALTKM(47)	-	See input
ODAY(27)	-	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 mixing-ratio of 3.2×10^{-4}.)

Table 9. Fit Functions for O Profiles.[a]

Altitude Range, km	Description
	Day
0-120	Not O but f is fitted by a 12th-degree polynomial
> 120	ATMOSU high-altitude model
	Night
0-60	Constant at data-point value
60-75	Exponential, with slope determined by data points at 60 and 75 km
75-90	5th-degree polynomial, to match data points at 75(5)85 km and daytime fit-function at 90 km and derivatives of 60-to-75-km fit-function at 75 km and daytime fit-function at 90 km
90-120	Daytime fit-function
> 120	ATMOSU high-altitude model

[a]Fits are made not in SPCMIN but in ATMOSU.

Table 10. Fit Functions for CO_2 Profile.

Altitude Range, km	Description
	Day or Night
0-100	Constant 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

Table 11. Fit Functions for N Profiles.

Altitude Range, km	Description
	Day
0-40	Constant at data-point value
40-230	8th-degree polynomial, determined by least squares for data points at 40(5)230 km
≥ 230	Proportional to N_2,[a] $[N] = \left\{[N]/[N_2]\right\}_{230} [N_2]$
	Night
0-85	Constant at data-point value
85-230	6th-degree polynomial, determined by least squares for data points at 85(5)230 km
≥ 230	Proportional to N_2,[a] $[N] = \left\{[N]/[N_2]\right\}_{230} [N_2]$

[a] This procedure makes [N] dependent on the time to the extent that $[N_2]$ is dependent on the time.

Table 12. Fit Functions for NO Profiles.

Altitude Range, km	Description
	Day
0-120	12th-degree polynomial, determined by least squares for data points at 0(5)120 km
120-125	Parabolic transition function, determined by the 120-km data point, the derivative at 120 km (estimated by using the daytime fit-function values at 115 and 120 km) and a prescribed value at 125 km. (The 125-km value is determined by the requirement that the slope of the function be continuous at 125 km. See Vol. 14b.)
> 125	Exponential, determined by the prescribed value at 125 km and a solar-flux dependent value at 215 km.
	Night
0-50	Constant at data-point value
50-55	Exponential, determined by data points at 50 and 55 km
55-85	8th-degree polynomial, to match data points at 55(5)80 km, daytime fit-function value at 85 km, and derivatives of 50-to-55-km fit function at 55 km and daytime fit-function at 85 km
85-100	Daytime fit-function
> 100	A prescribed altitude-dependent fraction of the daytime fit function

Table 13. Fit Functions for H_2O Profile.

Altitude Range, km	Description
	Day or Night
0-120	12th-degree polynomial, determined by least squares for data points at 0(5)120 km
≥ 120	Exponential, $[H_2O] = [H_2O]_{120} \exp[-0.166(h - 120)]$, where $[H_2O]_{120}$ is determined from the fit function from 0 to 120 km.

Table 14. Fit Functions for $O_2(^1\Delta_g)$ Profiles.

Altitude Range, km	Description
	Day
0-50	10th-degree polynomial, 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 fit-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

Table 15. Fit Functions for O_3 Profiles.

Altitude Range, km	Description
	Day
0-40	9th-degree polynomial, to match data points at 0(5)40 km and derivative of 40-to-75-km fit-function at 40 km
40-75	Exponential, determined by data points at 40 and 75 km
75-90	5th-degree polynomial, to match data points at 75(5)90 km and derivatives of 40-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
0-55	Daytime fit function
55-70	5th-degree polynomial, to match daytime fit-function at 55 km, data points at 60(5)70 km, and derivatives of 0-to-55-km fit-function at 55 km and 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, to match data points at 75(5)90 km and derivatives of 40-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

Table 16. Fit Functions for NO_2 Profiles.

Altitude Range, km	Description
	Day
0-160	12th-degree polynomial, determined by least squares 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

4.2 AUXILIARY SUBROUTINES

A brief description of the operation of Subroutines FITTER and SOLVE is given in Section 1.

4.2.1 Subroutine FITTER

A summary of inputs and outputs for Subroutine FITTER is given in Table 17.

4.2.2 Subroutine SOLVE

A summary of inputs and outputs for Subroutine SOLVE is given in Table 18.

Table 17. Summary of FITTER Input/Output Variables.

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_0, Z(2) to A_1, etc.

Common

None

Table 18. Summary of SOLVE Input/Output Variables.

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 and the same as DD(K) in ATMOSU.

4.3 PLOTS OF MINOR NEUTRAL SPECIES PROFILES

Comparisons of the fit-function values with the data-base values [Vol. 14b] of minor species densities are given in Figs. 3 through 10. Broken lines (solid for noon, dashed for midnight) connect data-base values at 5-km intervals. Circles represent fit-function values at 5-km intervals.

Plots of day and night values for five of the minor species densities of interest in the D region appear in the very recently published handbook by Knapp and Schwartz [KS-75, Fig. 8-1], reproduced here as Fig. 11. To aid in comparing our results with the handbook results, we have used their scales to replot our fit functions for the same species, shown in Fig. 12.

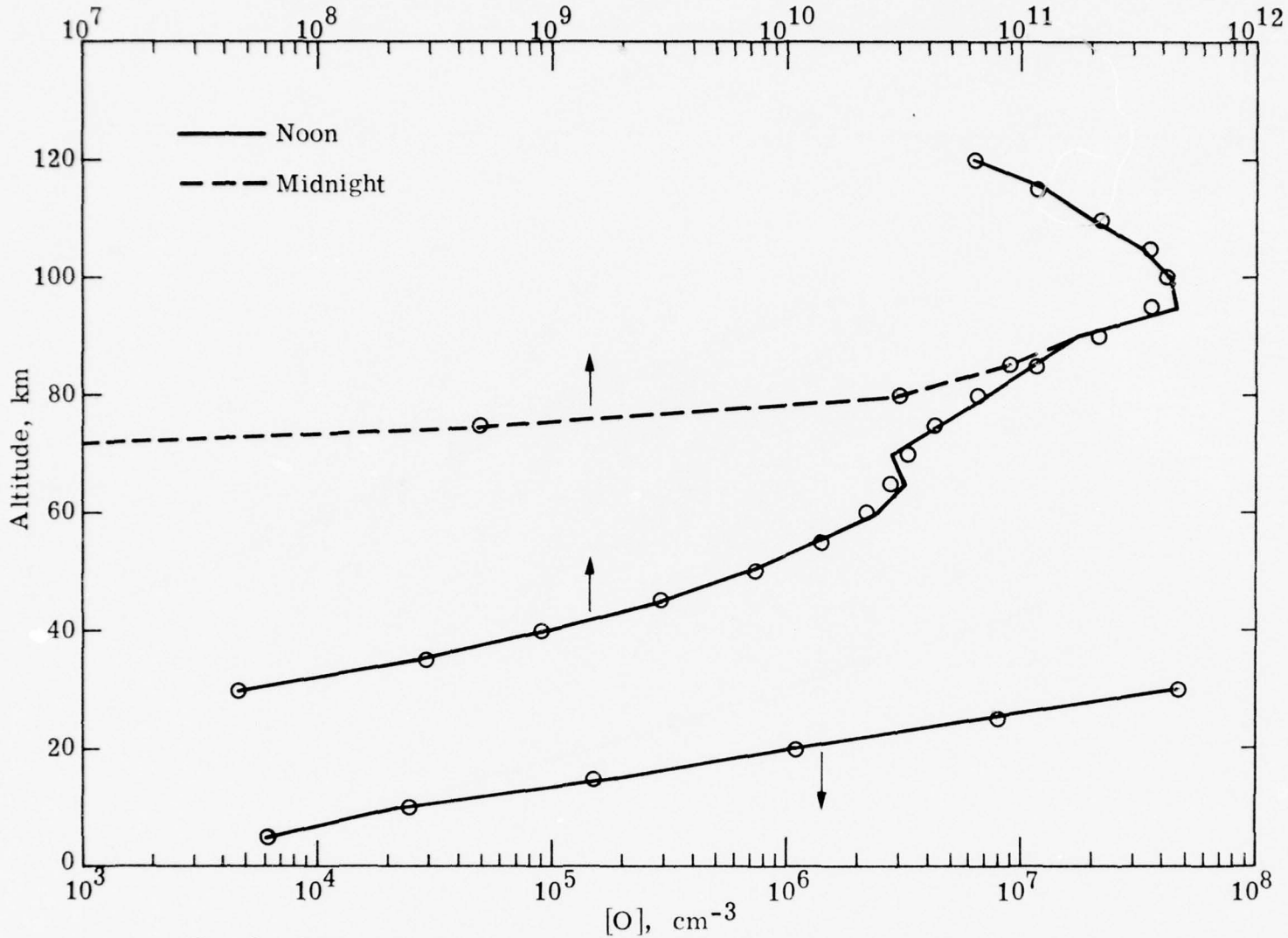

Fig. 3. O Density Profile. The ATMOSU-computed fit-function profile is shown with the adopted data-base profile [My-75].

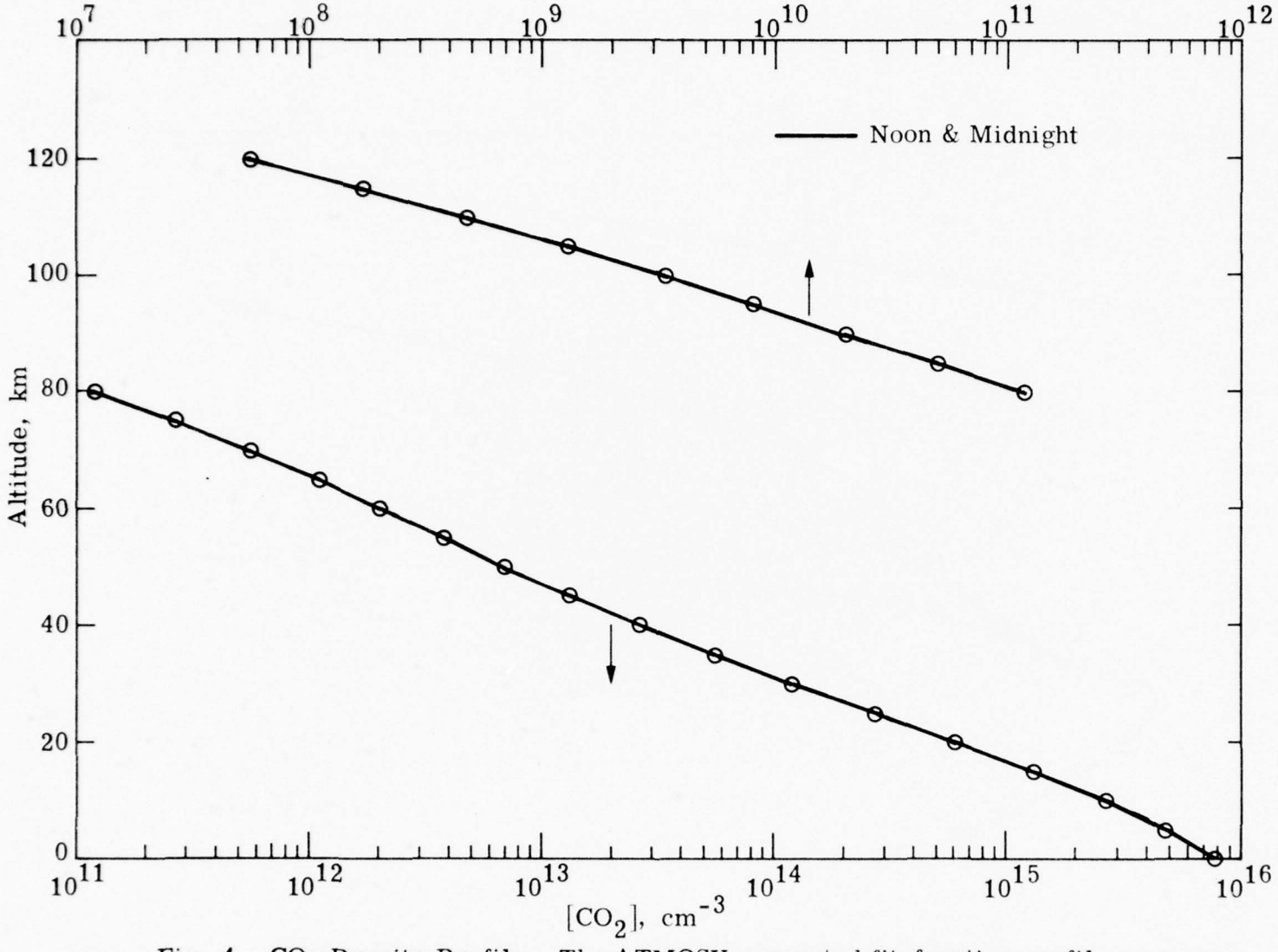

Fig. 4. CO_2 Density Profile. The ATMOSU-computed fit-function profile is shown with the adopted data-base profile [My-75].

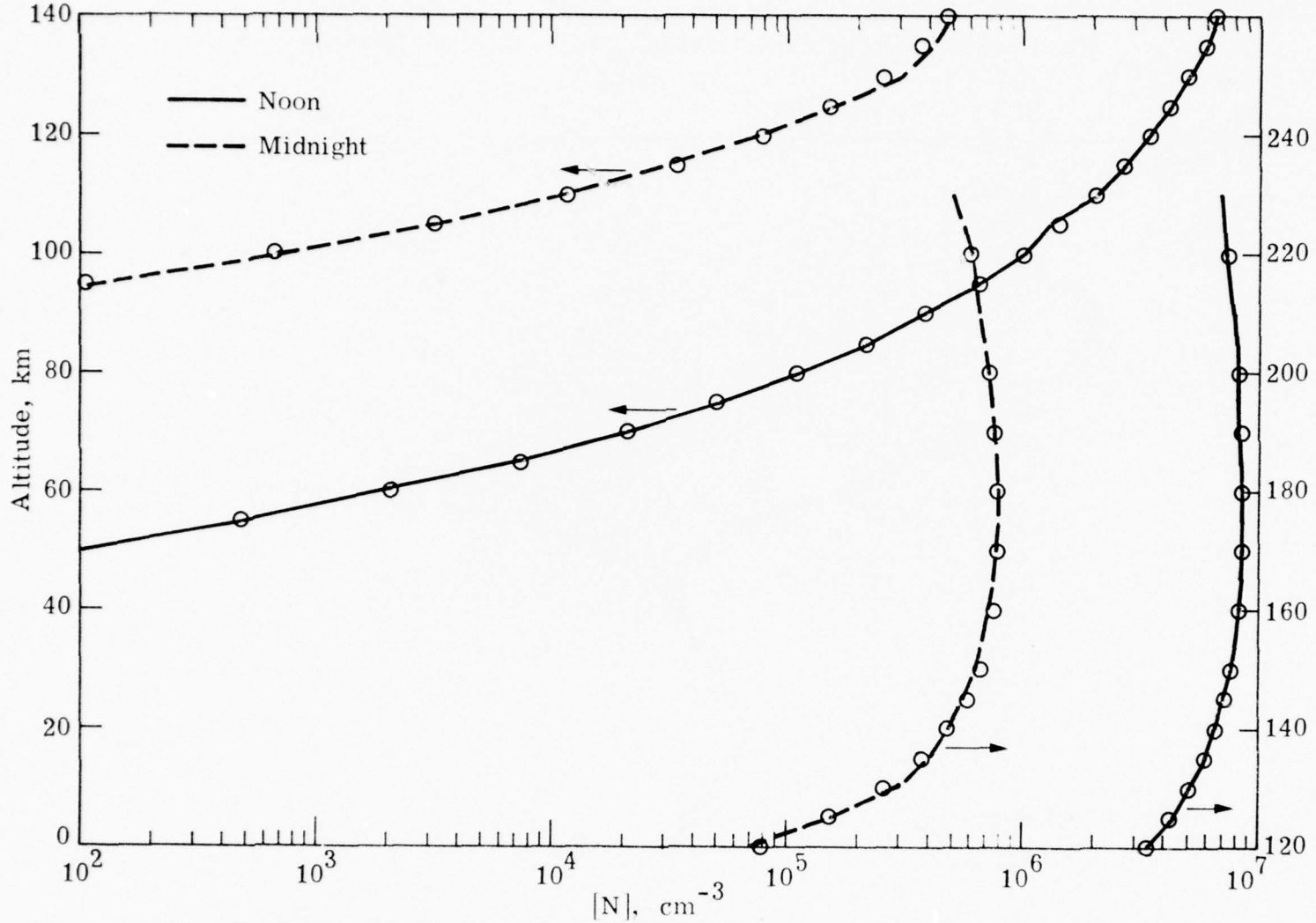

Fig. 5. N Density Profile. The SPCMIN-computed fit-function profile is shown with the adopted data-base profile [My-75].

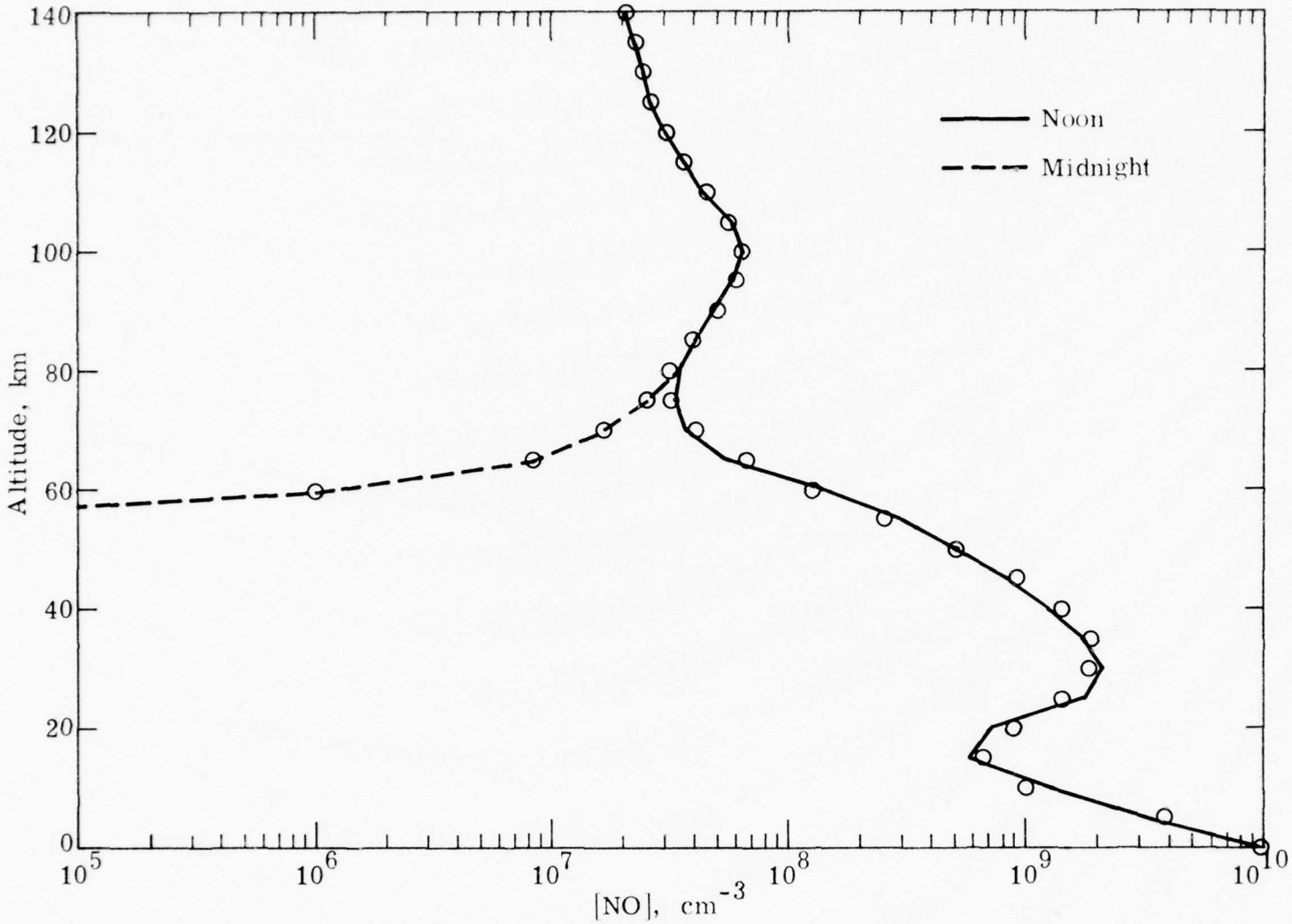

Fig. 6. NO Density Profile. The SPCMIN-computed fit-function profile is shown with the adopted data-base profile [My-75].

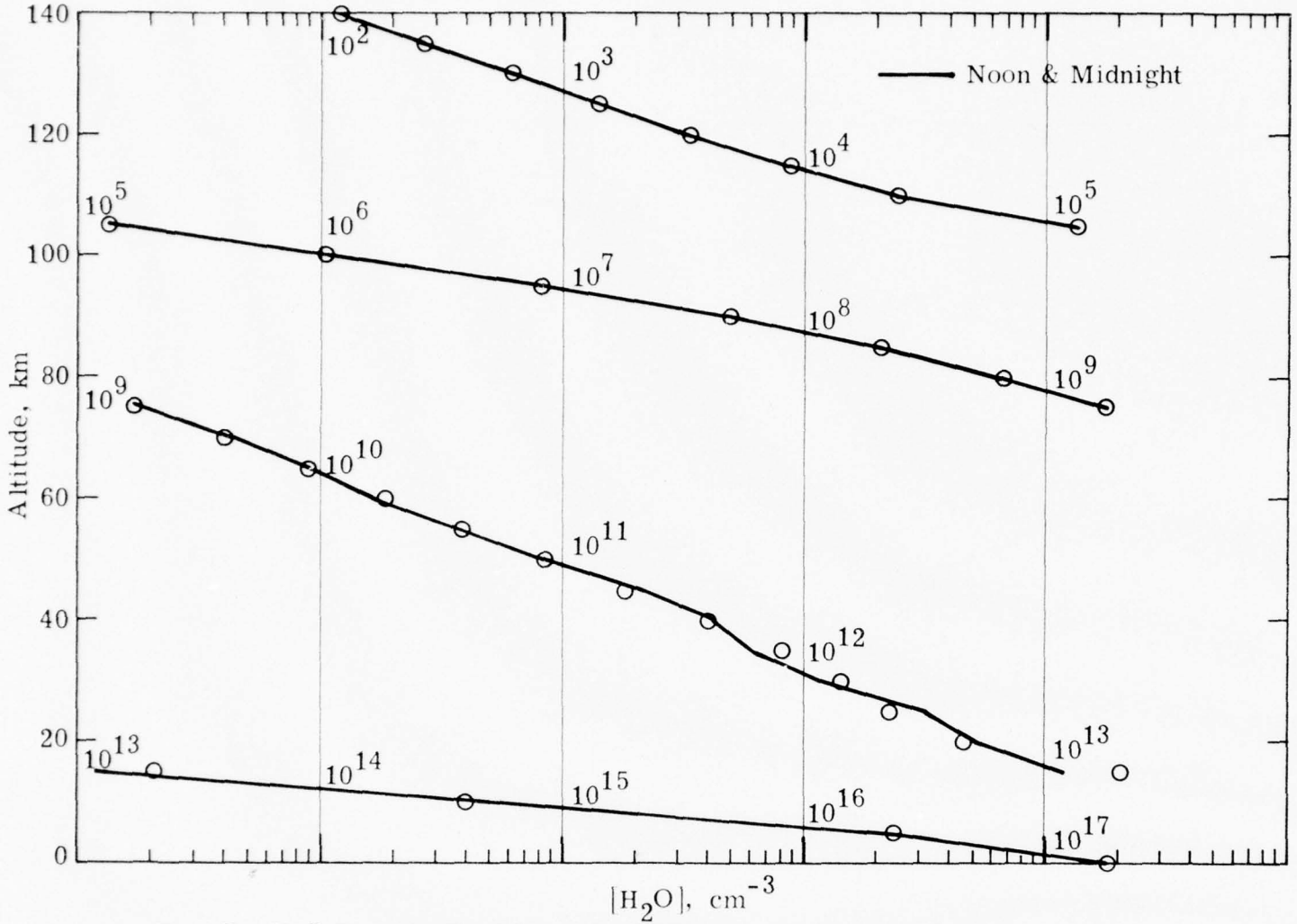

Fig. 7. H_2O Density Profile. The SPCMIN-computed fit-function profile is shown with the adopted data-base profile [My-75].

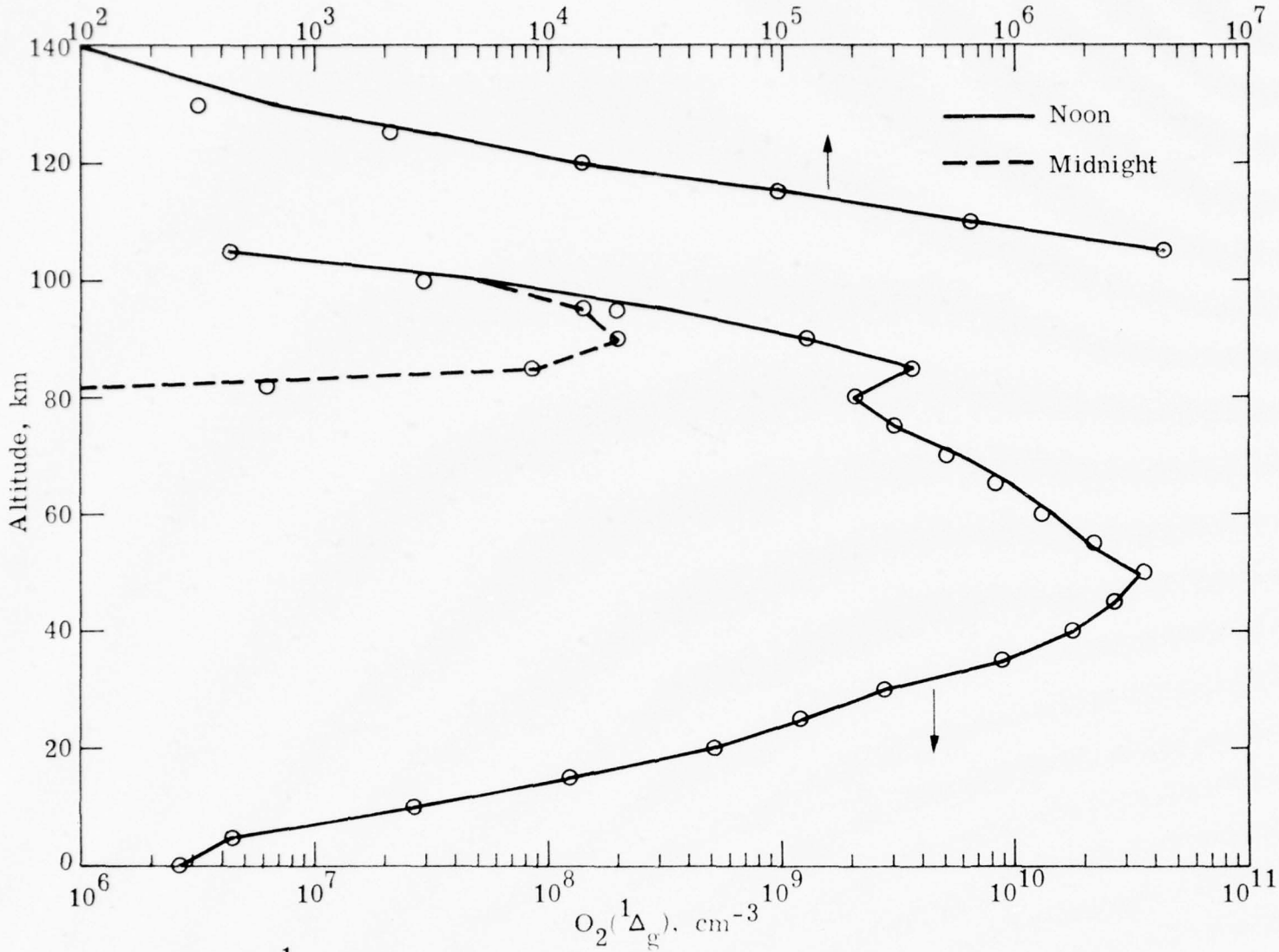

Fig. 8. $O_2(^1\Delta_g)$ Density Profile. The SPCMIN-computed fit-function profile is shown with the adopted data-base profile [My-75].

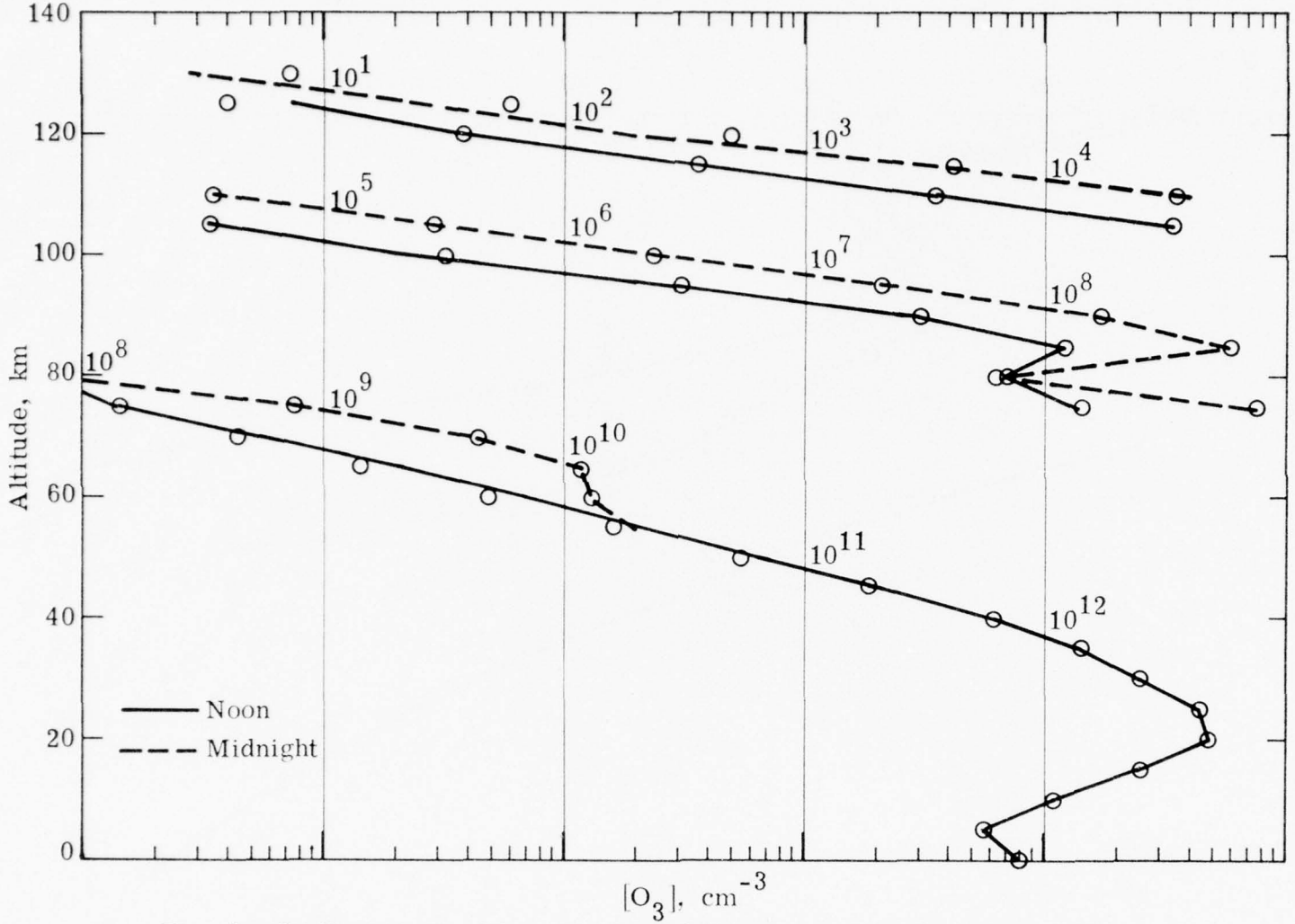

Fig. 9. O_3 Density Profile. The SPCMIN-computed fit-function profile is shown with the adopted data-base profile [My-75].

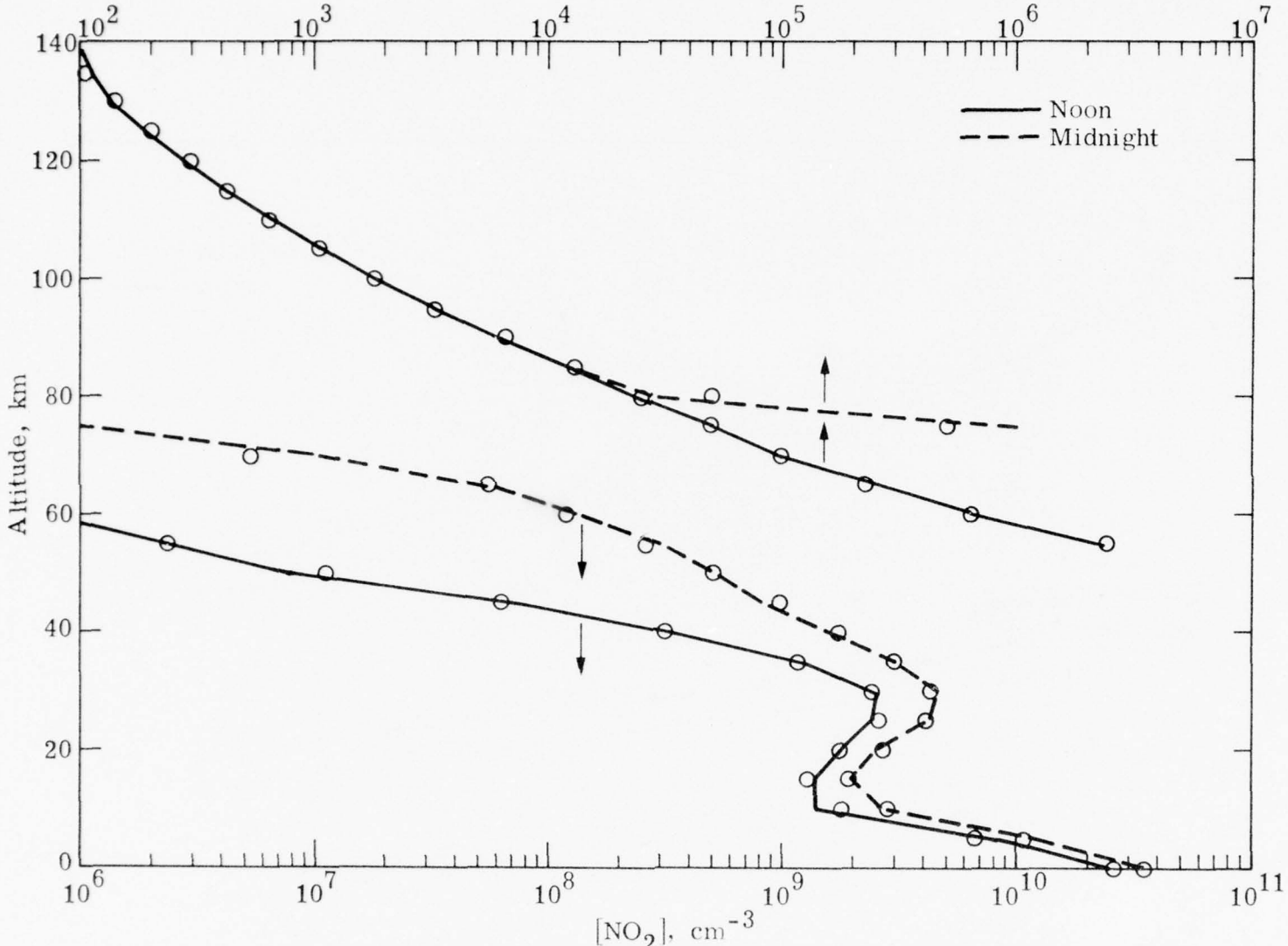

Fig. 10. NO_2 Density Profile. The SPCMIN-computed fit-function profile is shown with the adopted data-base profile [My-75].

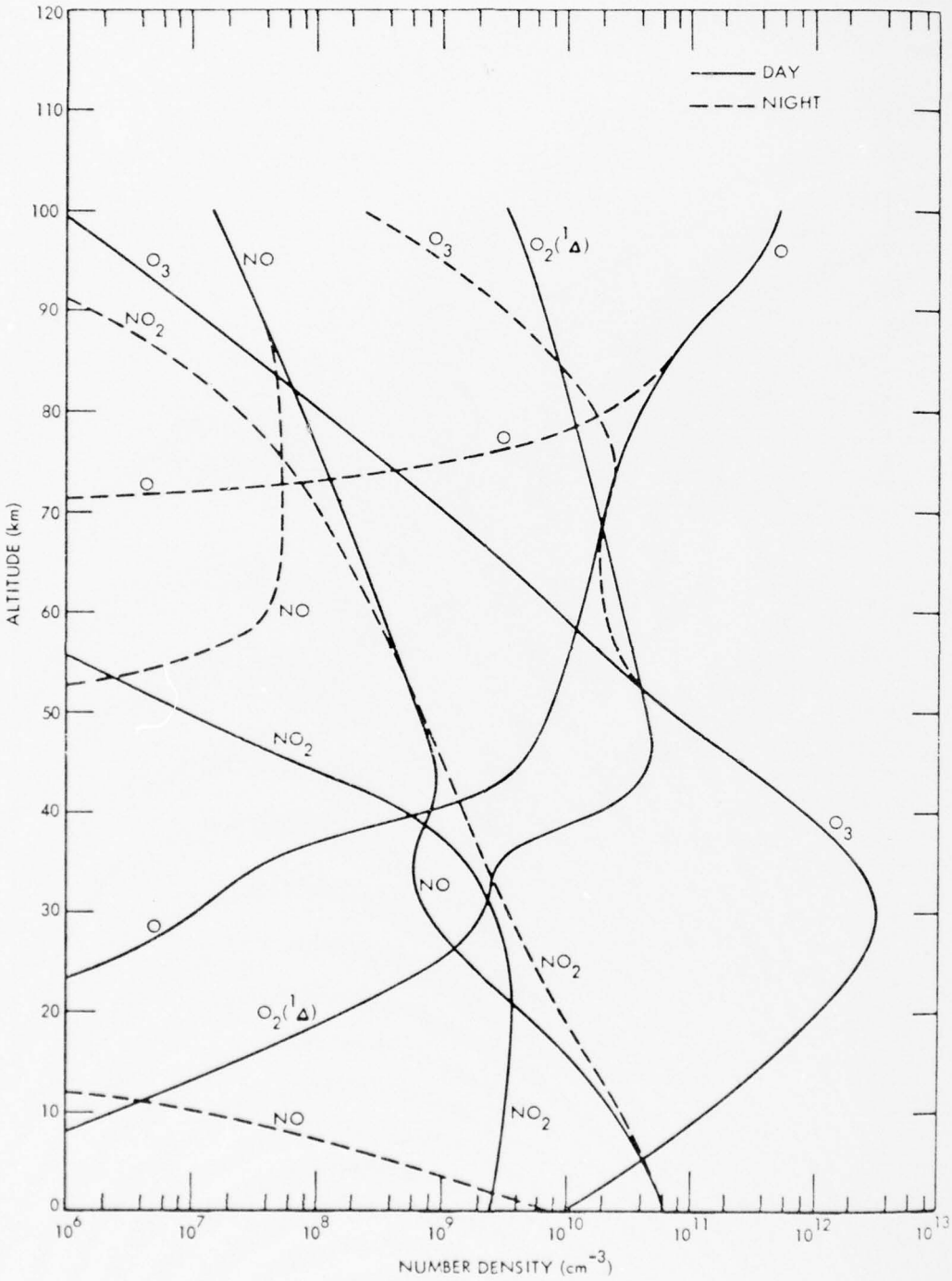

Fig. 11. D-Region Minor Neutral-Species Profiles from KS-75 (Fig. 8-1).

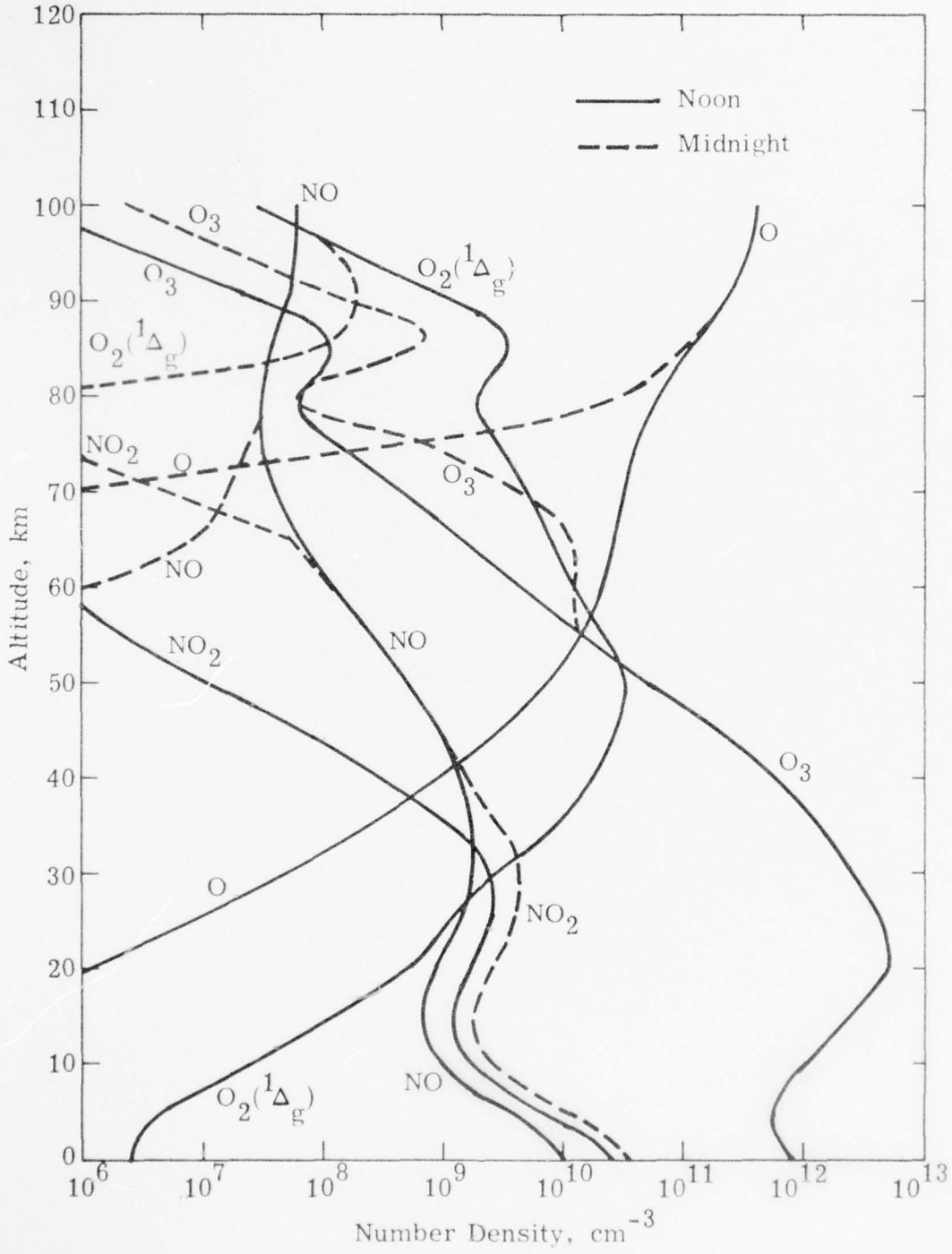

Fig. 12. Selected Minor Neutral-Species Profiles from Subroutines SPCMIN and ATMOSU. These profiles may be compared with those in Fig. 11.

5. AMBIENT IONOSPHERE (SUBROUTINE IONOSU)

See Table 19 for a summary of inputs and outputs for IONOSU.

5.1 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. M^+, the positive molecular-ion density (cm^{-3})

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

RANC IV uses unsatisfactory steady-state formulas [GE-70, Eqs. (2-276), (2-274), and (2-275)] for q, O^+, and M^+. The derivation [GE-70] of the RANC IV equations is incomplete because there are a number of tacit, (unnecessary) simplifying assumptions. The exact solutions may be derived as follows.

Equations (2-270) and (2-271) of GE-70, for steady-state conditions, become

$$[\dot{O}^+] = 0 = q_1 - \beta[O^+] - \alpha_r[O^+]\{[O^+] + [M^+]\} \quad (1)$$

$$[\dot{M}^+] = 0 = q_2 + \beta[O^+] - \alpha_d[M^+]\{[O^+] + [M^+]\} , \quad (2)$$

Table 19. Summary of IONOSU Input/Output Variables.

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 ($1/cm^3$)

TT - Heavy-particle temperature (°K)

ALTODN Common

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

RATE Function Routine

Reaction rate coefficients for chemical reactions (This routine prepared by Knapp and Jordano [Vol. II].)

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 ($1/cm^3$)

(cont'd)

Table 19. (Continued).

HF2MXD	-	Altitude at which the maximum daytime electron density occurs (km)
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])

(cont'd)

Table 19. (Continued).

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])

OUTPUT VARIABLES

ATMOUP Common

SNI(9)	-	Electron concentration for ZH ≥ 90 km ($1/cm^3$)
SNI(10)	-	Atomic oxygen ion concentration for ZH ≥ 90 km ($1/cm^3$)
SNI(11)	-	Molecular ion concentration for ZH ≥ 90 km ($1/cm^3$)
SNI(12)	-	Electron (and N_2 vibration) temperature (°K)

IONOUP Common

EFE	-	See SNI(9) above.
EFOP	-	See SNI(10) above.
EFMOLP	-	See SNI(11) above.
TX	-	See SNI(12) above.
QDEF	-	The effective total ion production rate that reproduces the ambient ionosphere when used with the chemistry model

where

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

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

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

q_2 = molecular-ion production rate (cm^{-3} sec^{-1})

$\beta = k_1[N_2] + k_2[O_2]$

k_1 = ion-molecule interchange rate coefficient (cm^3/sec)

k_2 = ion-molecule charge-exchange coefficient (cm^3/sec)

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

$= k_{11}(T_x) + k_{12}(T_x)[e] + 1.5 \times 10^{-7} [e]^{\frac{1}{2}} T_x^{-3}$

$k_{11}(T_x)$ = radiative recombination rate coefficient for the reaction $O^+ + e \rightarrow O + h\nu$

$k_{12}(T_x)$ = collisional-radiative recombination rate coefficient for the reaction $O^+ + e + e \rightarrow O + e$

α_d = dissociative recombination rate coefficient for the reaction $M^+ + e \rightarrow$ products (cm^3/sec).

By assuming charge conservation,

$$[e] = [O^+] + [M^+] \ , \tag{3}$$

one can write Eqs. (1) and (2) as

$$q_1 - \beta[O^+] - \alpha_r[O^+][e] = 0 \tag{4}$$

$$q_2 + \beta[O^+] - \alpha_d[M^+][e] = 0 \ . \tag{5}$$

Let

$$q_1 = f\,q \quad , \tag{6}$$

where

$$f = \frac{[O]}{[O] + 2[M]} \tag{7}$$

and

$$q = q_1 + q_2 \quad . \tag{8}$$

By adding Eqs. (4) and (5) and using Eq. (8), we have

$$q = \left\{\alpha_d[M^+] + \alpha_r[O^+]\right\}[e] \quad . \tag{9}$$

We have five equations [(3), (4), (5), (6), and (8)] and six variables; we can get analytic solutions for the five variables if we regard the electron density as given.

Equations (4) and (6) give

$$fq - \beta[O^+] - \alpha_r[O^+][e] = 0 \tag{10}$$

or

$$q = \left\{\beta + \alpha_r[e]\right\} f^{-1}[O^+] \quad . \tag{11}$$

Use Eqs. (9) and (11) to eliminate q:

$$\left\{\alpha_d[M^+] + \alpha_r[O^+]\right\}[e] = \left\{\beta + \alpha_r[e]\right\} f^{-1}[O^+] \quad . \tag{12}$$

Eliminate $[M^+]$ from Eq. (12) by using Eq. (3) to get

$$[O^+] = \frac{\alpha_d\, f\, [e]^2}{\beta + [e][\alpha_d f + \alpha_r(1 - f)]} \quad . \tag{13}$$

Eliminate $[O^+]$ from Eq. (11) by using Eq. (13) to get

$$q = \frac{\alpha_d [e]^2 \left\{1 + \alpha_r [e] \beta^{-1}\right\}}{1 + [e] \beta^{-1} \left\{\alpha_d f + \alpha_r (1 - f)\right\}} \quad . \tag{14}$$

Thus we have expressed q as a function of [e]. This equation differs from the corresponding equation in RANC IV [GE-70, Eq. (2-276)] by containing terms involving α_r.

The reader who likes Eq. (13) for $[O^+]$ can use it, of course, but we have used another expression for $[O^+]$,

$$[O^+] = \frac{f\, q}{\beta + \alpha_r [e]} \quad , \tag{15}$$

obtained by solving Eq. (11) for $[O^+]$, since q is known from Eq. (14).

From Eqs. (5), (8), (6), and (3) we get

$$[M^+] = \frac{q(1 - f) + \beta [e]}{\beta + \alpha_d [e]} \quad . \tag{16}$$

It may be shown that the sum of $[O^+]$ and $[M^+]$, as given by Eqs. (15) and (16), satisfies the requirement of charge conservation expressed by Eq. (3); this is not true for the corresponding RANC IV equations [GE-70, Eqs. (2-274) and (2-275)].

In Subroutine IONOSU we use Eqs. (14), (15), and (16) to compute q, $[O^+]$, and $[M^+]$ after prescribing analytic fits to nominal profiles

of E- and F-region electron density [Ri-73, Fig. 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 Fig. 13. The fit functions used to obtain these profiles are described in Table 20.

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 Fig. 14. The fit function used to obtain the electron temperature profile is described in Table 21.

For approximately mean solar-flux conditions, SBAR $\equiv \overline{S} \approx 158 \times 10^{-22}$ W m^{-2} Hz^{-1}, profiles of q are shown for noon and midnight conditions in Fig. 15 and the corresponding values of O^+ and M^+ are shown in Fig. 13.

5.2 D-REGION IONOSPHERIC PROPERTIES

The D-region chemistry module 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.

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.

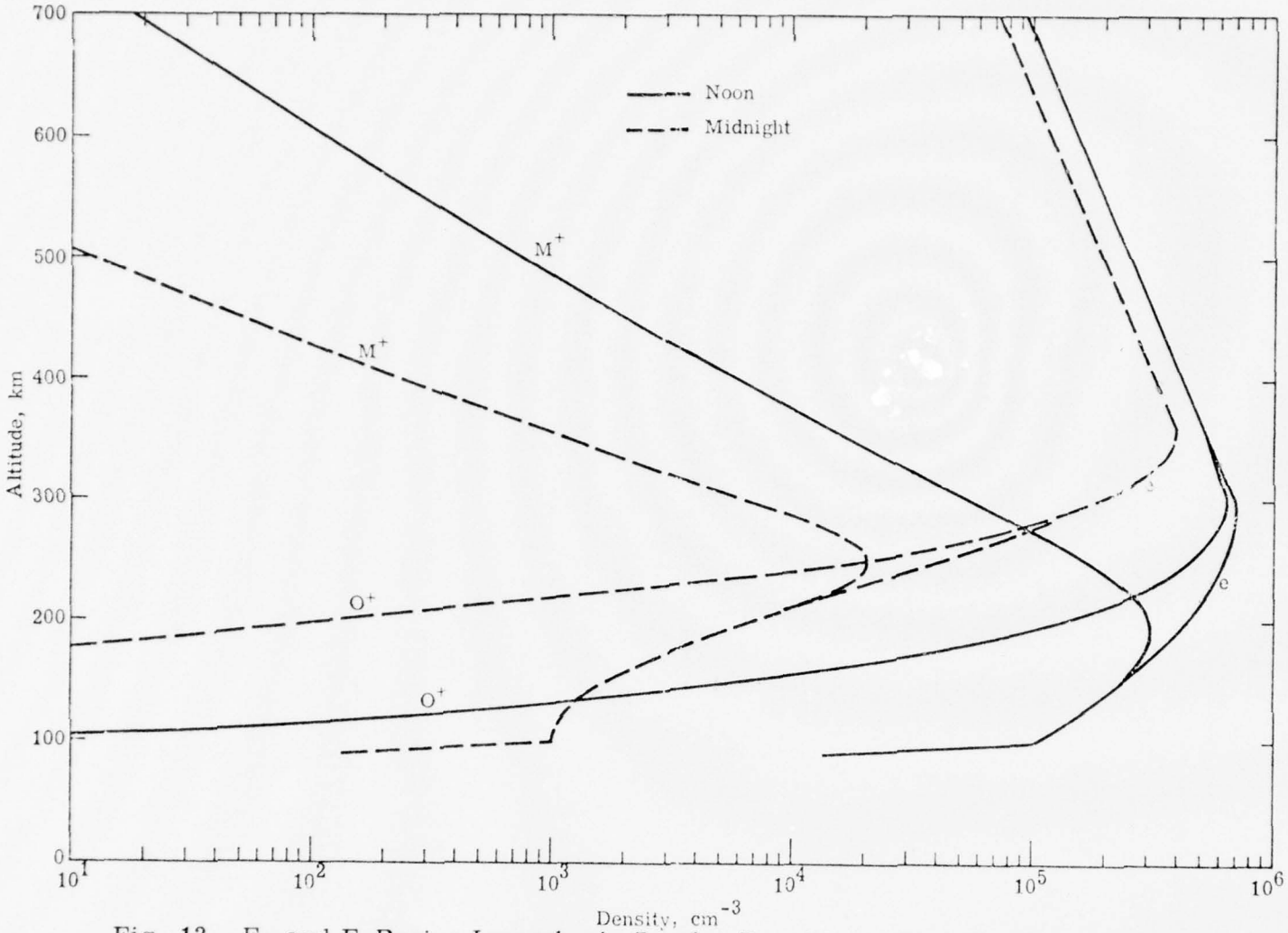

Fig. 13. E- and F-Region Ionospheric Species Densities. The electron density profiles are prescribed to be independent of the solar-flux conditions. The atomic-(O^+) and molecular-ion (NO^+) densities are IONOSU-computed steady-state values for approximately average solar-flux conditions ($\overline{S} \approx 158 \times 10^{-22}$ W m^{-2} Hz^{-1}).

Table 20. 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 Fig. 1 in Ri-73.

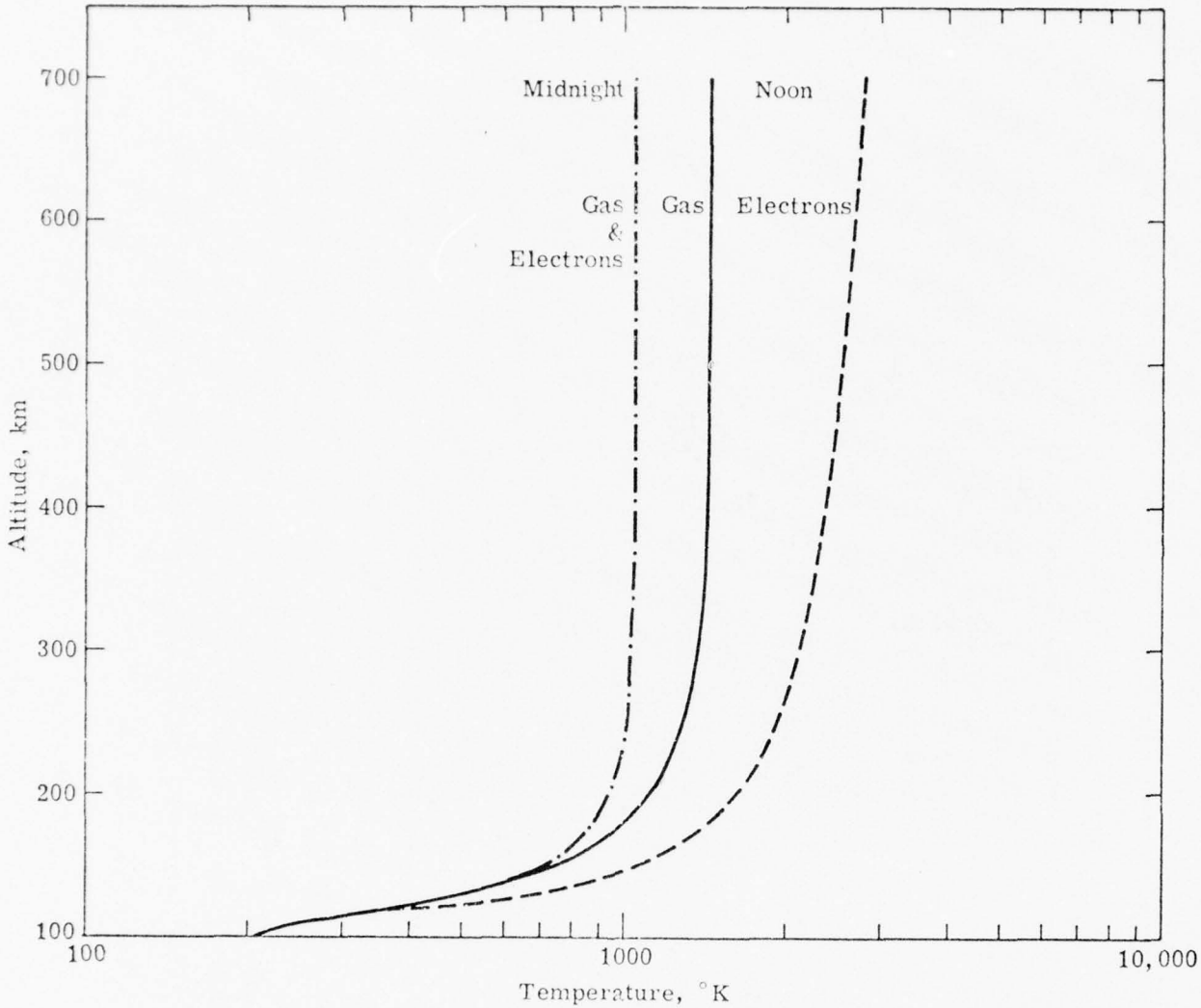

Fig. 14. E- and F-Region Ionospheric Temperatures. The difference between the electron and gas temperatures is prescribed to be independent of the solar-flux conditions. The absolute values shown are IONOSU-computed values for approximately average solar-flux conditions ($\bar{S} \approx 158 \times 10^{-22}$ W m^{-2} Hz^{-1}).

Table 21. 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 $T_X - T = 500\,[(ZH - 120)/80]^{\frac{1}{2}}$ is then used.
	Night
≥ 0	Same as heavy-particle temperature

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, Fig. 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 (Fig. 2.3) and Po-73a (Figs. 2 and 3).

The profiles of q in the D and adjacent regions for noon and midnight conditions are shown in Fig. 16. The fit functions used to obtain these profiles are described in Table 22.

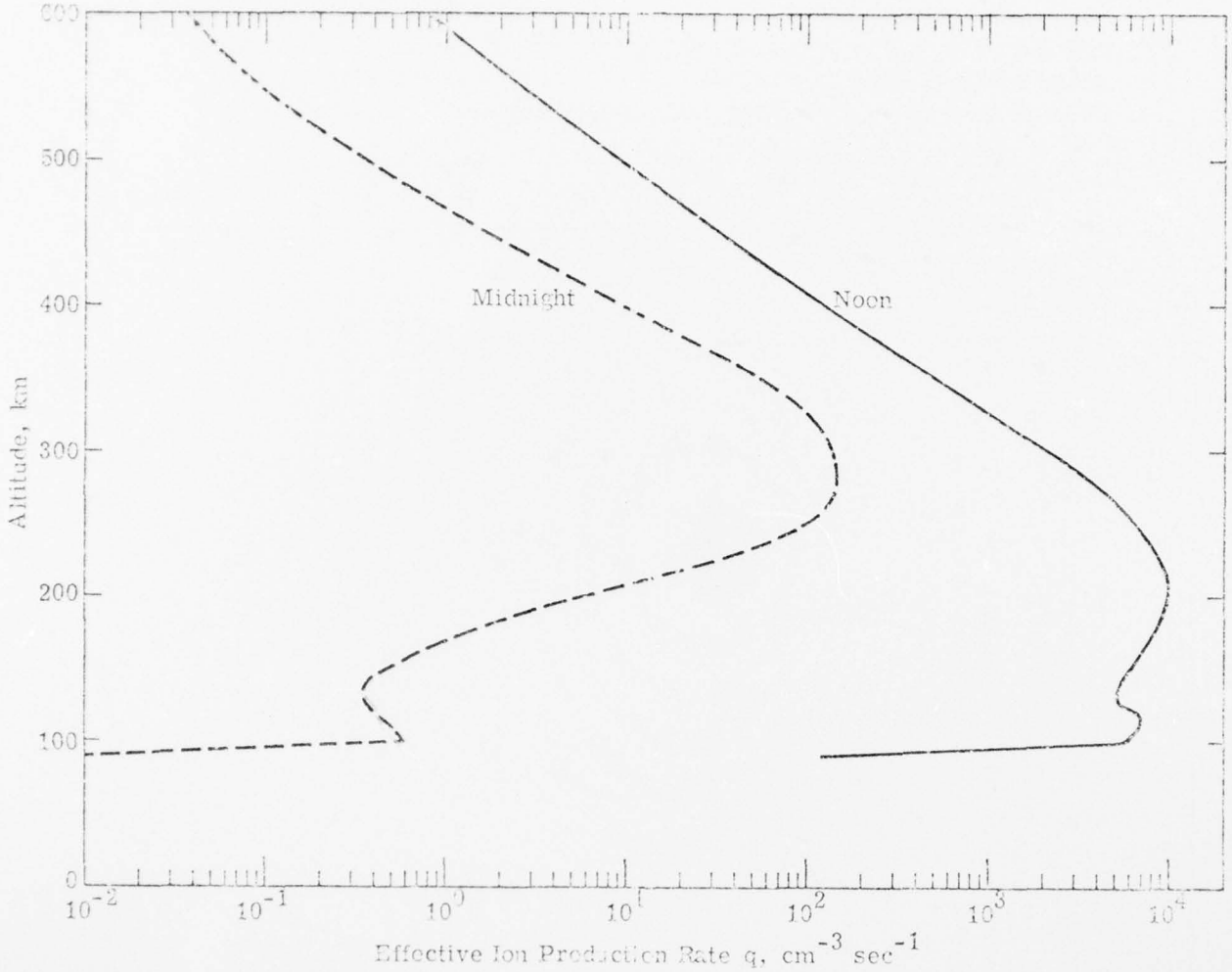

Fig. 15. E- and F-Region Effective Ion Production Rates. The values shown are IONOSU-computed steady-state values for the prescribed electron density profiles in Fig. 12 and for approximately average solar-flux conditions ($\overline{S} \approx 158 \times 10^{-22}$ W m^{-2} Hz^{-1}).

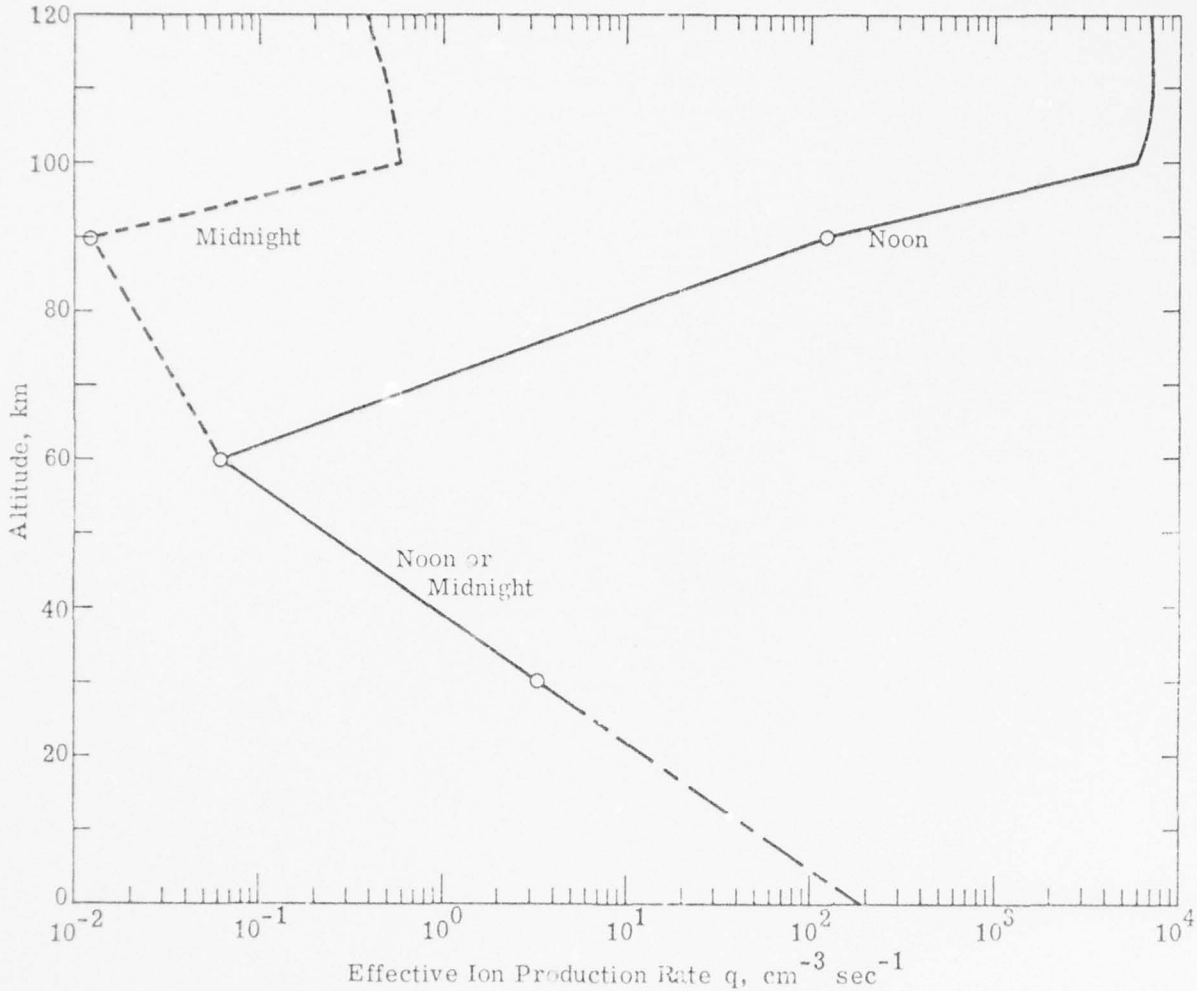

Fig. 16. D-Region Effective Ion Production Rates. The values shown are IONOSU-computed fit functions required to pass through adopted data-base values at 30- and 60-km altitude and to join the IONOSU E- and F-region values at 90-km altitude. The extrapolation below 30-km altitude is purely for modeling convenience.

Table 22. 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-km altitude and nighttime value of q from E- and F-region model at 90-km altitude

6. DRIVER, LISTING OF COMPUTER PROGRAM, AND SAMPLE PROBLEM RESULTS

A short driver routine 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, a set of test altitudes, and the number of such altitudes. Input quantities are more specifically described below in Table 23. The driver, after reading and writing the input, first initializes the ATMOSU routine by the call ATMOSU(1, 120.). The driver next loops over the test-altitude array, exercises the ATMOSU, SPCMIN, and IONOSU routines for each altitude, and prints out 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 M^+ in row-one computed by IONOSU. Subroutine CHEMQ, prepared by Knapp and Jordano [see Vol. II] for use with the NRL Simple-Chemistry module, computes steady-state ionization for the E- and F-region.

Table 23. Input Quantities to DRIVER

a.	NALTS (FORMAT-I5)	- Number of test altitude values
b.	ALTA(I)	- Test altitude values (km), eight values per card; NALTS values in total
	(FORMAT-8F10.2)	
c.	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)
	(FORMAT 3I5. 3E10.4)	

```
 53        WRITE(6,2002)(I,ALTS(I),I=1,NALTS)                                  DRIVER,58
 2002 FORMAT (5X,6(I8,2X,F10.2))                                               DRIVER,59
 71        WRITE(6,2004)  IYRS,IMONS,IDAYS,ZT,GCD,GLD                          DRIVER,60
 2004 FORMAT (///,8H  IYRS =I5,10H    IMONS =I5,10H    IDAYS =I5/             DRIVER,61
     * 8H     ZT =E12.4,14H HRS      GCD =E12.4,14H DEG      GLD =F12.4,     DRIVER,62
     * 4H DEG)                                                                DRIVER,63
C          CONVERT GCD AND GLD FROM DEGREES TO RADIANS.                       DRIVER,64
112       GCD = GCD*RADDEG                                                    DRIVER,65
113       GLD = GLD*RADDEG                                                    DRIVER,66
C          IDENTIFY THE GRID ORIGIN AS THE POINT P.                           DRIVER,67
114       PLAT = PID2-GCD                                                     DRIVER,68
116       PLON = GLD                                                          DRIVER,69
C                                                                             DRIVER,70
C  *  *  INITIALIZE THE ATMOSU ROUTINE                                       DRIVER,71
C                                                                             DRIVER,72
117       WRITE(6,8020)                                                       DRIVER,73
 8020 FORMAT(//20H INITIALIZATION CALL,//)                                    DRIVER,74
C                                                                             DRIVER,75
123       CALL ATMOSU(1,120.)                                                 DRIVER,76
C                                                                             DRIVER,77
125       WRITE(6,2006)  IYRS,IMONS,IDAYS,ZT,GCD,GLD                          DRIVER,78
 2006 FORMAT (///,8H  IYRS =I5,10H    IMONS =I5,10H    IDAYS =I5/             DRIVER,79
     * 8H     ZT =E12.4,14H HRS      GCD =E12.4,14H RAD      GLD =F12.4,     DRIVER,80
     * 4H RAD)                                                                DRIVER,81
145       WRITE(6,2005)  IDORN,UT,GAT,PLAT,PLON                               DRIVER,82
 2005 FORMAT (///,8H IDORN =I5,10H      UT =E12.4,10H      GAT =E12.4,10H     DRIVER,83
     *   PLAT =E12.4,10H     PLON =E12.4)                                      DRIVER,84
163       WRITE(6,2003)HL,SRAR                                                DRIVER,85
 2003 FORMAT(///,5H HL =,F10.3,5X,7H SRAR =,F10.3)                            DRIVER,86
C                                                                             DRIVER,87
C  *  *  LOOP OVER TEST ALTITUDES                                            DRIVER,88
C                                                                             DRIVER,89
173       WRITE(6,8002)                                                       DRIVER,90
 8002 FORMAT (1H0,129H      ALT         N2          O2           O           DRIVER,91
     * AR          HE          CO2          E          O+          M+        DRIVER,92
     *      QDEF    /10X,9(5X,4H1/CC,3X),2X,10H1/(CC SEC))                   DRIVER,93
177       WRITE(6,8003)                                                       DRIVER,94
 8003 FORMAT (1H0,9X,120H       N           NO          NO2        O2(SDG)   DRIVER,95
     *       O3          H2O          E          O+          M+             DRIVER,96
     * N+     /10X,10(5X,4H1/CC,3X))                                         DRIVER,97
203       WRITE(6,8004)                                                       DRIVER,98
 8004 FORMAT (1H0,9X,72H    PRESSURE     FEHSEQ       DENSITY     DEN SC HTDRIVER,99
     *       TEMP        E TEMP  /10X,72H DYNES/CM**2                GRAMS/CDRIVER,100
     *C         KM          DEG K        DEG K  )                           DRIVER,101
207       DO 50 I=1,NALTS                                                     DRIVER,102
211       ZH = ALTS(I)                                                        DRIVER,103
213       CALL ATMOSU(2,ZH)                                                   DRIVER,104
215       CALL SPCMIN(2,ZH)                                                   DRIVER,105
217       CALL IONOSU(2,ZH)                                                   DRIVER,106
221       ENEO = 0.0                                                          DRIVER,107
222       UPO  = 0.0                                                          DRIVER,108
223       ENPO = 0.0                                                          DRIVER,109
223       IF( ZH.LT.90. )  GO TO 45                                           DRIVER,110
226       CN2 = SNI(1)                                                        DRIVER,111
227       CO2 = SNI(2)                                                        DRIVER,112
230       CO = SNI(3)                                                         DRIVER,113
232       CNO = SNI(8)                                                        DRIVER,114
233       CNOS = SNI(7)                                                       DRIVER,115
235       CN2D = 1.0                                                          DRIVER,116
236       CNP = 0.0                                                           DRIVER,117
237       COP = 0.0                                                           DRIVER,118
240       CENE = 0.0                                                          DRIVER,119
240       TV = TX                                                             DRIVER,120
242       TE = TX                                                             DRIVER,121
```

```
242         TG = TT                                                          DRIVER,122
244         CALL CHEMQ(QDEE,ENPQ,OPQ,ENEQ)                                   DRIVER,123
247      45 EMPQ = ENEQ-OPQ-ENPQ                                             DRIVER,124
252         WRITE(6,8005)  7H,(SNI(J),J=1,6),(SNI(J),J=9,11),QDEE,SNI(7),    DRIVER,125
           *                SNI(8),SNI(15),SNI(13),SNI(14),SNI(16),ENEQ,OPQ,  DRIVER,126
           *                EMPQ,ENPQ,PP,PEMSEQ,RHO,HHQ,TT,SNI(12)            DRIVER,127
      8005 FORMAT (1X,F9.2,10E12.3/(10X,10E12.3))                            DRIVER,128
335      50 CONTINUE                                                         DRIVER,129
     C                                                                       DRIVER,130
340         WRITE(6,9050)                                                    DRIVER,131
      9050 FORMAT(//,20H END OF TEST PROBLEM)                                DRIVER,132
343         GO TO 1010                                                       DRIVER,133
344         END                                                              DRIVER,134
```

ATMOSU

```
      SUBROUTINE ATMOSU(JJ,ZH)                                          DRIVER.135
C                                                                       DRIVER.136
C         ATMOSU COMPUTES THE PROPERTIES OF THE UNDISTURBED ATMOSPHERE, DRIVER.137
C         GIVEN THE ALTITUDE ZH, AFTER ASSOCIATED SUBROUTINES COMPUTE   DRIVER.138
C         THE LOCAL APPARENT TIME HL, SOLAR FLUX SBAR, AND DAY-OR-NIGHT DRIVER.139
C         PARAMETER IDORN.                                              DRIVER.140
C         ATMOSU IS REVISION 09 (06/02/75) OF ATMOS DEVELOPED BY R. K.  DRIVER.141
C         LOWEN (SEE, AN AMBIENT ATMOSPHERE MODEL FOR ROSCOE, P. 187,   DRIVER.142
C         VOL. 5 OF PROC. DNA 1973 ATMOSPHERIC EFFECTS SYMPOSIUM, DNA   DRIVER.143
C         3131P-5, 5 JUNE 1973.)                                        DRIVER.144
C         REVISION 02 (06/07/74) PROVIDES                               DRIVER.145
C            1. IN HIGH-ALTITUDE MODEL, FOR USE OF GAF(120.) INSTEAD OF DRIVER.146
C               GAF(0.) = GZ IN COMPUTING GAM AND ZZ.                  DRIVER.147
C            2. DENSITY SCALE HEIGHT FOR BOTH LOW- AND HIGH-ALTITUDE    DRIVER.148
C               MODELS, WITH AN AD HOC PARABOLIC TRANSITION FROM 110- TODRIVER.149
C               120-KM ALTITUDE TO PROVIDE A CONTINUOUS DENSITY SCALE  DRIVER.150
C               HEIGHT ACROSS THE BOUNDARY BETWEEN THE TWO MODELS.     DRIVER.151
C            3. ALTERED FORMULA FOR O DENSITY ON FIRST CALL AND AT LOW  DRIVER.152
C               ALTITUDE SO AS TO USE SF-FUNCTION DIRECTLY.            DRIVER.153
C            4. COMMENT CARDS.                                         DRIVER.154
C         REVISION 03 (10/25/74) PROVIDES                               DRIVER.155
C            5. PROVISION FOR DAY OR NIGHT VALUES OF ATOMIC OXYGEN      DRIVER.156
C               (OBTAINED FROM THE MINOR SPECIES SUBROUTINE SPCMIN)    DRIVER.157
C               FOR ALTITUDES BELOW 120 KM.                            DRIVER.158
C            6. AUTOMATED PROCEDURE FOR EVALUATING CONSTANTS IN DENSITY DRIVER.159
C               SCALE-HEIGHT FORMULA USED IN THE 110- TO 120-KM        DRIVER.160
C               TRANSITION REGION.                                     DRIVER.161
C            7. PROCEDURE FOR LETTING SOLAR FLUX SBAR, AN INPUT TO      DRIVER.162
C               ATMOSU, BE DETERMINED BY THE AUXILIARY ROUTINE SOLCYC. DRIVER.163
C            8. PROCEDURE FOR LETTING THE LOCAL (APPARENT) TIME HL,     DRIVER.164
C               AN INPUT TO ATMOSU, BE DETERMINED BY THE AUXILIARY     DRIVER.165
C               SUBROUTINE SOLORB.                                     DRIVER.166
C            9. PROCEDURE FOR LETTING THE DAY OR NIGHT PARAMETER IDORN  DRIVER.167
C               BE DETERMINED BY THE AUXILIARY SUBROUTINE SOLZEN.      DRIVER.168
C         REVISION 04 (12/08/74) PROVIDES                               DRIVER.169
C           10. CARBON DIOXIDE AS THE SIXTH SPECIES IN ATMOSU, WITH     DRIVER.170
C               PROFILE SPECIFIED BY R. F. MYERS ON 12/07/74.          DRIVER.171
C           11. EVALUATION OF DEPARTURE FROM HYDROSTATIC EQUILIBRIUM,   DRIVER.172
C           12. A FLAG, ZHFLAG, TO INSURE THAT SUBROUTINES IONOSU AND   DRIVER.173
C               SPCMIN ARE CALLED AT THE SAME ALTITUDE AT WHICH ATMOSU  DRIVER.174
C               WAS LAST CALLED.                                       DRIVER.175
C           13. DAY AND NIGHT PROFILES OF ATOMIC OXYGEN SPECIFIED BY    DRIVER.176
C               R. F. MYERS ON 11/09/74 AND 11/23/74, RESPECTIVELY.    DRIVER.177
C           14. CORRECTED PROCEDURE FOR EVALUATING CONSTANTS IN DENSITY DRIVER.178
C               SCALE-HEIGHT FORMULA USED IN THE 110- TO 120-KM        DRIVER.179
C               TRANSITION REGION.                                     DRIVER.180
C           15. CORRECTED CONSTANT IN LOW-ALTITUDE FORMULA FOR DENSITY  DRIVER.181
C               SCALE HEIGHT.                                          DRIVER.182
C         REVISION 05 (02/04/75) PROVIDES                               DRIVER.183
C           16. INTERFACE WITH SPCMIN WHICH NOW COMPUTES DENSITIES OF   DRIVER.184
C               H2O, N, NO, NO2, O2(SINGLET DELTA G), AND O3.          DRIVER.185
C           17. INTERFACE WITH IONOSU WHICH NOW COMPUTES THE EFFECTIVE  DRIVER.186
C               ION PRODUCTION RATE AT ALL ALTITUDES.                  DRIVER.187
C         REVISION 06 (04/08/75) PROVIDES                               DRIVER.188
C           18. REVISED NIGHT PROFILE OF ATOMIC OXYGEN SPECIFIED BY     DRIVER.189
C               R.F.. MYERS ON 02/22/75 (MINOR CHANGE BELOW 60 KM).    DRIVER.190
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C           19. REVISED DAY AND NIGHT PROFILES OF NITRIC OXIDE                DRIVER.191
C               SPECIFIED BY R.F. MYERS ON 04/05/75.                          DRIVER.192
C           20. REVISED DAY AND NIGHT PROFILES OF ATOMIC NITROGEN             DRIVER.193
C               SPECIFIED BY R.F. MYERS ON 04/11/75.                          DRIVER.194
C         REVISION 07 (04/24/75) PROVIDES                                     DRIVER.195
C           21. REVISED PROCEDURE FOR SPECIFYING AND USING DATE OF THE        DRIVER.196
C               VERNAL EQUINOX (PER R. W. LOWEN (02/28/75)).                  DRIVER.197
C         REVISION 08 (05/23/75) PROVIDES                                     DRIVER.198
C           22. REVISED PROFILE OF WATER VAPOR SPECIFIED BY R. F. MYERS       DRIVER.199
C               ON 05/10/75.                                                  DRIVER.200
C         REVISION 09 (06/02/75) PROVIDES                                     DRIVER.201
C           23. CORRECTED FORMULA IN HIGH-ALTITUDE MODEL FOR EVALUATION       DRIVER.202
C               OF DEPARTURE FROM HYDROSTATIC EQUILIBRIUM.                    DRIVER.203
C         INPUT PARAMETERS                                                    DRIVER.204
C            ARGUMENT LIST                                                    DRIVER.205
C                JJ - CALCULATION FLAG                                        DRIVER.206
C                     = 1, CALCULATE INITIALIZATION PARAMETERS                DRIVER.207
C                     = 2, CALCULATE ATMOSPHERIC PROPERTIES                   DRIVER.208
C                ZH - ALTITUDE OF INTEREST (KM)                               DRIVER.209
C            ATMDUP COMMON                                                    DRIVER.210
C                     HL, SBAR, IDORN                                         DRIVER.211
C            TIME COMMON                                                      DRIVER.212
C                 IYRS, IMONS, IDAYS, ZT, PLAT, PLON                          DRIVER.213
C            ALTORN COMMON                                                    DRIVER.214
C                 NALTOD, ALTKM(47), ODAY(27), ONITE(18), CO2(25)             DRIVER.215
C         OUTPUT PARAMETERS                                                   DRIVER.216
C            ATMDUP COMMON                                                    DRIVER.217
C                     PP, RHO, TT, SNI(6), WRHO, FEHSEQ                       DRIVER.218
C            ALTORN COMMON                                                    DRIVER.219
C                     SIZEN                                                   DRIVER.220
C                                                                             DRIVER.221
      COMMON/ATMDUP/  HL,SBAR,IDORN,PP,RHO,TT,SNI(16),WRHO,FEHSEQ             DRIVER.222
      COMMON/TIME/  IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,GAT                      DRIVER.223
      COMMON/ALTORN/  NALTOD,ALTKM(47),ODAY(27),ONITE(18),SIZEN,CO2(25)       DRIVER.224
C                                                                             DRIVER.225
C         VARIABLES IN ATMDUP                                                 DRIVER.226
C               HL = LOCAL TIME, HRS                                          DRIVER.227
C             SBAR = AVER. 10.7-CM SOLAR FLUX, 1.E-22 W/(M**2 HZ)             DRIVER.228
C            IDORN = INDEX FOR DAY OR NIGHT. FOR 0 BELOW 120 KM, USE          DRIVER.229
C                    DAYTIME PROFILE IF(IDORN.GE.0) AND NIGHTTIME             DRIVER.230
C                    PROFILE IF(IDORN.LT.0)                                   DRIVER.231
C                PP = PRESSURE, DYNES/CM**2                                   DRIVER.232
C               RHO = DENSITY, G/CM**3                                        DRIVER.233
C                TT = TEMPERATURE, DEGREES KELVIN                             DRIVER.234
C            SNI(1) = N2,  1/CM**3  (FROM ATMOSU)                             DRIVER.235
C            SNI(2) = O2,  1/CM**3  (FROM ATMOSU)                             DRIVER.236
C            SNI(3) = O,   1/CM**3  (FROM ATMOSU)                             DRIVER.237
C            SNI(4) = AR,  1/CM**3  (FROM ATMOSU)                             DRIVER.238
C            SNI(5) = HE,  1/CM**3  (FROM ATMOSU)                             DRIVER.239
C            SNI(6) = CO2, 1/CM**3  (FROM ATMOSU)                             DRIVER.240
C            SNI(7) = N,   1/CM**3  (FROM SPCMIN)                             DRIVER.241
C            SNI(8) = NO,  1/CM**3  (FROM SPCMIN)                             DRIVER.242
C            SNI(9) = E,   1/CM**3  (FROM IONOSU)                             DRIVER.243
C           SNI(10) = O+,  1/CM**3  (FROM IONOSU)                             DRIVER.244
C           SNI(11) = M+,  1/CM**3  (FROM IONOSU)                             DRIVER.245
C           SNI(12) = TX,  DEG K    (FROM IONOSU)                             DRIVER.246
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C            SNI(13) = O2(1DG),  1/CM**3  (FROM SPCMIN)                      DRIVER,247
C            SNI(14) = O3,       1/CM**3  (FROM SPCMIN)                      DRIVER,248
C            SNI(15) = NO2,      1/CM**3  (FROM SPCMIN)                      DRIVER,249
C            SNI(16) = H2O,      1/CM**3  (FROM SPCMIN)                      DRIVER,250
C               HRHO = DENSITY SCALE HEIGHT, KM                              DRIVER,251
C             FEHSEN = FRACTIONAL ERROR IN HYDROSTATIC EQUILIBRIUM,          DRIVER,252
C                                                                            DRIVER,253
C                                                                            DRIVER,254
      COMMON/ZHCHEX/  ZHFLAG                                                 DRIVER,255
C                                                                            DRIVER,256
      DIMENSION  A(6),B(5),C(6),S(5),BB(3),AA(12),DD(13)                     DRIVER,257
      DIMENSION  SNIZ(6), SMI(6), ALP(6)                                     DRIVER,258
      DIMENSION  D(20,21),X(6),XC(7),ZIM2ON(5),ZION(5),ONZI(5)               DRIVER,259
      DIMENSION  ZIM1O(5),ZIO2(5),O2ZI(5)                                    DRIVER,260
      DIMENSION  FDAY(27)                                                    DRIVER,261
C                                                                            DRIVER,262
C          DEFINITIONS OF DATA QUANTITIES                                    DRIVER,263
C              BIGMS = SEA-LEVEL MEAN MOLECULAR WEIGHT, G/MOLE               DRIVER,264
C                 PZ = SEA-LEVEL PRESSURE, DYNES/CM**2                       DRIVER,265
C               BIGA = AVOGADRO NUMBER, PARTICLES/MOLE                       DRIVER,266
C                 RR = UNIVERSAL GAS CONSTANT, ERG/(MOLE DEG-K)              DRIVER,267
C                      (SET IN SUBROUTINE, RR=SK*BIGA)                       DRIVER,268
C                                                                            DRIVER,269
      DATA  BIGMS,PZ,BIGA / 28.96,1.01325E+06,6.022169E+23 /                 DRIVER,270
C                                                                            DRIVER,271
C                 SK = BOLTZMANN CONSTANT, ERG/(DEG-K)                       DRIVER,272
C               NDEG = DEGREE OF POLYNOMIAL TO BE FITTED FOR THE             DRIVER,273
C                      DAYTIME O PROFILE                                     DRIVER,274
C                                                                            DRIVER,275
C          CAUTION ----  NDEG MUST NOT EXCEED 12 WITHOUT MAKING             DRIVER,276
C                        APPROPRIATE CHANGES IN PROGRAM,                     DRIVER,277
      DATA  PI,SK / 3.141592653590,1.380622E-16 / , NDEG / 12 /              DRIVER,278
C                                                                            DRIVER,279
C                GZ = SEA-LEVEL GRAVITATIONAL ACCELERATION, CM/SEC**2        DRIVER,280
C                RE = RADIUS OF SPHERICAL EARTH, KM                          DRIVER,281
C                                                                            DRIVER,282
      DATA  GZ, RE / 980.621, 6.36765E+03 /                                  DRIVER,283
C                                                                            DRIVER,284
C                TS = TOTAL NUMBER OF SPECIES                                DRIVER,285
C             SMI(I) = MASS OF N2, O2, O, AR, HE, AND CO2,  GRAMS            DRIVER,286
C                                                                            DRIVER,287
      DATA  IS, (SMI(I),I=1,6) /  6, 4.6517E-23, 5.3135E-23, 2.6567E-23,     DRIVER,288
     *                            6.6335E-23, 6.6464E-24, 7.3080E-23/        DRIVER,289
C                                                                            DRIVER,290
C             ALP(I) = THERMAL DIFFUSION COEFFICIENT                         DRIVER,291
C                                                                            DRIVER,292
      DATA  (ALP(I),I=1,6) /  4*0.0, -0.40, 0.0 /                            DRIVER,293
C                                                                            DRIVER,294
C                                                                            DRIVER,295
C          COEFFICIENTS G-SUB-K FOR G/TM                                     DRIVER,296
C                                                                            DRIVER,297
      DATA  (AA(I),I=1,12) /  3.39543882E+00,  2.63451493E-02,               DRIVER,298
     *                        2.34156416E-02, -2.74474436E-03,               DRIVER,299
     *       1.43387285E-04, -4.34694163E-06,  8.17220927E-08,               DRIVER,300
     *      -9.59552213E-10,  6.82335587E-12, -2.68405784E-14,               DRIVER,301
     *       4.47990722E-17,  0.0 /                                          DRIVER,302
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C                                                                       DRIVER.303
C  * * *  ARITHMETIC STATEMENT FUNCTIONS TO CALCULATE                   DRIVER.304
C  * * *  G/TM, INTEGRAL OF G/TM, AND G.                                DRIVER.305
C                                                                       DRIVER.306
      GDTMAF( AQ ) = ((((((((((  AA(12)*AQ + AA(11))*AQ + AA(10))*AQ    DRIVER.307
     *           + AA(9))*AQ + AA(8))*AQ + AA(7))*AQ + AA(6))*AQ        DRIVER.308
     *           + AA(5))*AQ + AA(4))*AQ + AA(3))*AQ + AA(2))*AQ + AA(1) DRIVER.309
C                                                                       DRIVER.310
      GTMIAF( AQ ) = ((((((((((AA(12)/12.*AQ + AA(11)/11.)*AQ           DRIVER.311
     *           + AA(10)/10.)*AQ + AA(9)/9.)*AQ + AA(8)/8.)*AQ         DRIVER.312
     *           + AA(7)/7.)*AQ + AA(6)/6.)*AQ + AA(5)/5.)*AQ           DRIVER.313
     *           + AA(4)/4.)*AQ + AA(3)/3.)*AQ + AA(2)/2.)*AQ + AA(1))*AQ DRIVER.314
C                                                                       DRIVER.315
      GAF( BQ ) = GZ/(1.0+BQ/RE)**2                                     DRIVER.316
CCC                                                                     DRIVER.317
C  * * *  ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE M/MSTAR DAY,  DRIVER.318
CCC                                                                     DRIVER.319
      SFDAF( BQ ) = EXP( ((((((((((DD(13)*BQ + DD(12))*BQ + DD(11))*BQ  DRIVER.320
     *           + DD(10))*BQ + DD(9))*BQ + DD(8))*BQ + DD(7))*BQ       DRIVER.321
     *           + DD(6))*BQ + DD(5))*BQ + DD(4))*BQ + DD(3))*BQ        DRIVER.322
     *           + DD(2))*BQ + DD(1) )                                  DRIVER.323
CCC                                                                     DRIVER.324
C  * * *  ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE DENSITY SCALE DRIVER.325
C  * * *  HEIGHT (KM).                                                 DRIVER.326
CCC                                                                     DRIVER.327
      GKKZAF( AQ ) = ((((((((( AA(12)*11.*AQ + AA(11)*10.)*AQ           DRIVER.328
     *           + AA(10)*9.)*AQ + AA(9)*8.)*AQ + AA(8)*7.)*AQ          DRIVER.329
     *           + AA( 7)*6.)*AQ + AA(6)*5.)*AQ + AA(5)*4.)*AQ          DRIVER.330
     *           + AA( 4)*3.)*AQ + AA(3)*2.)*AQ + AA(2)                 DRIVER.331
CCC                                                                     DRIVER.332
C          STATEMENTS 100 TO 200-1 ARE DONE JUST ONCE, ON A CALL TO     DRIVER.333
C          ATMOSU(1,120), TO SET UP NEEDED PARAMETERS AND TO EVALUATE   DRIVER.334
C          SOLAR-FLUX-DEPENDENT FOURIER COEFFICIENTS USED IN COMPUTING  DRIVER.335
C          THE TIME-DEPENDENT VALUES OF TAU, THE VARIABLE CONTROLLING THEDRIVER.336
C          TEMPERATURE GRADIENT AT THE LOWER BOUNDARY, TIF, THE         DRIVER.337
C          EXOSPHERIC TEMPERATURE (SEE J. S. NISBET, RADIO SCIENCE VOL, DRIVER.338
C          6, P. 437 (1971)), AND THE COEFFICIENTS IN THE PARABOLIC     DRIVER.339
C          TRANSITION FUNCTION FOR THE DENSITY SCALE-HEIGHT BETWEEN     DRIVER.340
C          THE LOW- AND HIGH-ALTITUDE MODELS,                           DRIVER.341
C          SUBSEQUENT CALLS, TO ATMOSU(2,ZH),   GO TO STATEMENT 200     DRIVER.342
C          WHEREAFTER A LOW-ALTITUDE MODEL IS USED FOR ALTITUDES ZH     DRIVER.343
C          LESS THAN 120 KM AND A HIGH-ALTITUDE MODEL IS USED OTHERWISE, DRIVER.344
      GO TO (100,200), JJ                                               DRIVER.345
CCC                                                                     DRIVER.346
CCC         INITIALIZATION                                              DRIVER.347
CCC                                                                     DRIVER.348
  172   100 RR = SK*BIGA                                               DRIVER.349
  174       CC1 = 1.0E+05*BIGMS/RR                                      DRIVER.350
C           COMPUTE GRAV. ACCEL. G, G DIVIDED BY MOL. SCALE TEMP. TM, AND DRIVER.351
C           INTEGRAL OF G/TM AT 120 KM.                                 DRIVER.352
  176       GG = GAF( ZH )                                              DRIVER.353
  177       GDTM = GDTMAF( ZH )                                         DRIVER.354
  201       GTMI = GTMIAF( ZH )                                         DRIVER.355
C           COMPUTE PRESSURE, DENSITY, AND TEMPERATURE AT 120 KM        DRIVER.356
C           ACCORDING TO THE LOW-ALTITUDE MODEL.  THESE VALUES PROVIDE  DRIVER.357
C           THE BOUNDARY CONDITIONS AT 120 KM FOR THE HIGH-ALTITUDE MODEL.DRIVER.358
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203         PP = PZ*EXP(-CC1*GDTMT + 9.4144E-08*ZH**2.833)                    DRIVER.359
215         RHO = BIGMS*GDTM/RH*PP/GG                                         DRIVER.360
      C         NOW CALL THE 6 AUXILIARY ROUTINES.                          DRIVER.361
221         CALL ZTTOUT                                                       DRIVER.362
222         CALL JULIAN(IYRS,IMONS,IDAYS,YREJ,VEGJ,DAYJ)                      DRIVER.363
226         CALL SOLCYC(DAYJ)                                                 DRIVER.364
230         CALL SOLORB(YREJ,VEGJ,DAYJ,SOLLAT,SOLLON)                         DRIVER.365
234         CALL SOLZEN(SOLLAT,SOLLON)                                        DRIVER.366
236         CALL SPCMIN(1,ZH)                                                 DRIVER.367
      C         COMPUTE M/MSTAR (DEPENDS ON DAY OR NIGHT PROFILE OF O, IN   DRIVER.368
      C         PRINCIPLE, BUT WE COMPUTE IT ONLY FOR DAY) AFTER COMPUTING   DRIVER.369
      C         COEFFICIENTS DD(I).                                         DRIVER.370
241         BA2RR = 2.*BIGA/RR                                                DRIVER.371
244         DO 104 N=1,NALTOD                                                 DRIVER.372
247         WZZ = ALTKM(N)                                                    DRIVER.373
250         WGG = GAF( WZZ )                                                  DRIVER.374
252         WGDTM = GDTMAF( WZZ )                                             DRIVER.375
254         WPP = PZ*EXP(-CC1*GTMIAF( WZZ ) + 9.4144E-08*WZZ**2.833)          DRIVER.376
271         RMARHO = WGG/(BA2RR*WPP*WGDTM)                                    DRIVER.377
273         FDAY(N)  = RMARHO*DDAY(N)                                         DRIVER.378
300     104 CONTINUE                                                          DRIVER.379
303         DO 106 I=1,13                                                     DRIVER.380
307         DD(I) = 0.0                                                       DRIVER.381
310     106 CONTINUE                                                          DRIVER.382
311         CALL FITTER(NALTOD,ALTKM,FDAY,NDEG, 1 , 2 , DD)                   DRIVER.383
      C         USING DAY 0 PROFILE                                         DRIVER.384
317         SF = SFDAF( ZH )                                                  DRIVER.385
323         RMRMS = 1.0/( 1. + SF )                                           DRIVER.386
325         TZ    = RMRMS*GG/GDTM                                             DRIVER.387
      C         COMPUTE THE SPECIES NUMBER DENSITIES AT 120 KM.             DRIVER.388
      C         COMPUTE TOTAL NUMBER DENSITY,N(1/CM**3)                     DRIVER.389
330         SN = BIGA/BIGMS*RHO/RMBMS                                         DRIVER.390
      C         COMPUTE TOTAL NUMBER DENSITY IF NO DISSOCIATION,NSTAR(1/CM**3)DRIVER.391
333         SNS = BIGA*RHO/BIGMS                                              DRIVER.392
      C         COMPUTE DENSITIES (1/CM**3) OF N2, O2, O, AR, HE, AND CO2.  DRIVER.393
334         SNI7(1) = 0.78*SNS                                                DRIVER.394
335         SNI7(2) = 1.211*SNS - SN                                          DRIVER.395
340         SNI7(3) = 2.*SNS*SF                                               DRIVER.396
342         SNI7(4) = 0.009*SNS                                               DRIVER.397
343         SNI7(5) = 4.625E-05*SNS                                           DRIVER.398
345         SNI7(6) = CO2(25)                                                 DRIVER.399
      C                                                                       DRIVER.400
346         RE120 = RE+120.                                                   DRIVER.401
350         GGSK = GG/SK                                                      DRIVER.402
352         CC = PI*HL/12.                                                    DRIVER.403
355         FF = SBAR                                                         DRIVER.404
      C         COMPUTE FOURIER COEFFICIENTS USED FOR TAU AT 120 KM.         DRIVER.405
357         A(1) = +2.210158E-02 - 1.970030E-05 * FF                          DRIVER.406
361         A(2) = +6.712358E-03 - 1.181107E-05 * FF                          DRIVER.407
364         A(3) = +2.748180E-04 + 3.390522E-07 * FF                          DRIVER.408
367         A(4) = -5.663477E-04 + 8.669016E-07 * FF                          DRIVER.409
371         A(5) = -4.652258E-05 + 2.322930E-07 * FF                          DRIVER.410
374         A(6) = +8.984354E-05 - 1.128157E-07 * FF                          DRIVER.411
376         B(1) = -5.407398E-03 + 1.900959E-05 * FF                          DRIVER.412
401         B(2) = -5.428597E-04 + 4.101313E-06 * FF                          DRIVER.413
403         B(3) = -2.518983E-04 - 5.341112E-07 * FF                          DRIVER.414
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406         A(4) = -1.380845E-04 + 2.075324E-07 * FF                          DRIVER.415
410         A(5) = +1.358994E-04 + 3.931811E-07 * FF                          DRIVER.416
      C         COMPUTE FOURIER COEFFICIENTS USED FOR TIF.                    DRIVER.417
413         C(1) = +5.443538E+02 + 4.328897E+00 * FF                          DRIVER.418
415         C(2) = -1.179819E+02 - 6.495360E-01 * FF                          DRIVER.419
420         C(3) = +3.115091E+01 - 4.766818E-02 * FF                          DRIVER.420
422         C(4) = +4.069323E+00 + 4.154682E-02 * FF                          DRIVER.421
425         C(5) = -6.389061E+00 + 1.415760E-02 * FF                          DRIVER.422
427         C(6) = +1.045482E+00 - 1.995652E-02 * FF                          DRIVER.423
432         S(1) = -1.138663E+01 - 7.298749E-01 * FF                          DRIVER.424
434         S(2) = +1.359668E+01 + 2.815729E-03 * FF                          DRIVER.425
437         S(3) = +9.859158E-01 + 8.138881E-02 * FF                          DRIVER.426
441         S(4) = +7.041132E-01 - 1.151708E-02 * FF                          DRIVER.427
444         S(5) = -2.925315E-01 - 4.625236E-02 * FF                          DRIVER.428
      C         COMPUTE TAU (1/KM) AND TIF (DEGREES KELVIN)                   DRIVER.429
446         TAU = A(1)                                                        DRIVER.430
450         TIF = C(1)                                                        DRIVER.431
452         DO 110 I=1,5                                                      DRIVER.432
453         FI = I                                                            DRIVER.433
454         SFI = SIN(CC*FI)                                                  DRIVER.434
457         CFI = COS(CC*FI)                                                  DRIVER.435
463         TAU = TAU + CFI*A(I+1) + SFI*B(I)                                 DRIVER.436
472     110 TIF = TIF + CFI*C(I+1) + SFI*S(I)                                 DRIVER.437
      C                                                                       DRIVER.438
      C         TO PROVIDE A CONTINUOUS DENSITY SCALE HEIGHT ACROSS THE       DRIVER.439
      C         BOUNDARY BETWEEN THE LOW- AND HIGH-ALTITUDE MODELS, WE USE A  DRIVER.440
      C         PARABOLIC TRANSITION FUNCTION,                                DRIVER.441
      C             HRHO = FHR120 * ZHM110**2 + SB * ZHM110 + HRO110          DRIVER.442
      C         WHERE                                                         DRIVER.443
      C           HRO110 = DENSITY SCALE HEIGHT AT 110 KM                     DRIVER.444
      C           ZHM110 = ZH-110.                                            DRIVER.445
      C            SB    = APPROXIMATE DERIVATIVE OF DENSITY SCALE HEIGHT     DRIVER.446
      C                    AT 110-KM ALTITUDE                                 DRIVER.447
      C                  = HR1105-HR1095                                      DRIVER.448
      C           HR1105 = DENSITY SCALE HEIGHT AT 110.5 KM,                  DRIVER.449
      C           HR1095 = DENSITY SCALE HEIGHT AT 109.5 KM,                  DRIVER.450
      C           FHR120 = (HRO120 - 10.*SB - HRO110)/(120.-110.)**2          DRIVER.451
      C         IN THIS INITIALIZATION CALL WE NEED TO COMPUTE THE DENSITY     DRIVER.452
      C         SCALE HEIGHT AT 120 KM, HRO120, ACCORDING TO THE HIGH-ALTITUDEDRIVER.453
      C         MODEL, WHICH DEPENDS ON HL AND SBAR, AND ALSO THE DENSITY     DRIVER.454
      C         SCALE HEIGHTS ACCORDING TO THE LOW-ALTITUDE MODEL AT 110 KM,  DRIVER.455
      C         110.5 KM, AND 109.5 KM.                                       DRIVER.456
      C         COMPUTE SMALL A,                                              DRIVER.457
500         SA = (TIF - TZ)/TIF                                               DRIVER.458
      C         COMPUTE COEFFICIENT OF M-SUB-I IN GAMMA-SUB-I                 DRIVER.459
502         GAMT = 1.0E+05*GGSK/(TIF*TAU)                                     DRIVER.460
505         RHO = 0.0                                                         DRIVER.461
506         DRODZN = 0.0                                                      DRIVER.462
507         DO 120 I=1,IS                                                     DRIVER.463
517         SNZSMI = SNIZ(I)*SMI(I)                                           DRIVER.464
520         GAM = GAMT*SMI(I)                                                 DRIVER.465
521         ALGAM1 = ALP(I) + GAM + 1.0                                       DRIVER.466
523         RHO = RHO + SNZSMI                                                DRIVER.467
525         DRODZN = DRODZN + SNZSMI*(GAM + ALGAM1*SA/(1.-SA))                DRIVER.468
531     120 CONTINUE                                                          DRIVER.469
532         HRO120 = RHO/DRODZN/TAU                                           DRIVER.470
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      C          COMPUTE DENSITY SCALE HEIGHT AT 110 KM.                          DRIVER
  534       GDTM = GDTMAF( 110. )                                                  DRIVER
  537       HR0110 = 1.0/(CC1*GDTM - 2.6670995ZE-07*110.0**1.833                   DRIVER
     *            - 2.0/(RE+110.0) - GKKZAF( 110.0 )/GDTM)                        DRIVER
      C          COMPUTE DENSITY SCALE HEIGHT AT 110.5 KM.                        DRIVER
  556       GDTM = GDTMAF( 110.5 )                                                 DRIVER
  557       HR1105 = 1.0/(CC1*GDTM - 2.6670995ZE-07*110.5**1.833                   DRIVER
     *            - 2.0/(RE+110.5) - GKKZAF( 110.5 )/GDTM)                        DRIVER
      C          COMPUTE DENSITY SCALE HEIGHT AT 109.5 KM.                        DRIVER
  576       GDTM = GDTMAF( 109.5 )                                                 DRIVER
  577       HR1095 = 1.0/(CC1*GDTM - 2.6670995ZE-07*109.5**1.833                   DRIVER
     *            - 2.0/(RE+109.5) - GKKZAF( 109.5 )/GDTM)                        DRIVER
  616       SH = HR1105-HR1095                                                     DRIVER
  620       FHR120 = 0.01*(HR0120 - 10.*SH - HR0110)                               DRIVER
  624       WRITE(6,8001)TIF,TAU                                                   DRIVER
     8001 FORMAT(//,7H TIF = ,E13.6,7H TAU = ,E13.6,//)                           DRIVER
      C                                                                           DRIVER
      C          AT NIGHTTIME, O DIFFERS FROM DAYTIME O ONLY BELOW ALTITUDE       DRIVER
      C          ZION(5) = 90 KM.  IF( ZH.LT.ZION(1)), WHERE ZION(1) = 60 KM,     DRIVER
      C          SNI(3) = ONZI(1) = ONITE(13) = 1.1  .                            DRIVER
      C          IF(ZH.GE.ZION(1) .AND. ZH.LT.ZION(2)), WHERE ZION(2) = 75 KM,    DRIVER
      C          SNI(3) = ONZI(2)*EXP(ZM2ON*ONSCHI)  WHERE                        DRIVER
      C              ONZI(2) = ONITE(16) = 4.90E+08                               DRIVER
      C                ZM2ON = ZH-ZION(2)                                         DRIVER
      C              ONSCHI = ALOG(ONZI(2)/ONZI(1))/(ZION(2)-ZION(1))             DRIVER
      C          IF(ZH.GT.ZION(2) .AND. ZH.LT.ZION(5))  WHERE ZION(5) = 90 KM,    DRIVER
      C          SNI(3) = 10.**(((((X(1)*ZM2ON + X(2))*ZM2ON + X(3))*ZM2ON        DRIVER
      C                        + X(4))*ZM2ON + X(5))*ZM2ON + X(6))                DRIVER
      C          WHERE THE CONSTANTS X(I),I=1,6 ARE DETERMINED SO THAT THE        DRIVER
      C          SLOPE OF ALOG10(SNI(3)) AT ZION(2) = 75 KM, DLOZ7Z, AND AT       DRIVER
      C          ZION(5) = 90 KM, DLOZ5Z, IS CONTINUOUS AND ALOG10(SNI(3))        DRIVER
      C          EQUALS THE NIGHTTIME VALUES FOR O AT ZION(2) = 75 ,              DRIVER
      C          ZION(3) = 80 , AND ZION(4) = 85 KM AND EQUALS THE DAYTIME        DRIVER
      C          VALUE FOR O AT ZION(5) = 90 KM, ALOG10(ODAY75).                  DRIVER
      C          THE NIGHTTIME O CONSTANTS ARE NOW SET.                           DRIVER
  836       ZION(1) = ALTKM(13)                                                    DRIVER
  838       ONZI(1) = ONITE(13)                                                    DRIVER
  840       DO 130 I=2,5                                                           DRIVER
  846       ZION(I) = ALTKM(I+14)                                                  DRIVER
  847       ONZI(I) = ONITE(I+14)                                                  DRIVER
  850     130 CONTINUE                                                             DRIVER
  851       ZH2 = ZION(5)                                                          DRIVER
      C          TO RESET ONZI(5) TO ITS PROPER VALUE WE NEED TO FIRST            DRIVER
      C          CALCULATE ODAYZ5...                                              DRIVER
      C                                                                           DRIVER
      C          COMPUTE GRAV. ACCEL. G, G DIVIDED BY MOL. SCALE TEMP. TM,        DRIVER
      C          AND INTEGRAL OF G/TM AT ALTITUDE ZH2.                            DRIVER
      C                                                                           DRIVER
  852       GG = GAF( ZH2 )                                                        DRIVER
  854       GDTM = GDTMAF( ZH2 )                                                   DRIVER
  856       GDTMI = GTMIAF( ZH2 )                                                  DRIVER
      C          COMPUTE PRESSURE AND DENSITY AT ALTITUDE ZH2                     DRIVER
  860       PP = PZ*EXP(-CC1*GDTMI + 9.4144E-08*ZH2**2.833)                        DRIVER
  872       RHO = RTGMS*GDTM/RR*PP/GG                                              DRIVER
      C          COMPUTE M/MSTAR DAY AT ALTITUDE ZH2                              DRIVER
  878       SF = SFDAF( ZH2 )                                                      DRIVER
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      BMBMS = 1.0/(1. + SF)                                                  DRIVER,5
C          COMPUTE TOTAL NUMBER DENSITY, N(1/CM**3) AT ALTITUDE ZM2          DRIVER,5
      SN = BIGA/BIGMS*RHO/BMBMS                                              DRIVER,5
C          COMPUTE TOTAL NUMBER DENSITY IF NO DISSOCIATION,                  DRIVER,5
C          NSTAR (1/CM**3)                                                   DRIVER,5
      SNS = BIGA*RHO/BIGMS                                                   DRIVER,5
      ODAYZS = 2.*SNS*SF                                                     DRIVER,5
      ONZI(5) = ODAYZS                                                       DRIVER,5
      ONSCHI = ALOG(ONZI(2)/ONZI(1))/(ZION(2)-ZION(1))                       DRIVER,5
      DLOZZZ = ONSCHI*ALOG10( EXP(1.0) )                                     DRIVER,5
      X(5) = DLOZZZ                                                          DRIVER,5
      X(6) = ALOG10(ONZI(2))                                                 DRIVER,5
      DO 135 I=3,5                                                           DRIVER,5
      ZIM2ON(I) = ZION(I)*ZION(2)                                            DRIVER,5
  135 CONTINUE                                                               DRIVER,5
      DO 140 I=1,3                                                           DRIVER,5
      ZII2 = ZIM2ON(I+2)                                                     DRIVER,5
      D(I,4) = ZII2*ZII2                                                     DRIVER,5
      DO 140 J=1,3                                                           DRIVER,5
      D(I,4+J) = ZII2*D(I,5-J)                                               DRIVER,5
  140 CONTINUE                                                               DRIVER,5
      ZII5 = ZIM2ON(5)                                                       DRIVER,5
      D(4,4) = 2.*ZII5                                                       DRIVER,5
      DO 145 J=1,3                                                           DRIVER,5
      FJ1 = J+1                                                              DRIVER,5
      D(4,4+J) = ZII5*((FJ1+1.)/FJ1)*D(4,5-J)                                DRIVER,5
  145 CONTINUE                                                               DRIVER,5
      DO 150 I=1,3                                                           DRIVER,5
      D(I,5) = ALOG10(ONZI(I+2)) - X(5)*ZIM2ON(I+2) - X(6)                   DRIVER,5
  150 CONTINUE                                                               DRIVER,5
C          TO SET D(4,5) WE NEED THE DERIVATIVE OF ALOG10(SNI(3)) AT         DRIVER,5
C          ALTITUDE ZION(5) = 90 KM, DLOZSZ, GIVEN BY                        DRIVER,5
C             DLOZSZ = ALOG10( EXP(1.0) )*(D(SF)/DZ = 1.0/HRHO),             DRIVER,5
C          EVALUATED AT ZSON = ZION(5) = 90 KM,                              DRIVER,5
C          COMPUTE DENSITY SCALE HEIGHT AT 90 KM,                            DRIVER,5
      GDTM = GDTMAF( 90. )                                                   DRIVER,5
      HRO90 = 1.0/(CC1*GDTM - 2.6670995ZE-07*90.**1.833                      DRIVER,5
     *       - 2.0/(RE+90.) - GKKZAF( 90. )/GDTM)                            DRIVER,5
      ZSON = ZION(5)                                                         DRIVER,5
      DLOZSZ = ALOG10( EXP(1.0) )*(((((((((((12.*DD(13)*ZSON                 DRIVER,5
     *       + 11.*DD(12))*ZSON + 10.*DD(11))*ZSON + 9.*DD(10))*ZSON         DRIVER,5
     *       + 8.*DD(9))*ZSON + 7.*DD(8))*ZSON + 6.*DD(7))*ZSON              DRIVER,5
     *       + 5.*DD(6))*ZSON + 4.*DD(5))*ZSON + 3.*DD(4))*ZSON              DRIVER,5
     *       + 2.*DD(3))*ZSON + DD(2)) - 1.0/HRO90                           DRIVER,5
      D(4,5) = DLOZSZ-X(5)                                                   DRIVER,5
      NO = 4                                                                 DRIVER,5
      CALL SOLVE(D,X,NO)                                                     DRIVER,5
C          TO PROVIDE A CONTINUOUS TRANSITION IN THE CO2 DENSITY BETWEEN     DRIVER,5
C          THE ALTITUDE OF 100 KM, BELOW WHICH A CONSTANT MIXING RATIO       DRIVER,5
C          IS ASSUMED, AND THE ALTITUDE OF 120 KM, AT WHICH THE ATMOSU       DRIVER,5
C          HIGH-ALTITUDE MODEL (BASED ON DIFFUSIVE EQUILIBRIUM) BEGINS,      DRIVER,5
C          WE USE THE POLYNOMIAL                                             DRIVER,5
C             LOG10(SNI(6)) = SUM( XC(I)*ZM1CO2**(7-I)), I=1,7               DRIVER,5
C          WHERE THE CONSTANTS XC(I),I=1,7 , ARE DETERMINED SO THAT THE      DRIVER,5
C          SLOPE OF ALOG10(SNI(6)) AT ZICO2(1) = 100 KM, DLC71Z, AND         DRIVER,5
C          AT ZICO2(5) = 120 KM, DLCZ5Z, IS CONTINUOUS AND ALOG10(SNI(6))    DRIVER,5
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AD-A048 013 GENERAL RESEARCH CORP SANTA BARBARA CALIF F/G 4/1
THE ROSCOE MANUAL. VOLUME 14A. AMBIENT ATMOSPHERE (MAJOR AND MI--ETC(U)
JUN 75 D A HAMLIN, M R SCHOONOVER DNA001-74-C-0182
UNCLASSIFIED DNA-3964F-14A NL

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C          EQUALS THE VALUES FOR CO2 AT ZICO2(I) = 100,105,110,115, AND  DRIVER,583
C          120 KM FOR I=1,5 .                                            DRIVER,584
C          THE CO2 CONSTANTS ARE NOW SET...                              DRIVER,585
1124       DO 160 I=1,5                                                  DRIVER,586
1133       ZTCO2(I) = ALTKM(I+20)                                        DRIVER,587
1134       CO2ZI(I) = CO2(I+20)                                          DRIVER,588
1135   160 CONTINUE                                                      DRIVER,589
C          RESET CO2ZI(1) TO THE VALUE OBTAINED FROM THE LOW-ALTITUDE    DRIVER,590
C          MODEL AT ALTITUDE ZICO2(1) = 100 KM. TO DO THIS WE MUST FIRST DRIVER,591
C          COMPUTE GRAV. ACCEL. G, G DIVIDED BY MOL. SCALE TEMP. TM, AND DRIVER,592
C          INTEGRAL OF G/TM AT 100 KM.                                   DRIVER,593
C          COMPUTE GRAV. ACCEL. G, G DIVIDED BY MOL. SCALE TEMP. TM, AND DRIVER,594
C          INTEGRAL OF G/TM AT 100 KM                                    DRIVER,595
1136       GG = GAF( 100. )                                              DRIVER,596
1140       GDTM = GDTMAF( 100. )                                         DRIVER,597
1142       GDTMI = GTMTAF( 100. )                                        DRIVER,598
C          COMPUTE PRESSURE AND DENSITY AT 100 KM                        DRIVER,599
1144       PP = PZ*EXP(-CC1*GDTMT + 9.4144E-08*100.**2.833)              DRIVER,600
1157       RHO = BIGMS*GDTM/RR*PP/GG                                     DRIVER,601
C          COMPUTE TOTAL NUMBER DENSITY IF NO DISSOCIATION,              DRIVER,602
C          NSTAR, AT 100 KM.                                             DRIVER,603
1162       SNS = BIGA*RHO/BIGMS                                          DRIVER,604
1164       CO2ZI(1) = 3.20E-04 * SNS                                     DRIVER,605
1166       XC(7) = ALOG10(CO2ZI(1))                                      DRIVER,606
C          THE SLOPE OF ALOG10(SNI(6)) AT ALTITUDE ZICO2(1) = 100 KM,    DRIVER,607
C          DLCZ1Z, IS GIVEN BY DLCZ1Z = ALOG10(EXP(1.0))*((1./RHO)       DRIVER,608
C          *(D(RHO)/DZ)) = ALOG10(EXP(1.0))*(-1./HRHO).                  DRIVER,609
C          COMPUTE DENSITY SCALE HEIGHT AT 100 KM.                       DRIVER,610
1170       HRO100 = 1.0/(CC1*GDTM - 2.6670952E-07*100.**1.833            DRIVER,611
     *           = 2.0/(RE+100.) - GKKZAF( 100. )/GDTM)                  DRIVER,612
1210       DLCZ1Z = (-1.0/HRO100)*ALOG10( EXP(1.0) )                     DRIVER,613
1216       XC(6) = DLCZ1Z                                                DRIVER,614
1220       DO 164 I=2,5                                                  DRIVER,615
1226       ZIM1C(I) = ZICO2(I)-ZICO2(1)                                  DRIVER,616
1230   164 CONTINUE                                                      DRIVER,617
1231       DO 165 I=1,4                                                  DRIVER,618
1234       ZTI2 = ZIM1C(I+1)                                             DRIVER,619
1235       D(I,5) = ZTI2*ZTI2                                            DRIVER,620
1236       DO 165 J=1,4                                                  DRIVER,621
1242       D(I,5-J) = ZTI2*D(I,6-J)                                      DRIVER,622
1250   165 CONTINUE                                                      DRIVER,623
1253       ZTI5 = ZIM1C(5)                                               DRIVER,624
1254       D(5,5) = 2.*ZTI5                                              DRIVER,625
1256       DO 170 J=1,4                                                  DRIVER,626
1264       FJ1 = J+1                                                     DRIVER,627
1266       D(5,5-J) = ZTI5*((FJ1+1.)/FJ1)*D(5,6-J)                       DRIVER,628
1300   170 CONTINUE                                                      DRIVER,629
1301       DO 175 I=1,4                                                  DRIVER,630
1304       D(I,6) = ALOG10(CO2ZI(I+1)) - XC(6)*ZIM1C(I+1) - XC(7)        DRIVER,631
1314   175 CONTINUE                                                      DRIVER,632
1316       DLCZ5Z = ALOG10( EXP(1.0) )*TAU*(SA+SMI(6)*GAMI)/(SA-1.0)     DRIVER,633
1332       D(5,6) = DLCZ5Z-XC(6)                                         DRIVER,634
1333       NO = 5                                                        DRIVER,635
1335       CALL SOLVE(D,XC,NO)                                           DRIVER,636
C          COMPUTE N2 DENSITY AT 230-KM ALTITUDE FOR USE IN N-DENSITY    DRIVER,637
C          INITIALIZATION IN SUBROUTINE SPCMIN.                          DRIVER,638
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1337          ZZ = RE120*(ALTKM(47)-120.)/(RE+ALTKM(47))                    DRIVER,639
1343          ETZ = EXP(-TAU*ZZ)                                            DRIVER,640
1351          TTDTZ = ( TIF-(TIF-TZ)*ETZ )/TZ                               DRIVER,641
1355          GAM = GAMT*SMI(1)                                             DRIVER,642
1357          ALGAM1 = ALP(1)+GAM+1.0                                       DRIVER,643
1361          SIZZN = SNIZ(1)*ETZ**GAM/TTDTZ**ALGAM1                        DRIVER,644
      C           EVALUATE ATMOSPHERIC PROPERTIES AT 90-KM ALTITUDE PRIOR   DRIVER,645
      C           TO INITIALIZING IONOSU.                                   DRIVER,646
1371          ZHSAVE = ZH                                                   DRIVER,647
1372          ZH = 90.                                                      DRIVER,648
1374          JUMP = 0                                                      DRIVER,649
1375          GO TO 210                                                     DRIVER,650
1375      177 JUMP = 2                                                      DRIVER,651
      C           INITIALIZE IONOSU ROUTINE.                                DRIVER,652
1376          CALL IONOSU(1,ZH)                                             DRIVER,653
1402          ZH = ZHSAVE                                                   DRIVER,654
      C           SET ZHFLAG  (ARBITRARY NEGATIVE VALUE)                    DRIVER,655
1402          ZHFLAG = -20.                                                 DRIVER,656
1404          RETURN                                                        DRIVER,657
1404      200 CONTINUE                                                      DRIVER,658
1404          IF( ZH.EQ.ZHFLAG )  RETURN                                    DRIVER,659
      CCC                                                                   DRIVER,660
      C           AN ERRONEOUS CONDITION WILL OCCUR IF IONOSU OR SPCMIN IS   DRIVER,661
      C           CALLED WITH JJ=2 AND A GIVEN VALUE OF ZH IF ATMOSU HAS NOT DRIVER,662
      C           BEEN CALLED FIRST WITH JJ=2 AND FOR THE SAME VALUE OF ZH. DRIVER,663
      C           THE VARIABLE ZHFLAG IS USED TO DETECT THIS CONDITION AND   DRIVER,664
      C           TO MAKE THE REQUIRED CALL TO ATMOSU.                      DRIVER,665
      C           ZHFLAG IS INITIALIZED TO AN ARBITRARY NEGATIVE VALUE IN   DRIVER,666
      C           THE INITIALIZATION CALL TO ATMOSU.                        DRIVER,667
      CCC                                                                   DRIVER,668
1407          ZHFLAG = ZH                                                   DRIVER,669
1410      210 CONTINUE                                                      DRIVER,670
1410          REZHI = 1.0/( RE+ZH )                                         DRIVER,671
1412          IF( ZH .GE. 120. )  GO TO 250                                 DRIVER,672
      C                                                                     DRIVER,673
      CCCCCC      LOW-ALTITUDE MODEL (ZH .LT. 120.)                         DRIVER,674
      C                                                                     DRIVER,675
      C           COMPUTE GRAV. ACCEL. AT ALTITUDE ZH,   GG(CM/SEC**2).    DRIVER,676
1415          GG = GAF( ZH )                                                DRIVER,677
      C           COMPUTE GRAV. ACCEL. DIVIDED BY MOLECULAR-SCALE TEMPERATURE. DRIVER,678
1416          GDTM = GDTMAF( ZH )                                           DRIVER,679
      C           COMPUTE INTEGRAL OF G/TM.                                 DRIVER,680
1420          GDTMI = GTMIAF( ZH )                                          DRIVER,681
      C            COMPUTE FUNCTION NEEDED FOR DENSITY SCALE HEIGHT         DRIVER,682
1422          GKKZ = GKKZAF( ZH )                                           DRIVER,683
      C           COMPUTE PRESSURE (DYNES/CM**2)                            DRIVER,684
1424          PP = PZ*EXP(-CC1*GDTMI + 9.4144E-08*ZH**2.833)                DRIVER,685
      C           COMPUTE DENSITY (G/CM**3)                                 DRIVER,686
1436          RHO = BTGMS*GDTM/RR*PP/GG                                     DRIVER,687
      C           COMPUTE DENSITY SCALE HEIGHT (KM).                        DRIVER,688
1442          IF (ZH .GE. 110.) GO TO 230                                   DRIVER,689
1446          HRHO = 1.0/(CC1*GDTM - 2.66709952E-07*ZH**1.833 - 2.0*REZHI   DRIVER,690
             *       - GKKZ/GDTM)                                           DRIVER,691
1460          GO TO 240                                                     DRIVER,692
1462      230 ZHM110 = ZH - 110.                                            DRIVER,693
1463          HRHO = (EHR120*ZHM110 + 88)*ZHM110 + HRO110                   DRIVER,694
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      C          USING DAY O PROFILE                                          DRIVER,695
1467    240 SF = SFDAF( ZH )                                                   DRIVER,696
1472        BMBMS = 1.0/(1. + SF)                                              DRIVER,697
      C          COMPUTE TEMPERATURE (DEG K)                                  DRIVER,698
1474        TT = BMBMS*GG/GDTM                                                 DRIVER,699
      C          COMPUTE NUMBER DENSITIES OF SPECIES.  WE PRESCRIBE THE       DRIVER,700
      C          DAY-NIGHT DEPENDENCE OF O AND USE THE LOW-ALTITUDE MODEL TO  DRIVER,701
      C          COMPUTE THE ASSOCIATED SLIGHT DAY-NIGHT DEPENDENCE OF O2 .   DRIVER,702
1477        SNS = BIGA*RHO/BIGMS                                               DRIVER,703
1501        SN = SNS/BMBMS                                                     DRIVER,704
1502        SNI(1)  = 0.78*SNS                                                 DRIVER,705
1504        SNI(2)  = 1.211*SNS - SN                                           DRIVER,706
1506        SNI(3) = 2.*SNS*SF                                                 DRIVER,707
1510        IF( IDORN.GE.0 )  GO TO 245                                        DRIVER,708
      C          COMPUTE NIGHTTIME VALUE OF O                                 DRIVER,709
1512        IF( ZH.GE.ZSUN )  GO TO 245                                        DRIVER,710
1514        IF( ZH-ZION(2) )  242,242,241                                      DRIVER,711
1517    241 ZM2ON = ZH-ZION(2)                                                 DRIVER,712
1520        SNI(3) = 10.**(((((X(1)*ZM2ON + X(2))*ZM2ON + X(3))*ZM2ON          DRIVER,713
           *       + X(4))*ZM2ON + X(5))*ZM2ON + X(6))                        DRIVER,714
1534        GO TO 245                                                          DRIVER,715
1535    242 IF( ZH-ZION(1) )  244,243,243                                      DRIVER,716
1540    243 ZM2ON = ZH-ZION(2)                                                 DRIVER,717
1542        SNI(3) = ONZI(2)*EXP(ZM2ON*ONSCHI)                                 DRIVER,718
1547        GO TO 245                                                          DRIVER,719
1551    244 SNI(3) = ONZI(1)                                                   DRIVER,720
1553    245 SNI(4)  = 0.009*SNS                                                DRIVER,721
1555        SNI(5)  = 4.625E-05*SNS                                            DRIVER,722
1556        IF( ZH.LE.100. )  GO TO 24                                         DRIVER,723
1562        ZM1CO2 = ZH-ZICO2(1)                                               DRIVER,724
1563        SNI(6) = 10.**((((((XC(1)*ZM1CO2 + XC(2))*ZM1CO2 + XC(3))*ZM1CO2   DRIVER,725
           *       + XC(4))*ZM1CO2 + XC(5))*ZM1CO2 + XC(6))*ZM1CO2 + XC(7))   DRIVER,726
1601        GO TO 247                                                          DRIVER,727
1602    246 SNI(6) = 3.20E-04 * SNS                                            DRIVER,728
      C          COMPUTE FRACTIONAL ERROR FROM HYDROSTATIC EQUILIBRIUM...     DRIVER,729
      C          FEHSEQ = -1.0E-05*DPPDZH/(RHO*GG) - 1.0                      DRIVER,730
      C                 = -2.66709952E-12 * RR * ZH**1.833 / (BIGMS * GDTM)   DRIVER,731
      C          WHERE   2.66709952E-12 = 1.0E-05 * 2.833 * 9.4144E-08        DRIVER,732
1604    247 FEHSEQ = -2.66709952E-12 * RR * ZH**1.833 / (BIGMS * GDTM)         DRIVER,733
1613        IF( JUMP.EQ.0 )  GO TO 177                                         DRIVER,734
1615        RETURN                                                             DRIVER,735
      C                                                                        DRIVER,736
      CCCCCC     HIGH-ALTITUDE MODEL (ZH .GE. 120.)                            DRIVER,737
      C                                                                        DRIVER,738
      C          COMPUTE THE GEOPOTENTIAL ALTITUDE ABOVE 120 KM, ZZ(KM),      DRIVER,739
1615    250 CONTINUE                                                           DRIVER,740
1615        ZZ = RE120*(ZH-120.)*REZHI                                         DRIVER,741
      C          COMPUTE THE TEMPERATURE AT THE GEOPOTENTIAL ALTITUDE,TT(DEG K)DRIVER,742
1620        ETZ = EXP(-TAU*ZZ)                                                 DRIVER,743
1625        TT = TIF - (TIF-TZ)*ETZ                                            DRIVER,744
      C          COMPUTE RATIO OF TEMPERATURE TO TEMPERATURE AT 120 KM.       DRIVER,745
1630        TTOTZ = TT/TZ                                                      DRIVER,746
1630        PP = 0.0                                                           DRIVER,747
1631        RHO = 0.0                                                          DRIVER,748
1632        DRODZN = 0.0                                                       DRIVER,749
1633        DPPDZH = 0.0                                                       DRIVER,750
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1634          DO 260 I=1,IS                                                  DRIVER,751
      C           COMPUTE GAMMA-SUB-I.                                     DRIVER,752
1646          GAM = GAMT*SMI(I)                                            DRIVER,753
1647          ALGAM1 = ALP(I) + GAM + 1.0                                  DRIVER,754
      C           COMPUTE DENSITIES (1/CM**3) OF N2, O2, O, AR, HE, AND CO2. DRIVER,755
1651          SNI(I) = SNIZ(I)*ETZ**GAM / TTOTZ**ALGAM1                    DRIVER,756
      C           COMPUTE TOTAL NUMBER DENSITY (1/CM**3).                  DRIVER,757
1661          PP = PP + SNI(I)                                             DRIVER,758
      C           COMPUTE TOTAL MASS DENSITY (G/CM**3).                    DRIVER,759
1663          RHO = RHO + SMI(I)*SNI(I)                                    DRIVER,760
      C           COMPUTE A PORTION OF THE SPATIAL DERIVATIVE OF THE DENSITY. DRIVER,761
1664          SGAFT = SNI(I)*(GAM + ALGAM1*ETZ*(TTF-TZ)/TT)                DRIVER,762
1671          DRODZN = DRODZN + SGAFT*SMI(I)                               DRIVER,763
      C           COMPUTE A PORTION OF THE SPATIAL DERIVATIVE OF THE PRESSURE. DRIVER,764
1673      260 DPPDZH = DPPDZH + SGAFT                                      DRIVER,765
      C           COMPUTE SPATIAL DERIVATIVE OF PRESSURE.                  DRIVER,766
1675          DPPDZH = ( GAF( ZH )/GAMT ) *(SA*PP*ETZ - TT*DPPDZH/TTF)     DRIVER,767
      C           COMPUTE FRACTIONAL ERROR FROM HYDROSTATIC EQUILIBRIUM.   DRIVER,768
1707          FRHSEQ = -(DPPDZH/(RHO*GAF( ZH )) + 1.0)                     DRIVER,769
      C           COMPUTE PRESSURE (DYNES/CM**2).                          DRIVER,770
1714          PP = PP*TT*SK                                                DRIVER,771
      C           COMPUTE DENSITY SCALE HEIGHT (KM).                       DRIVER,772
1716          DRODZN = DRODZN*TAU*(RE120-ZZ)*RE7HI                         DRIVER,773
1722          HRHO = RHO/DRODZN                                            DRIVER,774
1724          RETURN                                                       DRIVER,775
1724          END                                                          DRIVER,776
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BLKCHM

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      BLOCK DATA BLKCHM                                                 DRIVER,777
C                                                                       DRIVER,778
      COMMON/CHEMR/  AR(66),  BR(66),  CR(66)                           DRIVER,779
C     FOR REACTION I, RATE = AR(I)(T/300)**BR(I)*EXP(-CR(I)/T)          DRIVER,780
C                                                                       DRIVER,781
C                                                                       DRIVER,782
      DATA AR/5.0E-10,3.0E-10,1.0E-12,4.0E-11,8.0E-10,1.0E-12,4.4E-12,  DRIVER,783
     1         1.2E-19,2.0E-11,6.0E-14,4.4E-12,1.2E-19,1.0E-7,3.0E-7,   DRIVER,784
     2         2.1E-13,2.4E-13,1.2E-17,1.0E-17,3.3E-12,6.9E-12,2.7E-11, DRIVER,785
     3         7.0E-11,1.3E-9,5.0E-10,2.5E-10,1.4E-29,2.7E-10,3.0E-10,  DRIVER,786
     4         1.4E-3,3.5E-31,2.1E-4,4.0E-10,4.4E-11,2.5E-10,1.8E-8,    DRIVER,787
     5         1.0E-11,5.0E-11,1.0E-11,6.2E-11,1.5E-11,8.3E-13,8.0E-10, DRIVER,788
     6         2.3E-9,4.0E-11,1.5E9,4.0E-12,7.2E-11,2.0E-7,5.6E-26,     DRIVER,789
     7         3.2E-28,1.6E-7,1.0E-6,1.3E-4,1.0E-26,1.3E-15,2.0E-10,    DRIVER,790
     8         2.0E-10,2.2E-10,2.0E-17,5.6E-29,7.3E-9,5.0E-7,9.0E-12,   DRIVER,791
     9         6.4E-12,1.0E-12,6.2E-6/                                  DRIVER,792
C                                                                       DRIVER,793
      DATA BR/    0.0,    0.0,    0.0,    0.0,    0.0,    0.0,  -0.75,  DRIVER,794
     1          -5.0,   -0.5,   +2.,       -0.75,   -5.0,   -1.0,   -1.0,DRIVER,795
     2          +0.5,   +0.5,   -0.35,  -1.0,    1.,     +0.5,    0.0,  DRIVER,796
     3           0.0,    0.0,    0.0,    0.0 ,  -1.0,   +0.5,   0.0,    DRIVER,797
     4         -1.98,   -1.5,   -1.71,   0.0,   -0.23,   0.0,   -0.97,   DRIVER,798
     5          0.0,   +0.15,   0.0,    -0.09,   0.0,   +0.4,   0.0,     DRIVER,799
     6         +0.62,   0.0,   +1.45,   0.0,   -0.4,   -0.5,   -1.5,     DRIVER,800
     7         -1.5,   -1.0,   0.0,    -3.0,   -2.5,   0.0,    0.0,     DRIVER,801
     8         -1.0,   0.0,   +3.0,    -1.6,   -.03,   -1.0,   0.0,     DRIVER,802
     9         -0.25,  0.0,   -1.5/                                     DRIVER,803
C                                                                       DRIVER,804
      DATA CR/    0.0,    0.0,    0.0, 2060.,    0.0,    0.0,    0.0,  DRIVER,805
     1            0.0,    0.0,  -900.,     0.0,    0.0,    0.0,    0.0,  DRIVER,806
     2         1900.,  4300.,    0.0,    0.0,  3150.,    0.0,    0.0,  DRIVER,807
     3           0.0, 2600.,     0.0, 3700.,   600.,  5590.,   0.0,     DRIVER,808
     4         7194.,   0.0,   6230.,   0.0,  2543.,   0.0,  2833.,     DRIVER,809
     5         0.0,  2771.,    0.0,  2821.,    0.0,  2167.,    0.0,     DRIVER,810
     6         2376.,   0.0,  2877.,    0.0,  6113.,    0.0,    0.0,     DRIVER,811
     7         0.0,  5420.,   2460.,   2300.,    0.0,    0.0,    0.0,   DRIVER,812
     8         0.0,   0.0,          4600.,   600.,  5142.,   0.0,   0.0,  DRIVER,813
     9         2320.,   0.0,   390./                                    DRIVER,814
C                                                                       DRIVER,815
      END                                                               DRIVER,816
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FITTER

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      SUBROUTINE FITTER(NPTS,X,Y,NO,IKIND,ISIGN,Z)                          DRIVER.A17
CCC                                                                         DRIVER.A18
C         SUBROUTINE FITTER USES THE METHOD OF LEAST SQUARES TO COMPUTE     DRIVER.A19
C         THE COEFFICIENTS, Z(J),J=1,NO IN A POLYNOMIAL OF DEGREE NO        DRIVER.A20
C         REPRESENTING THE DEPENDENT VARIABLE Y(I) (OR, OPTIONALLY, ITS     DRIVER.A21
C         NATURAL LOGARITHM) SPECIFIED (AND GIVEN EQUAL WEIGHTS) AT         DRIVER.A22
C         NPTS VALUES OF THE INDEPENDENT VARIABLE X(I).                     DRIVER.A23
CCC                                                                         DRIVER.A24
C     INPUT PARAMETERS                                                      DRIVER.A25
C               NPTS = NUMBER OF DATA POINTS                                DRIVER.A26
C               X(I) = VALUES OF THE INDEPENDENT VARIABLE, E.G.,            DRIVER.A27
C                      ALTITUDE, KM                                         DRIVER.A28
C               Y(I) = VALUES OF THE DEPENDENT VARIABLE, E.G., SPECIES      DRIVER.A29
C                      CONCENTRATION, 1./CM**3                              DRIVER.A30
C                 NO = DEGREE OF POLYNOMIAL TO BE FITTED                    DRIVER.A31
C              IKIND = INDEX FOR KIND OF EQUATION TO BE FITTED              DRIVER.A32
C                    = 1 IF EQUATION IS                                     DRIVER.A33
C                        LN(Y) = A0 + A1*X + A2*X**2 + ... + AN*X**N        DRIVER.A34
C                    = 2 IF EQUATION IS                                     DRIVER.A35
C                          Y  = A0 + A1*X + A2*X**2 + ... + AN*X**N         DRIVER.A36
C              ISIGN = INDEX FOR SIGN OF EXPONENTS                          DRIVER.A37
C                    = 1  FOR NEGATIVE EXPONENTS                            DRIVER.A38
C                    = 2  FOR POSITIVE EXPONENTS                            DRIVER.A39
CCC                                                                         DRIVER.A40
C     OUTPUT PARAMETERS                                                     DRIVER.A41
C               Z(J) = THE LEAST-SQUARES FIT COEFFICIENTS,                  DRIVER.A42
C                      Z(1) CORRESPONDS TO A0, Z(2) TO A1, ETC.             DRIVER.A43
CCC                                                                         DRIVER.A44
      DIMENSION  A(20,21), X(100), Y(100), Z(20)                            DRIVER.A45
      NO1 = NO+1                                                            DRIVER.A46
12    NO2 = NO+2                                                            DRIVER.A47
14    DO 9 I=1,NO1                                                          DRIVER.A48
15    DO 9 J=1,NO2                                                          DRIVER.A49
24    A(I,J) = 0.                                                           DRIVER.A50
25  9 CONTINUE                                                              DRIVER.A51
34    DO 20 I=1,NPTS                                                        DRIVER.A52
34    R = Y(I)                                                              DRIVER.A53
36    A(1,1) = A(1,1) + 1.0                                                 DRIVER.A54
41    GO TO (10,12), IKIND                                                  DRIVER.A55
52  10 R = ALOG(R)                                                          DRIVER.A56
60  12 S = X(I)                                                             DRIVER.A57
62    GO TO (14,16), ISIGN                                                  DRIVER.A58
70  14 S = 1.0/S                                                            DRIVER.A59
76  16 Q = 1.0                                                              DRIVER.A60
77    A(1,NO2) = A(1,NO2) + R                                               DRIVER.A61
102   DO 18 J=2,NO1                                                         DRIVER.A62
114   Q = Q*S                                                               DRIVER.A63
115   A(1,J) = A(1,J) + Q                                                   DRIVER.A64
116 18 A(J,NO2) = A(J,NO2) + Q*R                                            DRIVER.A65
121   DO 20 K=2,NO1                                                         DRIVER.A66
134   Q = Q*S                                                               DRIVER.A67
135 20 A(K,NO1) = A(K,NO1) + Q                                              DRIVER.A68
145   DO 30 I=2,NO1                                                         DRIVER.A69
146   DO 30 J=1,NO                                                          DRIVER.A70
155   A(I,J) = A(I-1,J+1)                                                   DRIVER.A71
156 30 CONTINUE                                                             DRIVER.A72
165   CALL SOLVE(A,Z,NO1)                                                   DRIVER.A73
170   RETURN                                                                DRIVER.A74
171   END                                                                   DRIVER.A75
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      SUBROUTINE IONOSU(JJ,ZH)                                          DRIVER.876
CCC                                                                     DRIVER.877
C         SUBROUTINE IONOSU PROVIDES THE PROPERTIES OF THE AMBIENT      DRIVER.878
C         IONOSPHERE REQUIRED BY ALL THE CHEMISTRY MODULES.             DRIVER.879
CCC                                                                     DRIVER.880
C         HOWEVER, THIS THIRD VERSION OF IONOSU IS LIMITED IN THAT THE  DRIVER.881
C         PROFILES OF IONOSPHERIC PROPERTIES ARE REPRESENTATIVE BUT     DRIVER.882
C         NOT NECESSARILY THE FINAL SELECTIONS.                         DRIVER.883
CCC                                                                     DRIVER.884
C         THE E- AND F-REGION CHEMISTRY MODULE REQUIRES...              DRIVER.885
C         (1) Q(1/(CM**3 SEC)) = EFQ, THE EFFECTIVE TOTAL ION           DRIVER.886
C             PRODUCTION RATE THAT REPRODUCES THE AMBIENT IONOSPHERE     DRIVER.887
C             WHEN USED WITH THE CHEMISTRY MODEL,                       DRIVER.888
C         (2) O+(1/CM**3) = EFOP, THE POSITIVE ATOMIC ION DENSITY,      DRIVER.889
C         (3) M+(1/CM**3) = EFMOLP, THE POSITIVE MOLECULAR ION DENSITY, DRIVER.890
C         (4) TX(DEG K), THE ELECTRON AND N2 VIBRATIONAL TEMPERATURE,   DRIVER.891
CCC                                                                     DRIVER.892
C         THE D-REGION CHEMISTRY MODULE REQUIRES...                     DRIVER.893
C         (1) Q(1/(CM**3 SEC)) = DQ, THE EFFECTIVE TOTAL ION PRODUCTION DRIVER.894
C             RATE THAT REPRODUCES THE AMBIENT IONOSPHERE WHEN USED WITHDRIVER.895
C             THE CHEMISTRY MODEL.                                      DRIVER.896
CCC                                                                     DRIVER.897
C         INPUT PARAMETERS                                              DRIVER.898
C            ARGUMENT LIST                                              DRIVER.899
C                JJ - CALCULATION FLAG                                  DRIVER.900
C                     = 1, CALCULATE INITIALIZATION PARAMETERS          DRIVER.901
C                     = 2, CALCULATE IONOSPHERIC PROPERTIES             DRIVER.902
C                ZH - ALTITUDE OF INTEREST (KM)                         DRIVER.903
C            ATMOUP COMMON                                              DRIVER.904
C                     IDORN, SNI(1), SNI(2), SNI(3), TT                 DRIVER.905
C            ALTOUN COMMON                                              DRIVER.906
C                     ALTKM(47)                                         DRIVER.907
C            RATE FUNCTION                                              DRIVER.908
C                     RATE                                              DRIVER.909
C         OUTPUT PARAMETERS                                             DRIVER.910
C            ATMOUP COMMON                                              DRIVER.911
C                     SNI( 9), SNI(10), SNI(11), SNI(12)                DRIVER.912
C            IONOUP COMMON                                              DRIVER.913
C                     EFE,EFOP,EFMOLP,TX,QDEF                           DRIVER.914
C            VARIABLES IN IONOUP                                        DRIVER.915
C                 EFE=SNI( 9) - ELECTRON DENSITY IN E- AND              DRIVER.916
C                               F-REGION, 1/CM**3                       DRIVER.917
C                EFOP=SNI(10) - ATOMIC OXYGEN ION DENSITY IN E- AND     DRIVER.918
C                               F-REGION, 1/CM**3                       DRIVER.919
C              EFMOLP=SNI(11) - MOLECULAR ION DENSITY IN E- AND         DRIVER.920
C                               F-REGION, 1/CM**3                       DRIVER.921
C                  TX=SNI(12) - ELECTRON AND N2 VIBRATIONAL             DRIVER.922
C                               TEMPERATURE, DEG K                      DRIVER.923
C                        QDEF - EFFECTIVE TOTAL ION PRODUCTION RATE,    DRIVER.924
C                               1/(CM**3 SEC)                           DRIVER.925
CCC                                                                     DRIVER.926
C         THE REQUIRED QUANTITIES FOR THE E- AND F-REGION CHEMISTRY ARE DRIVER.927
C         OBTAINED AS FOLLOWS...                                        DRIVER.928
C         (1) EFQ IS COMPUTED FROM A MODIFIED FORM OF EQ.(2-276) OF     DRIVER.929
C             DASA 2497-1 (GE-70),,                                     DRIVER.930
C             EFQ = EFALPD*EFE*EFE*(1.0 + EFALPR*EFE/EFBETA)/(1.0 +     DRIVER.931
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C                  (EFALPD*EFSE + EFALPR*(1.-EFSE)*EFE/EFBETA)                  DRIVER.932
C              WHERE                                                            DRIVER.933
C              EFE = ELECTRON DENSITY PROVIDED AS INPUT DATA TO                 DRIVER.934
C                    IONOSU  (1/CM**3)                                          DRIVER.935
C             EFSE = SNI(3)/(SNI(3) + 2.*(SNI(1)+SNI(2)))                       DRIVER.936
C           SNI(1) = N2 CONCENTRATION                                           DRIVER.937
C           SNI(2) = O2 CONCENTRATION                                           DRIVER.938
C           SNI(3) = O  CONCENTRATION                                           DRIVER.939
C          EFALPD = DISSOCIATIVE RECOMBINATION RATE COEFFICIENT FOR              DRIVER.940
C                   THE REACTION M+ + E = PRODUCTS  (CM**3/SEC)                  DRIVER.941
C                 = RATE(13,TX) + RATE(14,TX)  WHERE RATE(INDX,TEM) IS          DRIVER.942
C                   THE FUNCTION ROUTINE FOR E- AND F-REGION RATE               DRIVER.943
C                   COEFFICIENTS,  (CM**3/SEC)                                  DRIVER.944
C          EFBETA = RATE(10,TX)*SNI(1) + RATE(9,TT)*SNI(2)  (1/SEC)             DRIVER.945
C      RATE(10,TX) = REACTION RATE COEFFICIENT FOR THE REACTION                 DRIVER.946
C                   O+ + N2 = NO+ + N                                           DRIVER.947
C      RATE( 9,TT) = REACTION RATE COEFFICIENT FOR THE REACTION                 DRIVER.948
C                   O+ + O2 = O2+ + O                                           DRIVER.949
C          (2) EFOP IS COMPUTED FROM A MODIFIED FORM OF EQ.(2-274) OF           DRIVER.950
C              DASA 2497-1 (GE-70),,                                            DRIVER.951
C              EFOP = EFSE*EFQ/(EFBETA + EFALPR*EFE)                            DRIVER.952
C              WHERE                                                            DRIVER.953
C           EFALPR = EFFECTIVE TWO-BODY COLLISIONAL-RADIATIVE RECOMBINA-         DRIVER.954
C                   TION RATE COEFFICIENT FOR ATOMIC IONS                       DRIVER.955
C                 = RATE(11,TX) + RATE(12,TX)*EFE + 1.5E-07*SQRT(EFE)/          DRIVER.956
C                   TX**3 (CM**3/SEC)                                           DRIVER.957
C          (3) EFMOLP IS COMPUTED FROM A MODIFIED FORM OF EQ.(2-275) OF         DRIVER.958
C              DASA 2497-1 (GE-70),                                             DRIVER.959
C          EFMOLP =  ((1.-EFSE)*EFQ + EFBETA*EFE)/(EFALPD*EFE + EFBETA)         DRIVER.960
C          (4) TX(DEG K) IS COMPUTED FROM AN ITERIM PRESCRIPTION.               DRIVER.961
CCC                                                                             DRIVER.962
C          ELECTRON DENSITY PROFILES FOR NOMINAL MIDLATITUDE DAYTIME AND        DRIVER.963
C          NIGHTTIME CONDITIONS IN THE E- AND F-REGIONS ARE PROVIDED AS         DRIVER.964
C          APPROXIMATE FITS TO CURVES IN FIG. 1 OF H. RISHBETH, PHYSICS         DRIVER.965
C          AND CHEMISTRY OF THE IONOSPHERE, CONTEMP. PHYSICS, VOL. 14,          DRIVER.966
C          P. 229(1973) (RI-73).                                                DRIVER.967
CCC                                                                             DRIVER.968
C          FOR DAYTIME ELECTRON DENSITY...                                      DRIVER.969
CCC                                                                             DRIVER.970
C          ASSUME PARABOLIC INCREASE IN LOG OF ELECTRON DENSITY FROM            DRIVER.971
C          ALOG10(EBOTD) = 5.0 AT ALTITUDE HEBOTD = 100.0 KM TO                 DRIVER.972
C          ALOG10(EF2MXD) = ALOG10(7.5E+05) AT ALTITUDE HF2MXD = 300. KM,       DRIVER.973
C          FOLLOWED AT HIGHER ALTITUDE BY EXPONENTIAL DECREASE WITH             DRIVER.974
C          SCALE HEIGHT F2DSCH = 200. KM.  BELOW ALTITUDE HEBOTD, ASSUME        DRIVER.975
C          EXPONENTIAL DECREASE WITH SCALE HEIGHT EDDSCH = 5.0 KM.              DRIVER.976
C                                                                               DRIVER.977
C          IF(ZH.GT.HF2MXD)  EFE = EF2MXD*EXP((HF2MXD-ZH)/F2DSCH)               DRIVER.978
C          IF(ZH.GE.EBOTD .AND. ZH.LE.HF2MXD)                                   DRIVER.979
C          EFE = EF2MXD*10.**(EFEA*(HF2MXD-ZH)**2)                              DRIVER.980
C          WHERE THE COEFFICIENT EFEA IS DETERMINED SO THAT EFE = EBOTD         DRIVER.981
C          AT ALTITUDE HEBOTD,                                                  DRIVER.982
C          I.E.,  EFEA = ALOG10(EBOTD/EF2MXD)/(HF2MXD-HEBOTD)**2                DRIVER.983
C          WITH                                                                 DRIVER.984
C             HF2MXD = ALTITUDE OF F2MAX IN DAYTIME,  KM                        DRIVER.985
C             EF2MXD = ELECTRON DENSITY AT F2MAX IN DAYTIME,  1/CM**3           DRIVER.986
C              EBOTD = ELECTRON DENSITY AT HEBOTD,  1/CM**3                     DRIVER.987
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C         IF(ZH.LT.HEBOTD)  EFE = EBOTD*EXP((ZH-HEBOTD)/EDNSCH)          DRIVER.988
CCC                                                                      DRIVER.989
C         FOR NIGHTTIME ELECTRON DENSITY...                              DRIVER.990
CCC                                                                      DRIVER.991
C         ASSUME SINUSOID INCREASE IN LOG OF ELECTRON DENSITY FROM       DRIVER.992
C         ALOG10(EBOTN) = 3.0 AT ALTITUDE HEBOTN = 100. KM TO            DRIVER.993
C         ALOG10(EF2MXN) = ALOG10(4.0E+05) AT ALTITUDE HF2MXN = 360. KM, DRIVER.994
C         FOLLOWED AT HIGHER ALTITUDE BY EXPONENTIAL DECREASE WITH SCALE DRIVER.995
C         HEIGHT F2NSCH = 200. KM.  BELOW HEBOTN, ASSUME EXPONENTIAL     DRIVER.996
C         DECREASE WITH SCALE HEIGHT EDNSCH = 5.0 KM.                    DRIVER.997
C         IF(ZH.GT.HF2MXN)  EFE = EF2MXN*EXP((HF2MXN-ZH)/F2NSCH)         DRIVER.998
C         IF(ZH.GE.EBOTN .AND. ZH.LE.HF2MXN)                             DRIVER.999
C         ALOG10(EFE) = ALOG10(EBOTN) + 0.50*ALOG10(EF2MXN/EBOTN)        DRIVER.1000
C                     * (1.0+SIN(PID2*(2.*ZH-HEBOTN-HF2MXN)/             DRIVER.1001
C                       (HF2MXN-HEBOTN)))                                DRIVER.1002
C         IF(ZH.LT.HEBOTN)  EFE = EBOTN*EXP((ZH-HEBOTN)/EDNSCH)          DRIVER.1003
CCC                                                                      DRIVER.1004
C         ELECTRON TEMPERATURE PROFILES IN THE E- AND F-REGION ARE       DRIVER.1005
C         OBTAINED, FOR (NOON) DAYTIME CONDITIONS, BY PRESCRIBING THE    DRIVER.1006
C         DIFFERENCE BETWEEN THE ELECTRON TEMPERATURE TX AND THE GAS     DRIVER.1007
C         TEMPERATURE TT AT  TWO  ALTITUDES AND USING A PARABOLIC FIT    DRIVER.1008
C         TO THIS DIFFERENCE.  FOR NIGHTTIME CONDITIONS, WE ASSUME TX=TT DRIVER.1009
CCC                                                                      DRIVER.1010
C         FOR DAYTIME ELECTRON TEMPERATURE...                            DRIVER.1011
C         ALTITUDE, KM       TX-TT, DEG K      TT(CIRA-65, MODEL-5, 8-HR) DRIVER.1012
C                                                                        DRIVER.1013
C            120              0 = TXT120                    335          DRIVER.1014
C            200            500 = TXT200                    933          DRIVER.1015
CCC                                                                      DRIVER.1016
C         THESE VALUES OF TX-TT ARE CONSISTENT WITH THE VALUES OF TX     DRIVER.1017
C         REPORTED BY J.V. EVANS (MILLSTONE HILL THOMSON SCATTER RESULTS DRIVER.1018
C         FOR 1966 AND 1967, PLANET. SPACE SCI.  VOL. 21, PP. 763-792    DRIVER.1019
C         (1973), (EV-73))  AND THE CIRA-1965 MODEL-5 8-HR ATMOSPHERE    DRIVER.1020
C         (CI-65).                                                       DRIVER.1021
C                                                                        DRIVER.1022
C         IF(ZH.LT.120.)  TX = TT                                        DRIVER.1023
C         IF(ZH.GE.120.)  TXT = SQRT( ZHM120/A )                         DRIVER.1024
C         WHERE                                                          DRIVER.1025
C            ZHM120 = ZH-120.                                            DRIVER.1026
C                 A = 80. / 500.**2                                      DRIVER.1027
CCC                                                                      DRIVER.1028
C         THE REQUIRED QUANTITY FOR THE D-REGION CHEMISTRY IS OBTAINED   DRIVER.1029
C         AS FOLLOWS...                                                  DRIVER.1030
C         QQ IS FORCED TO EQUAL THE VALUE OF EFQ AT THE BOTTOM OF THE    DRIVER.1031
C         GRID (90-KM) AND IS DETERMINED BY INPUT DATA AT LOWER          DRIVER.1032
C         ALTITUDES.                                                     DRIVER.1033
C          NOTE ...  QDEF = QQ OR QDEF = EFQ DEPENDING ON THE            DRIVER.1034
C                    ALTITUDE ZH.                                        DRIVER.1035
CCC                                                                      DRIVER.1036
C         FOR DAYTIME...                                                 DRIVER.1037
C                                                                        DRIVER.1038
C         IF(ZH.LE.60.)                                                  DRIVER.1039
C               QQ = QQDAY(7) * QQ1307**(ZHMZ07/Z13M07)                  DRIVER.1040
C           QQ1307 = QQDAY(13)/QQDAY(7)                                  DRIVER.1041
C           ZHMZ07 = ZH-ALTKM(7)                                         DRIVER.1042
C           Z13M07 = ALTKM(13)-ALTKM(7)                                  DRIVER.1043
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C           IF(60.,LT.ZH .AND. ZH.LT.90)                                    DRIVER.1044
C                 DQ = DQDAY(13) * QD1913**(ZHM713/Z19M13)                  DRIVER.1045
C             QD1913 = FFQZ19/DQDAY(13)                                     DRIVER.1046
C             ZHM713 = ZH-ALTKM(13)                                         DRIVER.1047
C             Z19M13 = ALTKM(19)-ALTKM(13)                                  DRIVER.1048
CCC                                                                         DRIVER.1049
C           FOR NIGHTTIME...                                                DRIVER.1050
C                                                                           DRIVER.1051
C           IF(ZH.LE.60.)                                                   DRIVER.1052
C                 DQ = DQNIT(7) * QN1307**(ZHMZ07/Z13M07)                   DRIVER.1053
C             QN1307 = DQNIT(13)/DQNIT(7)                                   DRIVER.1054
C                                                                           DRIVER.1055
C           IF(60..LT.ZH .AND. ZH.LT.90.)                                   DRIVER.1056
C                 DQ = DQNIT(13) * QN1913**(ZHM713/Z19M13)                  DRIVER.1057
C             QN1913 = FFQZ19/DQNIT(13)                                     DRIVER.1058
CCC                                                                         DRIVER.1059
      DIMENSION  DQDAY(18),DQNIT(18)                                        DRIVER.1060
      COMMON/ATMOUP/  HL,SBAR,IDORN,PP,RHO,TT,SNI(16),HRHO,FFHSFQ           DRIVER.1061
      COMMON/IONOUP/  EFE,EFUP,EFMOLP,TX,QDFF                               DRIVER.1062
      COMMON/ALTORN/  NALTOD,ALTKM(47),QDAY(27),QNITE(18),S1Z2N,CO2(25)     DRIVER.1063
      COMMON/ZHCHEX/  ZHFLAG                                                DRIVER.1064
CCC                                                                         DRIVER.1065
      DATA  EBOTD,HEBOTD,EF2MXD,HF2MXD,F2DSCH,EDDSCH /  1.0E+05,1.0E+02,DRIVER.1066
     *  7.0E+05,3.0E+02,2.0E+02,5.0 /                                       DRIVER.1067
      DATA  EBOTN,HEBOTN,EF2MXN,HF2MXN,F2NSCH,EDNSCH /  1.0E+03,1.0E+02,DRIVER.1068
     *  4.0E+05,3.6E+02,2.0E+02,5.0 /                                       DRIVER.1069
      DATA  TXT120,TXT200,TXT800 / 0.0,5.0E+02,1.8E+03 /                    DRIVER.1070
      DATA  PI / 3.14159265359 /                                            DRIVER.1071
C           INTERIM VALUES 06/10/75                                         DRIVER.1072
      DATA (DQDAY(I),I=1,18)/6*0.,3.3,5*0.,.06,5*0./                        DRIVER.1073
C           INTERIM VALUES 06/10/75                                         DRIVER.1074
      DATA (DQNIT(I),I=1,18)/6*0.,.3,3.5*0.,.06,5*0./                       DRIVER.1075
CCC                                                                         DRIVER.1076
      GO TO (100,200), JJ                                                   DRIVER.1077
C           INITIALIZATION, CALLED FROM SUBROUTINE ATMOSU DURING TTS        DRIVER.1078
C           INITIALIZATION.                                                 DRIVER.1079
11    100 CONTINUE                                                          DRIVER.1080
11        PID2 = PI/2.                                                      DRIVER.1081
13        H2PBD2 = 0.50*(HF2MXN+HEBOTN)                                     DRIVER.1082
16        H2MBD2 = 0.50*(HF2MXN-HEBOTN)                                     DRIVER.1083
20        ALG2D1 = 0.50*ALOG10(EF2MXN/EBOTN)                                DRIVER.1084
24        EFEA = ALOG10(EBOTD/EF2MXD)/(HF2MXD-HEBOTD)**2                    DRIVER.1085
34        A = 80. / (500.*500.)                                             DRIVER.1086
C           INITIALIZATION FOR D-REGION Q...                                DRIVER.1087
C           COMPUTE ELECTRON TEMPERATURE AT 90-KM ALTITUDE                  DRIVER.1088
36        TX = TT                                                           DRIVER.1089
37        IF(IDORN.LT.0) GO TO 150                                          DRIVER.1090
C           COMPUTE DAYTIME ELECTRON DENSITY AT 90 KM                       DRIVER.1091
42        EFE = EBOTD * EXP( (90.-HEBOTD)/EDDSCH)                           DRIVER.1092
51        GO TO 180                                                         DRIVER.1093
C           COMPUTE NIGHTTIME ELECTRON DENSITY AT 90-KM ALTITUDE            DRIVER.1094
53    150 EFE = EBOTN * EXP((90. - HEBOTN)/EDNSCH)                          DRIVER.1095
63    180 EFALPD = RATE (13,TX) + RATE (14,TX)                              DRIVER.1096
72        EFALPR = RATE(11,TX)+RATE(12,TX)*EFE+1.5E-07*SQRT(EFE)/TX**3      DRIVER.1097
110       EFSF   = SNI(3)/(SNI(3) + 2.*(SNI(1) + SNI(2)))                   DRIVER.1098
114       EFBETA = RATE(10,TX)*SNI(1) + RATE(9,TT)*SNI(2)                   DRIVER.1099
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125         EFNZ19 = EFALPD*EFE*EFE*(1.0 + EFALPR*EFE/EFBETA) /                 DRIVER.1100
           *           (1.0 + (EFALPD*EFSF + EFALPR*(1.-EFSF))*EFE/EFBETA)      DRIVER.1101
140         IF(IDORN.LT.0) GO TO 190                                            DRIVER.1102
144         QN1913 = EFNZ19/DQDAY(13)                                           DRIVER.1103
145         QN1307 = DQDAY(13)/DQDAY(7)                                         DRIVER.1104
147         GO TO 195                                                           DRIVER.1105
150     190 QN1913 = EFNZ19/DQNIT(13)                                           DRIVER.1106
152         QN1307 = DQNIT(13)/DQNIT(7)                                         DRIVER.1107
154     195 CONTINUE                                                            DRIVER.1108
154         Z19M13 = ALTKM(19)-ALTKM(13)                                        DRIVER.1109
156         Z13M07 = ALTKM(13)-ALTKM(7)                                         DRIVER.1110
160         RETURN                                                              DRIVER.1111
161     200 CONTINUE                                                            DRIVER.1112
161         IF( ZH.NE.ZHFLAG )  CALL ATMOSU(2,ZH)                               DRIVER.1113
        CCC                                                                     DRIVER.1114
        C           AN ERRONEOUS CONDITION WILL OCCUR IF IONOSU IS CALLED WITH  DRIVER.1115
        C           JJ=2 AND A GIVEN VALUE OF ZH IF ATMOSU HAS NOT BEEN CALLED  DRIVER.1116
        C           FIRST WITH JJ=2 AND FOR THE SAME VALUE OF ZH.               DRIVER.1117
        C           THE VARIABLE ZHFLAG IS USED TO DETECT THIS CONDITION AND    DRIVER.1118
        C           TO MAKE THE REQUIRED CALL TO ATMOSU.                        DRIVER.1119
        C           ZHFLAG IS INITIALIZED TO AN ARBITRARY NEGATIVE VALUE IN     DRIVER.1120
        C           THE INITIALIZATION CALL TO ATMOSU.                          DRIVER.1121
        CCC                                                                     DRIVER.1122
165         IF(ZH.GE.90.) GO TO 205                                             DRIVER.1123
        C           SET ELECTRON TEMPERATURE FOR ZH.LT.90.                      DRIVER.1124
172         TX = TT                                                             DRIVER.1125
        C           ZERO EFE, EFOP, AND EFMOLP FOR ZH.LT.90.                    DRIVER.1126
173         EFE = EFOP = EFMOLP = 0.0                                           DRIVER.1127
        C           PROCEED WITH DQ CALCULATION FOR ZH.LT.90.                   DRIVER.1128
176         IF(IDORN.LT.0) GO TO 350                                            DRIVER.1129
        C           COMPUTE DAYTIME DQ                                          DRIVER.1130
177         IF(ZH.LE.60.) GO TO 325                                             DRIVER.1131
        C           COMPUTE DAYTIME DQ FOR 60.LT.ZH.LT.90.                      DRIVER.1132
202         ZHMZ13 = ZH-ALTKM(13)                                               DRIVER.1133
203         DQ = DQDAY(13) * QD1913**(ZHMZ13/Z19M13)                            DRIVER.1134
212         GO TO 385                                                           DRIVER.1135
212     325 CONTINUE                                                            DRIVER.1136
        C           COMPUTE DAYTIME DQ FOR ZH.LE.60.                            DRIVER.1137
212         ZHMZ07 = ZH-ALTKM(7)                                                DRIVER.1138
214         DQ = DQDAY(7) * QD1307**(ZHMZ07/Z13M07)                             DRIVER.1139
222         GO TO 385                                                           DRIVER.1140
222     350 CONTINUE                                                            DRIVER.1141
        C           COMPUTE NIGHTTIME DQ                                        DRIVER.1142
222         IF(ZH.LE.60.) GO TO 375                                             DRIVER.1143
        C           COMPUTE NIGHTTIME DQ FOR 60.LT.ZH.LT.90.                    DRIVER.1144
225         ZHMZ13 = ZH-ALTKM(13)                                               DRIVER.1145
226         DQ = DQNIT(13) * QN1913**(ZHMZ13/Z19M13)                            DRIVER.1146
235         GO TO 385                                                           DRIVER.1147
235     375 CONTINUE                                                            DRIVER.1148
        C           COMPUTE NIGHTTIME DQ FOR ZH.LE.60.                          DRIVER.1149
235         ZHMZ07 = ZH-ALTKM(7)                                                DRIVER.1150
237         DQ = DQNIT(7) * QN1307**(ZHMZ07/Z13M07)                             DRIVER.1151
245     385 DQEF = DQ                                                           DRIVER.1152
246         SNI( 9) = 0.0                                                       DRIVER.1153
247         SNI(10) = 0.0                                                       DRIVER.1154
247         SNI(11) = 0.0                                                       DRIVER.1155
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250         SNI(12) = TX                                                    DRIVER,1156
252         RETURN                                                          DRIVER,1157
      CCC                                                                   DRIVER,1158
253     205 IF( IDUSN.LT.0 ) GO TO 250                                      DRIVER,1159
      CCC                                                                   DRIVER,1160
      C           COMPUTE DAYTIME ELECTRON DENSITY AND TEMPERATURE OF       DRIVER,1161
      C           E- AND F-REGIONS.                                         DRIVER,1162
      CCC                                                                   DRIVER,1163
      C           ELECTRON DENSITY                                          DRIVER,1164
255         IF( ZH-HEBOTD )  210,212,212                                    DRIVER,1165
257     210 EFE = EBOTD * EXP((ZH-HEBOTD)/EDDSCH)                           DRIVER,1166
265         GO TO 220                                                       DRIVER,1167
267     212 IF( ZH-HF2MXD )  214,214,216                                    DRIVER,1168
272     214 EFE = EF2MXD * 10.**(FFEA*(HF2MXD-ZH)**2)                       DRIVER,1169
302         GO TO 220                                                       DRIVER,1170
302     216 EFE = EF2MXD * EXP((HF2MXD-ZH)/F2DSCH)                          DRIVER,1171
      C           ELECTRON TEMPERATURE                                      DRIVER,1172
311     220 IF( ZH-120. )  222,224,224                                      DRIVER,1173
314     222 TX = TT                                                         DRIVER,1174
316         GO TO 280                                                       DRIVER,1175
316     224 ZHM120 = ZH-120.                                                DRIVER,1176
320         TX = TT + SQRT( ZHM120/A )                                      DRIVER,1177
325         GO TO 280                                                       DRIVER,1178
      CCC                                                                   DRIVER,1179
      C           COMPUTE NIGHTTIME ELECTRON DENSITY AND TEMPERATURE OF     DRIVER,1180
      C           E- AND F-REGIONS.                                         DRIVER,1181
      CCC                                                                   DRIVER,1182
      C           ELECTRON DENSITY                                          DRIVER,1183
327     250 IF( ZH-HEBOTN )  260,262,262                                    DRIVER,1184
332     260 EFE = EBOTN * EXP((ZH-HEBOTN)/EDNSCH)                           DRIVER,1185
340         GO TO 270                                                       DRIVER,1186
342     262 IF( ZH-HF2MXN )  264,264,266                                    DRIVER,1187
345     264 EFE = EBOTN * 10.**( ALG2D1*(1.0+SIN(PID2*(ZH-H2PRD2)/H2MRD2))) DRIVER,1188
361         GO TO 270                                                       DRIVER,1189
363     266 EFE = EF2MXN * EXP((HF2MXN-ZH)/F2NSCH)                          DRIVER,1190
      C           ELECTRON TEMPERATURE                                      DRIVER,1191
372     270 TX = TT                                                         DRIVER,1192
      CCC                                                                   DRIVER,1193
      C           COMPUTE EFQ, EFOP, AND EFMOLP                             DRIVER,1194
      CCC                                                                   DRIVER,1195
      C           EFQ                                                       DRIVER,1196
374     280 EFALPD = RATE(13,TX) + RATE(14,TX)                              DRIVER,1197
403         EFALPR = RATE(11,TX) + RATE(12,TX)*EFE + 1.5E-07*SQRT(EFE)/TX**3 DRIVER,1198
421         EFSF = SNI(3)/(SNI(3) + 2.*(SNI(1)+SNI(2)))                     DRIVER,1199
425         EFBETA = RATE(10,TX) * SNI(1) + RATE(9,TT) * SNI(2)             DRIVER,1200
441         EFQ = EFALPD*EFE*EFE*(1.0+EFALPR*EFE/EFBETA)/                   DRIVER,1201
           *       (1.0+(EFALPD*EFSF + EFALPR*(1.-EFSF))*EFE/EFBETA)        DRIVER,1202
452         QDEF = EFQ                                                      DRIVER,1203
      C           EFOP                                                      DRIVER,1204
452         EFOP = EFSF*EFQ/(EFBETA + EFALPR*EFE)                           DRIVER,1205
      C           EFMOLP                                                    DRIVER,1206
455         EFMOLP = ((1.-EFSF)*EFQ + EFBETA*EFE)/(EFALPD*EFE + EFBETA)     DRIVER,1207
463         SNI(9) = EFE                                                    DRIVER,1208
464         SNI(10) = EFOP                                                  DRIVER,1209
465         SNI(11) = EFMOLP                                                DRIVER,1210
467         SNI(12) = TX                                                    DRIVER,1211
471         RETURN                                                          DRIVER,1212
471         END                                                             DRIVER,1213
```

JULIAN

```
      SUBROUTINE JULIAN(IYRS,IMONS,IDAYS,YRFJ,VEQJ,DAYJ)                DRIVER.1214
CCC                                                                     DRIVER.1215
C         SUBROUTINE JULIAN CONVERTS A GREGORIAN CALENDAR DATE TO       DRIVER.1216
C         JULIAN DAY NUMBER DAYJ FOR SUBROUTINE SOLORB.                 DRIVER.1217
C         SUBROUTINE JULIAN IS VALID FOR YEARS 1901 TO 1999 INCLUSIVE.  DRIVER.1218
CCC                                                                     DRIVER.1219
C     INPUT PARAMETERS                                                  DRIVER.1220
C              IYRS - NUMBER OF THE YEAR IN THE 1900 S (E.G., 1974      DRIVER.1221
C                     BECOMES 74).                                      DRIVER.1222
C             IMONS - NUMBER OF THE MONTH (E.G., FEBRUARY BECOMES 2),   DRIVER.1223
C             IDAYS - DAY OF THE MONTH                                  DRIVER.1224
CCC                                                                     DRIVER.1225
C     OUTPUT PARAMETERS                                                 DRIVER.1226
C              YRFJ - JULIAN DAY NUMBER (A HALF INTEGER) AT 0 HRS UT    DRIVER.1227
C                     ON JANUARY 1 OF THE YEAR OF INTEREST,             DRIVER.1228
C              VEQJ - JULIAN DATE FOR VERNAL EQUINOX,                   DRIVER.1229
C              DAYJ - JULIAN DAY NUMBER (A HALF INTEGER) AT 0 HRS UT    DRIVER.1230
C                     ON THE DAY OF INTEREST,                           DRIVER.1231
CCC                                                                     DRIVER.1232
C     DEFINITION OF DATA                                                DRIVER.1233
C          DAYM(I) - THE CUMULATIVE NUMBER OF DAYS FROM THE BEGINNING   DRIVER.1234
C                    OF THE YEAR TO THE END OF THE (I-1)TH MONTH, IN    DRIVER.1235
C                    A NON-LEAP YEAR,                                   DRIVER.1236
CCC                                                                     DRIVER.1237
      DIMENSION  DAYM(12)                                               DRIVER.1238
      DATA  (DAYM(I),I=1,12) /  0.,31.,59.,90.,120.,151.,181.,212.,     DRIVER.1239
     *                          243.,273.,304.,334. /                   DRIVER.1240
      DAYS = IDAYS                                                      DRIVER.1241
11    YRS = IYRS                                                        DRIVER.1242
CCC                                                                     DRIVER.1243
C         THE FIRST TERM FOR DAYJ IS THE JULIAN DAY NUMBER AT 0 HRS UT  DRIVER.1244
C         1900 JANUARY 1.  THE THIRD TERM FOR DAYJ IS THE NUMBER OF     DRIVER.1245
C         EXTRA (LEAP-YEAR) DAYS SINCE 1900 TO THE START OF THE YEAR    DRIVER.1246
C         OF INTEREST.                                                  DRIVER.1247
CCC                                                                     DRIVER.1248
12    DAYJ = 2415020.5 + 365.*YRS + AINT( (YRS-1.)/4. )                 DRIVER.1249
20    YRFJ = DAYJ                                                       DRIVER.1250
C         VERNAL EQUINOX OCCURS WITHIN ABOUT 7 SECONDS OF TIME AT       DRIVER.1251
C         00 HOURS ON 21 MARCH 1974, AT WHICH TIME THE JULIAN DAY       DRIVER.1252
C         NUMBER IS 2442127.5 .  FOR NEARBY YEARS THE JULIAN DATE FOR   DRIVER.1253
C         VERNAL EQUINOX WILL BE GIVEN BY VEQJ..                        DRIVER.1254
20    VEQJ = 2442127.5 + 365.25*(YRS-74.)                               DRIVER.1255
CCC                                                                     DRIVER.1256
C         LEAP IS AN INDEX THAT EQUALS 0  FOR A LEAP YEAR AND OTHERWISE DRIVER.1257
C         EQUALS 1, 2, OR 3 .                                           DRIVER.1258
CCC                                                                     DRIVER.1259
23    LEAP = MOD(IYRS,4)                                                DRIVER.1260
25    IF( IMONS.LT.3 )  GO TO 1                                         DRIVER.1261
30    IF(  LEAP.EQ.0  )  DAYJ = DAYJ+1.0                                DRIVER.1262
32  1 DAYJ = DAYJ + DAYM(IMONS) + (DAYS-1.0)                            DRIVER.1263
36    RETURN                                                            DRIVER.1264
37    END                                                               DRIVER.1265
```

RATE

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      FUNCTION RATE(INDX,TEM)                                                    DRIVER,1266
C                                                                                DRIVER,1267
C     REACTION RATE COEFFICIENT FOR A SPECIFIED REACTION                         DRIVER,1268
C                                                                                DRIVER,1269
C         INPUTS                                                                 DRIVER,1270
C     INDX = REACTION INDEX (SEE BELOW)                                          DRIVER,1271
C     TEM  = TEMPERATURE (DEG K)                                                 DRIVER,1272
C            VIBRATIONAL/ELECTRON TEMPERATURE FOR REACTIONS 7,8,10-14,23DRIVER,1273
C            AND 24                                                              DRIVER,1274
C         OUTPUT                                                                 DRIVER,1275
C     RATE = REACTION RATE COEFFICIENT                                           DRIVER,1276
C                                                                                DRIVER,1277
C     REACTIONS INCLUDED                                                         DRIVER,1278
C                                                                                DRIVER,1279
C      1 N+ + O2 = NO+ + O          2 N+ + O2 = O2+ + N                          DRIVER,1280
C      3 N+ + O2 = O+ + NO          4 N+ + N2 = N2+ + N                          DRIVER,1281
C      5 N+ + NO = NO+ + N          6 N+ + O = O+ + N                            DRIVER,1282
C      7 N+ + E = N + HNU           8 N+ + E + E = N + E                         DRIVER,1283
C      9 O+ + O2 = O2+ + O         10 O+ + N2 = NO+ + N                          DRIVER,1284
C     11 O+ + E = O + HNU          12 O+ + E + E = O + E                        DRIVER,1285
C     13 NO+ + E = N(4S) + O       14 NO+ + E = N(2D) + O                       DRIVER,1286
C     15 N(4S) + O = NO+ + E       16 N(2D) + O = NO+ + E                       DRIVER,1287
C     17 N + O = NO + HNU          18 N + N = N2 + HNU                          DRIVER,1288
C     19 N(4S) + O2 = NO + O       20 N(2D) + O2 = NO + O                       DRIVER,1289
C     21 N(4S) + NO = N2 + O       22 N(2D) + NO = N2 + O                       DRIVER,1290
C     23 N(4S) + E = N(2D) + E     24 N(2D) + E = N(4S) + E                     DRIVER,1291
C     25 O + N2 = NO + N           26 E+O2+O2 = O2-+O2                          DRIVER,1292
C     27 O2-+O2 = E+O2+O2          28 O2-+O = O3+E                              DRIVER,1293
C     29 O3+E = O2-+O              30 O2-+O2+M = O4-+M                          DRIVER,1294
C     31 O4-+M = O2-+O2+M          32 O4-+O = O3-+O2                            DRIVER,1295
C     33 O3-+O2 = O4-+O            34 O4-+NO = OONO-+O2                         DRIVER,1296
C     35 OONO-+O2 = O4-+NO         36 O3-+O = O2-+O2                            DRIVER,1297
C     37 O2-+O2 = O3-+O            38 O3-+NO = NO2-+O2                          DRIVER,1298
C     39 O2+NO2- = O3-+NO          40 OONO-+NO = NO2-+NO2                       DRIVER,1299
C     41 NO2-+NO2 = OONO-+NO       42 O2-+NO2 = NO2-+O2                         DRIVER,1300
C     43 NO2-+O2 = O2-+NO2         44 NO2+E = NO2-+HNU                          DRIVER,1301
C     45 NO2-+HNU = NO2+E          46 NO2-+NO2 = NO3-+NO                        DRIVER,1302
C     47 NO3-+NO = NO2-+NO2        48 X++Y- = PRODUCTS                          DRIVER,1303
C     49 X++Y-+M = PRODUCTS        50 AL++E+M = AL+M                            DRIVER,1304
C     51 OO2++E = O+O2             52 OO++E = O+O                               DRIVER,1305
C     53 OO2++E = OO+O             54 O++E+M = O+M                              DRIVER,1306
C     55 O+E = O-+HNU              56 O-+O = O2+E                               DRIVER,1307
C     57 O-+NO = NO2+E             58 O-+N = NO+E                               DRIVER,1308
C     59 O-+O2 = O3+E              60 ALO2+E+M = ALO2-+M                        DRIVER,1309
C     61 ALO2-+M = ALO2+E+M        62 ALO++E =AL+O                              DRIVER,1310
C     63 O+NO2 = NO+O2             64 NO+O2 = O+NO2                             DRIVER,1311
C     65 O2-+NO = NO2-+O           66 NO2-+3 = O2-+O                            DRIVER,1312
C                                                                                DRIVER,1313
      COMMON/CHEMR/  AR(66),  BR(66),  CR(66)                                    DRIVER,1314
C                                                                                DRIVER,1315
      TMX=TEM                                                                    DRIVER,1316
    4 TMY=TEM/300.                                                               DRIVER,1317
    6 EX1=1.0                                                                    DRIVER,1318
    7 IF(BR(INDX).NE.0.0) EX1=TMY**(BR(INDX))                                    DRIVER,1319
   15 EX2=1.0                                                                    DRIVER,1320
   16 IF(CR(INDX).EQ.0.0) GO TO 30                                               DRIVER,1321
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```
RATE
      20          EXPO=-CR(INDX)/TMX                                                    DRIVER,1322
      22          IF(EXPO,GT,-70,0) GO TO 25                                            DRIVER,1323
      26          RATE = 0,0                                                            DRIVER,1324
      26          GO TO 100                                                             DRIVER,1325
      27       25 EX2=EXP(EXPO)                                                         DRIVER,1326
      33       30 RATE=AR(INDX)*EX1*EX2                                                 DRIVER,1327
      36          IF(INDX,EQ,10) RATE = AMAX1(1,3E-12, AMIN1(1,E-10, RATE))            DRIVER,1328
      47      100 RETURN                                                               DRIVER,1329
      51          END                                                                   DRIVER,1330
```

SOLCYC

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      SUBROUTINE SOLCYC(DAYJ)                                                DRIVER.1331
C     CCC                                                                    DRIVER.1332
C           SUBROUTINE SOLCYC COMPUTES THE SOLAR FLUX SBAR, AN INPUT TO      DRIVER.1333
C           ATMOSU THROUGH COMMON ATMOUP, BASED ON AN ASSUMED SINUSOIDAL     DRIVER.1334
C           11-YR (OR 4018-DAY) VARIATION, WITH THE MAXIMUM VALUE OF 250     DRIVER.1335
C           FOR SBAR, ASSOCIATED WITH CIRA-65 MODEL 9, OCCURRING ON          DRIVER.1336
C           1958 JUNE 1.  THE MINIMUM VALUE OF 65 FOR SBAR IS ASSOCIATED     DRIVER.1337
C           WITH CIRA-65 MODEL 1.                                            DRIVER.1338
C     CCC                                                                    DRIVER.1339
C     INPUT PARAMETER                                                        DRIVER.1340
C              DAYJ - JULIAN DAY NUMBER (A HALF INTEGER) AT 0 HRS UT         DRIVER.1341
C                     ON THE DAY OF INTEREST.                                DRIVER.1342
C     CCC                                                                    DRIVER.1343
C     OUTPUT PARAMETER                                                       DRIVER.1344
C              SBAR - AVERAGE 10.7-CM SOLAR FLUX, 1.0E-22 W/(M**2 HZ).       DRIVER.1345
C                     SBAR IS AN INPUT TO ATMOSU THROUGH COMMON ATMOUP.      DRIVER.1346
C     CCC                                                                    DRIVER.1347
      COMMON/ATMOUP/  HL,SBAR,IDURN,PP,RHO,TT,SNI(16),HRHO,FEHSEQ            DRIVER.1348
C     CCC                                                                    DRIVER.1349
C     DEFINITION OF DATA                                                     DRIVER.1350
C           DJ5806 - JULIAN DAY NUMBER ON 1958 JUNE 1 =  2436355.5           DRIVER.1351
      DATA  DJ5806 / 2436355.5 /                                             DRIVER.1352
      DATA  PI / 3.141592653590 /                                            DRIVER.1353
C     CCC                                                                    DRIVER.1354
      PI2 = 2.*PI                                                            DRIVER.1355
    4 SBAR = 157.5 + 92.5*COS( (DAYJ-DJ5806)*PI2/4018. )                     DRIVER.1356
   14 RETURN                                                                 DRIVER.1357
   15 END                                                                    DRIVER.1358
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SOLORB

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      SUBROUTINE SOLORB(YREJ,VEQJ,DAYJ,SOLLAT,SOLLON)                    DRIVER.1359
CCC                                                                      DRIVER.1360
C         SUBROUTINE SOLORB COMPUTES THE NORTH LATITUDE SOLLAT AND       DRIVER.1361
C         EAST LONGITUDE SOLLON OF THE APPARENT (ACTUAL MOTION)          DRIVER.1362
C         SUBSOLAR POINT, GIVEN THE JULIAN DAY NUMBER AT 0 HRS UT ON     DRIVER.1363
C         JANUARY 1 OF THE YEAR OF INTEREST (YREJ), THE JULIAN DATE AT   DRIVER.1364
C         WHICH VERNAL EQUINOX OCCURS (VEQJ), THE JULIAN DAY NUMBER AT   DRIVER.1365
C         0 HRS ON THE DAY OF INTEREST (DAYJ), AND THE UNIVERSAL         DRIVER.1366
C         TIME (UT).                                                     DRIVER.1367
CCC                                                                      DRIVER.1368
C     INPUT PARAMETERS                                                   DRIVER.1369
C           YREJ - JULIAN DAY NUMBER (A HALF INTEGER) AT 0 HRS UT ON     DRIVER.1370
C                  JANUARY 1 OF THE YEAR OF INTEREST.                    DRIVER.1371
C           VEQJ - JULIAN DATE FOR VERNAL EQUINOX.                       DRIVER.1372
C           DAYJ - JULIAN DAY NUMBER (A HALF INTEGER) AT 0 HRS UT        DRIVER.1373
C                  ON THE DAY OF INTEREST.                               DRIVER.1374
C             UT - UNIVERSAL TIME (DECIMAL HRS).                         DRIVER.1375
CCC                                                                      DRIVER.1376
C     OUTPUT PARAMETERS                                                  DRIVER.1377
C           GAT - GREENWICH APPARENT TIME (DECIMAL HRS).                 DRIVER.1378
C                 GAT IS PLACED IN COMMON TIME.                          DRIVER.1379
C        SOLLAT - NORTH LATITUDE OF SUBSOLAR POINT (RADIANS).            DRIVER.1380
C        SOLLON - EAST LONGITUDE OF SUBSOLAR POINT (RADIANS).            DRIVER.1381
CCC                                                                      DRIVER.1382
C     DEFINITIONS AND COMMENTS                                           DRIVER.1383
C         UTD24 IS THE DECIMAL FRACTION OF DAY CORRESPONDING TO UT.      DRIVER.1384
C         DAYJUT IS THE JULIAN (DECIMAL) DAY NUMBER AT UT HRS ON THE     DRIVER.1385
C         DAY OF INTEREST.                                               DRIVER.1386
C         DAYNO IS THE NUMBER OF ELAPSED (DECIMAL) DAYS SINCE THE        DRIVER.1387
C         BEGINNING OF THE YEAR AT 0 HRS UT ON JANUARY 1.                DRIVER.1388
C         THE QUANTITY (DAYJUT - AINT(DAYJUT)), THE WEST LONGITUDE OF    DRIVER.1389
C         THE SUBSOLAR POINT EXPRESSED AS A DECIMAL FRACTION OF 2*PI     DRIVER.1390
C         RADIANS, IS SUBTRACTED FROM 1 TO OBTAIN THE FRACTIONAL EAST    DRIVER.1391
C         LONGITUDE.  THE FIRST TWO EXPRESSIONS FOR SOLLON ARE THE EAST  DRIVER.1392
C         LONGITUDE OF THE SUBSOLAR POINT OF THE (FICTITIOUS) MEAN SUN.  DRIVER.1393
C         IT IS POSSIBLE TO MAKE AN APPROXIMATE CORRECTION FOR THE       DRIVER.1394
C         DIFFERENCE BETWEEN THE APPARENT (ACTUAL MOTION) SOLAR TIME     DRIVER.1395
C         AND THE MEAN SOLAR TIME, KNOWN AS THE EQUATION-OF-TIME (SEE,   DRIVER.1396
C         E.G., AMERICAN PRACTICAL NAVIGATOR (ORIGINALLY BY N.           DRIVER.1397
C         BOWDITCH), U.S. NAVY H.O. PUB. NO. 9, P. 375, OF 1962          DRIVER.1398
C         CORRECTED REPRINT EDITION, AVAILABLE FROM U.S. GOV. PRINTING   DRIVER.1399
C         OFFICE).  IN THE U.S.A. (IN CONTRAST TO GREAT BRITAIN) THE     DRIVER.1400
C         SIGN OF THE EQUATION-OF-TIME IS CONSIDERED POSITIVE IF THE     DRIVER.1401
C         TIME OF THE MERIDIAN TRANSIT BY THE SUN IS EARLIER THAN 1200   DRIVER.1402
C         HRS AND NEGATIVE IF LATER THAN 1200 HRS.  (NOTE THAT A         DRIVER.1403
C         MERIDIAN TRANSIT BEFORE 1200 HRS CORRESPONDS TO THE EAST       DRIVER.1404
C         LONGITUDE OF THE SUN BEING SMALLER THAN THE VALUE EXPECTED     DRIVER.1405
C         BASED ON A MEAN SUN.)  ANNUAL EDITIONS OF THE NAUTICAL         DRIVER.1406
C         ALMANAC PRIOR TO 1962 TABULATED VALUES OF THE EQUATION-OF-TIMEDRIVER.1407
C         AT 12-HR INTERVALS.  THESE TABULATED VALUES OF THE EQUATION-OFDRIVER.1408
C         -TIME COULD BE ADDED TO THE GREENWICH MEAN TIME (OR UNIVERSAL  DRIVER.1409
C         TIME) TO OBTAIN THE GREENWICH APPARENT (OR ACTUAL MOTION)      DRIVER.1410
C         TIME.  NEWER ANNUAL EDITIONS OF THE AMERICAN EPHEMERIS AND     DRIVER.1411
C         NAUTICAL ALMANAC OR THE ASTRONOMICAL EPHEMERIS DO NOT EVEN     DRIVER.1412
C         EXPLICITLY REFER TO THE TERM EQUATION-OF-TIME.  INSTEAD, FOR   DRIVER.1413
C         MERIDIAN TRANSITS AND OTHER PHENOMENA THAT DEPEND ON HOUR      DRIVER.1414
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C          ANGLES AND GEOGRAPHIC LOCATION, THE NEWER EDITIONS REFER NOT   DRIVER,1415
C          TO THE GREENWICH MERIDIAN AND TO UNIVERSAL TIME BUT TO A       DRIVER,1416
C          MERIDIAN 1.002738*(DELTA T) EAST OF THE GEOGRAPHIC MERIDIAN    DRIVER,1417
C          OF GREENWICH (KNOWN AS THE EPHEMERIS MERIDIAN) AND TO          DRIVER,1418
C          EPHEMERIS TIME.  THE SOLAR EPHEMERIS TRANSIT, WHICH IS THE     DRIVER,1419
C          EPHEMERIS TIME AT THE INSTANT OF SOLAR TRANSIT ACROSS THE      DRIVER,1420
C          EPHEMERIS MERIDIAN, IS TABULATED AT 1-DAY INTERVALS IN THE     DRIVER,1421
C          NEWER EDITIONS.  WE HAVE ADOPTED THE DEPARTURE OF THE VALUE OF DRIVER,1422
C          THE SOLAR EPHEMERIS TRANSIT FROM 12 HR 00 MIN 00 SEC AS A      DRIVER,1423
C          CONVENIENT APPROXIMATION TO THE NEGATIVE VALUE OF THE          DRIVER,1424
C          EQUATION-OF-TIME.  IN PARTICULAR, WE HAVE USED VALUES OF THE   DRIVER,1425
C          SOLAR EPHEMERIS TRANSIT FOR 1974 TABULATED IN THE 1974 EDITIONDRIVER,1426
C          OF EITHER THE ASTRONOMICAL EPHEMERIS OR THE AMERICAN EPHEMERISDRIVER,1427
C          AND NAUTICAL ALMANAC, AND FITTED OUR ADOPTED VALUES OF THE     DRIVER,1428
C          EQUATION-OF-TIME BY A FOUR-TERM FOURIER SERIES.  WE IGNORE THEDRIVER,1429
C          WEAK DEPENDENCE OF THE EQUATION-OF-TIME ON THE YEAR OF         DRIVER,1430
C          INTEREST.  LOWEN'S FITTED EXPRESSION FOR THE EQUATION-OF-TIME  DRIVER,1431
C          IS GIVEN BY                                                    DRIVER,1432
C                                                                         DRIVER,1433
C          EQT = 0.385175*COS(F) - 3.146125*COS(F2)                       DRIVER,1434
C              + 7.392635*SIN(F) - 9.536825*SIN(F2) ,  MIN                DRIVER,1435
C                                                                         DRIVER,1436
C          WHERE                                                          DRIVER,1437
C                   F = RADDAY*(DAYJ-YREJ)                                DRIVER,1438
C                  F2 = 2.*F                                              DRIVER,1439
C             RADDAY = 2.*PI/365.25 RADIANS PER DAY                       DRIVER,1440
C                    = 0.017202423R ,                                     DRIVER,1441
C          TO CONVERT FROM MINUTES OF TIME TO RADIANS OF LONGITUDE WE     DRIVER,1442
C          MUST MULTIPLY EQT BY                                           DRIVER,1443
C             RADMIN = 2.*PI/1440 RADIANS PER MINUTE                      DRIVER,1444
C                    = 0.00436332313 ,                                    DRIVER,1445
C          THUS, THE EAST LONGITUDE (RADIANS) OF THE APPARENT SUN IS      DRIVER,1446
C             SOLLON = SOLLON-RADMIN*EQT                                  DRIVER,1447
C          THE NORTH LATITUDE (RADIANS) OF THE APPARENT SUN IS            DRIVER,1448
C             SOLLAT = SLATMX*SIN( (DAYJUT-VEQJ)*RADDAY )                 DRIVER,1449
C          WHERE THE MAXIMUM VALUE OF THE SOLAR LATITUDE IS               DRIVER,1450
C             SLATMX = 0.409123 RADIANS .                                 DRIVER,1451
CCC                                                                       DRIVER,1452
      COMMON/TIME/  IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,GAT                  DRIVER,1453
CCC                                                                       DRIVER,1454
C     DEFINITIONS OF DATA AND CONSTANTS                                   DRIVER,1455
C                PI = 3.141592653590                                      DRIVER,1456
C               PI2 = 2.*PI                                               DRIVER,1457
C           RADDAY = PI2/365.25 RADIANS PER DAY IN A JULIAN YEAR          DRIVER,1458
C                  = 0.017202423R                                         DRIVER,1459
C           RADMIN = PI2/1440 RADIANS PER MINUTE IN A DAY                 DRIVER,1460
C                  = 0.00436332313                                        DRIVER,1461
C           SLATMX = MAXIMUM VALUE OF SOLAR LATITUDE                      DRIVER,1462
C                  = 0.409123 RADIANS                                     DRIVER,1463
CCC                                                                       DRIVER,1464
      DATA  PI,SLATMX / 3.141592653590, 0.409123 /                        DRIVER,1465
CCC                                                                       DRIVER,1466
      PI2 = 2.*PI                                                         DRIVER,1467
11    RADDAY = PI2/365.25                                                 DRIVER,1468
12    RADMIN = PI2/1440.                                                  DRIVER,1469
13    UTD24 = UT/24.                                                      DRIVER,1470
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15          DAYJUT = DAYJ + UTD24                                          DRIVER.1471
16          DAYNO = DAYJUT - YREJ                                          DRIVER.1472
20          SOLLON = PI2*(1.0-DAYJUT+AINT( DAYJUT ))                       DRIVER.1473
24          IF( SOLLON.LT.0.0 )  SOLLON = SOLLON+PI2                       DRIVER.1474
27          F = RADDAY*DAYNO                                               DRIVER.1475
31          F2 = 2.*F                                                      DRIVER.1476
33          EQT = 0.385175*COS(F) - 3.146125*COS(F2)                       DRIVER.1477
           *     - 7.392635*SIN(F) - 9.536825*SIN(F2)                      DRIVER.1478
54          GAT = UT + EQT/60.                                             DRIVER.1479
57          SOLLON = SOLLON - RADMIN*EQT                                   DRIVER.1480
61          SOLLAT = SLATMX*SIN( (DAYJUT-VEQJ)*RADDAY )                    DRIVER.1481
72          RETURN                                                         DRIVER.1482
72          END                                                            DRIVER.1483
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SOLVE

```
      SUBROUTINE SOLVE (A, X, NO)                                          DRIVER,1484
CCC                                                                        DRIVER,1485
C          SUBROUTINE SOLVE, CALLED FROM SUBROUTINE FITTER, SOLVES A SET   DRIVER,1486
C          OF NO SIMULTANEOUS LINEAR ALGEBRAIC EQUATIONS BY USING          DRIVER,1487
C          GAUSS-JORDAN METHOD WITH MAXIMUM PIVOT FEATURE. (SEE, FORTRAN   DRIVER,1488
C          IV PROGRAMMING AND COMPUTING BY JAMES T. GOLDEN, PRENTICE-HALL, DRIVER,1489
C          INC., PAGES 88-99) 1965                                         DRIVER,1490
CCC                                                                        DRIVER,1491
C      INPUT PARAMETERS                                                    DRIVER,1492
C            A(I,J) - MATRIX OF CONSTANT COEFFICIENTS IN SET CONTAINING    DRIVER,1493
C                     THE NUMBER NO SIMULTANEOUS LINEAR ALGEBRAIC          DRIVER,1494
C                     EQUATIONS                                            DRIVER,1495
C                NO - THE NUMBER OF EQUATIONS                              DRIVER,1496
CCC                                                                        DRIVER,1497
C      OUTPUT PARAMETERS                                                   DRIVER,1498
C              X(K) - THE LEAST-SQUARES FIT COEFFICIENTS                   DRIVER,1499
CCC                                                                        DRIVER,1500
      DIMENSION  A(20,21), B(20,21), X(20), LOC(20), ROW(20)               DRIVER,1501
      KNO = NO+1                                                           DRIVER,1502
  6   DO 150 I=1,NO                                                        DRIVER,1503
 10   DO 150 J=1,KNO                                                       DRIVER,1504
 17   B(I,J) = A(I,J)                                                      DRIVER,1505
 20 150 CONTINUE                                                           DRIVER,1506
 26   DO 10 M=1,NO                                                         DRIVER,1507
 33   LOC(M) = 0                                                           DRIVER,1508
 34  10 ROW(M) = 0.0                                                       DRIVER,1509
 35   NP = NO+1                                                            DRIVER,1510
 41   DO 100 I=1,NO                                                        DRIVER,1511
 42   IP = I+1                                                             DRIVER,1512
C-----FIND MAX ELEMENT IN I-TH COL.                                        DRIVER,1513
 43   AMAX = 0.0                                                           DRIVER,1514
 44   DO 2 K=1,NO                                                          DRIVER,1515
 46   IF(AMAX - ABS( A(K,I))) 3,2,2                                        DRIVER,1516
C-----IS NEW MAX IN ROW PREVIOUSLY USED AS PIVOT.                          DRIVER,1517
 50 3 IF(ROW(K)) 4,4,2                                                     DRIVER,1518
 62 4 LOC(I) = K                                                           DRIVER,1519
 63   AMAX = ABS( A(K,I))                                                  DRIVER,1520
 64 2 CONTINUE                                                             DRIVER,1521
 67   IF(AMAX) 99,99,98                                                    DRIVER,1522
C-----MAX ELEMENT IN I-TH COL IS A(L,I)                                    DRIVER,1523
 70  98 L = LOC(I)                                                         DRIVER,1524
 72   ROW(L) = 1.0                                                         DRIVER,1525
C-----PERFORM ELIMINATION, L IS PIVOT ROW, A(L,I) IS PIVOT ELEMENT.        DRIVER,1526
 74   DO 50 J=1,NO                                                        DRIVER,1527
 75   IF(L-J) 6,50,6                                                       DRIVER,1528
 76 6 QF = -A(J,I)/A(L,I)                                                  DRIVER,1529
104   DO 40 K=IP,NP                                                        DRIVER,1530
115   A(J,K) = A(J,K)+QF*A(L,K)                                            DRIVER,1531
117  40 CONTINUE                                                           DRIVER,1532
122  50 CONTINUE                                                           DRIVER,1533
125 100 CONTINUE                                                           DRIVER,1534
127   DO 200 I=1,NO                                                        DRIVER,1535
137   L = LOC(I)                                                           DRIVER,1536
140 200 X(I) = A(L,NO+1)/A(L,I)                                            DRIVER,1537
C     WRITE(6,103)  (J, X(J),J=1,NO)                                       DRIVER,1538
C 103 FORMAT (4(I8,2X,E15,8))                                              DRIVER,1539
146   RETURN                                                               DRIVER,1540
146  99 WRITE(6,104)                                                       DRIVER,1541
     104 FORMAT (5X,27H NO UNIQUE SOLUTION EXISTS.)                        DRIVER,1542
150   RETURN                                                               DRIVER,1543
155   END                                                                  DRIVER,1544
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SOLZEN

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      SUBROUTINE SOLZEN(SOLLAT,SOLLON)                                  DRIVER,1545
CCC                                                                     DRIVER,1546
C          SUBROUTINE SOLZEN COMPUTES COSCHI, THE COSINE OF THE ZENITH  DRIVER,1547
C          ANGLE OF THE SUN AT A POINT P, GIVEN THE GEOGRAPHIC NORTH    DRIVER,1548
C          LATITUDE PLAT AND EAST LONGITUDE PLON OF THE POINT P AND THE DRIVER,1549
C          NORTH LATITUDE SOLLAT AND EAST LONGITUDE SOLLON OF THE       DRIVER,1550
C          SUBSOLAR POINT.  THE DAY-OR-NIGHT PARAMETER IDORN IS 1 FOR   DRIVER,1551
C          DAYTIME, I.E., IF(COSCHI.GE.0.0),  AND IS -1 FOR NIGHTTIME,  DRIVER,1552
C          I.E., IF(COSCHI.LT.0.0).  THE LOCAL APPARENT TIME HL         DRIVER,1553
C          IS ALSO COMPUTED FROM THE GREENWICH APPARENT TIME GAT AND THE DRIVER,1554
C          LONGITUDE PLON.                                              DRIVER,1555
CCC                                                                     DRIVER,1556
C     INPUT PARAMETERS                                                  DRIVER,1557
C               PLAT = NORTH LATITUDE OF POINT P (RADIANS)              DRIVER,1558
C               PLON = EAST LONGITUDE OF POINT P (RADIANS)              DRIVER,1559
C             SOLLAT = NORTH LATITUDE OF SUBSOLAR POINT (RADIANS)       DRIVER,1560
C             SOLLON = EAST LONGITUDE OF SUBSOLAR POINT (RADIANS)       DRIVER,1561
CCC                                                                     DRIVER,1562
C     OUTPUT PARAMETERS                                                 DRIVER,1563
C               IDORN = PARAMETER FOR DAY OR NIGHT.  IF COSCHI IS       DRIVER,1564
C                       THE COSINE OF THE ZENITH ANGLE OF THE SUN AT    DRIVER,1565
C                       POINT P, IDORN IS 1 FOR DAYTIME, I.E.,          DRIVER,1566
C                       IF(COSCHI.GE.0.0), AND IS -1 FOR NIGHTTIME,     DRIVER,1567
C                       I.E., IF(COSCHI.LT.0.0) .  IDORN IS AN INPUT TO DRIVER,1568
C                       ATMOSU THROUGH COMMON ATMOUP.                   DRIVER,1569
C                  HL = LOCAL APPARENT TIME (DECIMAL HRS, E.G. 2230 HRS DRIVER,1570
C                       BECOMES 22.50 HRS).  HL IS AN INPUT TO ATMOSU   DRIVER,1571
C                       THROUGH COMMON ATMOUP.                          DRIVER,1572
CCC                                                                     DRIVER,1573
      COMMON/ATMOUP/  HL,SHAB,IDORN,PP,PHO,TT,SNI(16),HRHO,FEHSEQ       DRIVER,1574
      COMMON/TIME/  TYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,GAT                DRIVER,1575
      DATA  PI / 3.141592653590 /                                       DRIVER,1576
CCC                                                                     DRIVER,1577
C          THE FOLLOWING FORMULA IS BASED ON EQ. (1.41) OF IONOSPHERIC  DRIVER,1578
C          RADIO PROPAGATION BY K. DAVIES, NBS MONOGRAPH 80, 1965       DRIVER,1579
C          APRIL 1.  IT MAY ALSO BE DERIVED BY APPLYING THE LAW OF      DRIVER,1580
C          COSINES FOR AN OBLIQUE SPHERICAL TRIANGLE.                   DRIVER,1581
CCC                                                                     DRIVER,1582
      COSCHI = SIN(PLAT) * SIN(SOLLAT)                                  DRIVER,1583
     *       + COS(PLAT) * COS(SOLLAT) * COS(PLON-SOLLON)               DRIVER,1584
27    IDORN = 1                                                         DRIVER,1585
30    IF( COSCHI.LT.0.0 )  IDORN = -IDORN                               DRIVER,1586
34    PI2 = 2.*PI                                                       DRIVER,1587
36    RADHR = PI/12.                                                    DRIVER,1588
37    HL = GAT - (PI2-PLON)/RADHR                                       DRIVER,1589
42    IF( HL.LT.0.0 )  HL = HL+24.                                      DRIVER,1590
46    RETURN                                                            DRIVER,1591
47    END                                                               DRIVER,1592
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SPCMIN

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      SUBROUTINE SPCMIN(KK,ZH)                                              DRIVER,1593
CCC                                                                         DRIVER,1594
C          THE HIGH-ALTITUDE CHEMISTRY MODULE REQUIRES THE MINOR NEUTRAL    DRIVER,1595
C          SPECIES O, CO2, N, AND NO.  PROFILES FOR DAY AND NIGHT AT ALL    DRIVER,1596
C          ALTITUDES ARE PROVIDED FOR O AND CO2 IN ATMOSU.  HERE IN         DRIVER,1597
C          SPCMIN WE PROVIDE PROFILES OF N AND NO.                          DRIVER,1598
C          THE LOW-ALTITUDE CHEMISTRY MODULE REQUIRES, IN ADDITION TO O,    DRIVER,1599
C          CO2, N, AND NO, THE MINOR NEUTRAL SPECIES H2O, O2(SINGLET        DRIVER,1600
C          DELTA G), O3, AND NO2, ALSO PROVIDED BY SPCMIN.                  DRIVER,1601
C      INPUT PARAMETERS                                                     DRIVER,1602
C          ARGUMENT LIST                                                    DRIVER,1603
C                KK - CALCULATION FLAG                                      DRIVER,1604
C                     = 1, CALCULATE INITIALIZATION PARAMETERS              DRIVER,1605
C                     = 2, CALCULATE ATMOSPHERIC PROPERTIES                 DRIVER,1606
C                ZH - ALTITUDE OF INTEREST (KM)                             DRIVER,1607
C          ATMOUP COMMON                                                    DRIVER,1608
C              IDORN - INDEX FOR DAY OR NIGHT                               DRIVER,1609
C                     = +1, DAY                                             DRIVER,1610
C                     = -1, NIGHT                                           DRIVER,1611
C          ALTODN COMMON                                                    DRIVER,1612
C              SIZ2N                                                        DRIVER,1613
C      OUTPUT PARAMETERS                                                    DRIVER,1614
C          ATMOUP COMMON                                                    DRIVER,1615
C            SNI( 7) - N        DENSITY,  1/CM**3                          DRIVER,1616
C            SNI( 8) - NO       DENSITY,  1/CM**3                          DRIVER,1617
C            SNI(13) - O2(SDG)  DENSITY,  1/CM**3                          DRIVER,1618
C            SNI(14) - O3       DENSITY,  1/CM**3                          DRIVER,1619
C            SNI(15) - NO2      DENSITY,  1/CM**3                          DRIVER,1620
C            SNI(16) - H2O      DENSITY,  1/CM**3                          DRIVER,1621
C          ALTODN COMMON                                                    DRIVER,1622
C             NALTOD - NUMBER OF ALTITUDES AT WHICH THE DAYTIME             DRIVER,1623
C                      O-VALUES ARE SPECIFIED AS DATA                       DRIVER,1624
C          ALTKM(47) - THE ALTITUDES AT WHICH MINOR SPECIES ARE             DRIVER,1625
C                      SPECIFIED AS DATA                                    DRIVER,1626
C           ODAY(27) - THE DAYTIME O-VALUES SPECIFIED AS DATA               DRIVER,1627
C          ONITE(18) - THE NIGHTTIME O-VALUES SPECIFIED AS DATA             DRIVER,1628
C            CO2(25) - THE CO2-VALUES SPECIFIED AS DATA                     DRIVER,1629
CCC                                                                         DRIVER,1630
      DIMENSION  AA(13),BB(13),CC(13),ANONIT(18),ANDAY(47),ANNITE(47)       DRIVER,1631
      DIMENSION  O2SDGD(47),O2SDGN(47),O3DAY(27),O3NIT(27),DD(11)           DRIVER,1632
      DIMENSION  Y(6),Z(6),EE(10),UO3(6),VO3(6),WO3(6)                      DRIVER,1633
      DIMENSION  H2ODN(25),GG(13),ANODAY(45)                                DRIVER,1634
      DIMENSION A(20,21),X(9),ZINDN(8),ANONZI(8),ZIM2NO(8)                  DRIVER,1635
      DIMENSION  SNO2D(33),SNO2N(33),HH(13)                                 DRIVER,1636
      COMMON/ATMOUP/  HL,SBAR,IDORN,PP,RHO,TT,SNI(16),HRHO,FEHSEQ           DRIVER,1637
      COMMON/ALTODN/  NALTOD,ALTKM(47),ODAY(27),ONITE(18),SIZ2N,CO2(25)     DRIVER,1638
      COMMON/ZHCHEX/  ZHFLAG                                                DRIVER,1639
CCC                                                                         DRIVER,1640
      DATA  NDEGND / 12 /, NDEGND,NDEGNN / 8, 6 /                           DRIVER,1641
      DATA  NALTOD,NALTND / 27,25 /, NALTND,NALTNN / 39,30 /                DRIVER,1642
      DATA  NDGO2D,NALTO2 / 10,11 /                                         DRIVER,1643
      DATA  NDGH2O,NKMH2O / 12,25 /                                         DRIVER,1644
      DATA  NDGNO2,NKMNO2 / 12,33 /                                         DRIVER,1645
      DATA  (ALTKM(I),I=1,47) /  0.,5.,10.,15.,20.,25.,30.,35.,40.,45.,     DRIVER,1646
     *                          50.,55.,60.,65.,70.,75.,80.,85.,90.,95.,    DRIVER,1647
     *  100.,105.,110.,115.,120.,125.,130.,135.,140.,145.,150.,155.,        DRIVER,1648
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     *  160.,165.,170.,175.,180.,185.,190.,195.,200.,205.,210.,215.,     DRIVER.1649
     *  220.,225.,230. /                                                 DRIVER.1650
C         BFM VALUES  11/09/74     FOR  O   DAY                        DRIVER.1651
      DATA  (ODAY(I),I=1,27) /  1.0E+03,6.2E+03,2.2E+04,1.9E+05,1.0E+06,DRIVER.1652
     *                          7.0E+06,4.5E+07,2.6E+08,9.8E+08,2.9E+09,DRIVER.1653
     *  6.7E+09,1.3E+10,2.4E+10,3.1E+10,2.8E+10,4.5E+10,7.1E+10,1.1E+11,DRIVER.1654
     *  1.7E+11,4.6E+11,4.3E+11,3.3E+11,2.0E+11,1.3E+11,6.3E+10,4.4E+10,DRIVER.1655
     *  3.7E+10 /                                                        DRIVER.1656
C         BFM VALUES  02/22/75     FOR O   NIGHT                       DRIVER.1657
      DATA  (ONITE(I),I=1,18) /  13*1.1, 2*0.0, 4.90E+08,               DRIVER.1658
     *                           3.00E+10, 9.00E+10 /                  DRIVER.1659
C         BFM VALUES  12/07/74     FOR CO2                             DRIVER.1660
      DATA  (CO2(I),I=1,25) / 21*0.0, 1.30E+09,4.80E+08,1.70E+08,       DRIVER.1661
     *                                 5.65E+07 /                      DRIVER.1662
C         THE CO2 VALUES AT ALTITUDES FROM 0.0 TO 100. KM ARE RESET     DRIVER.1663
C         IN SUBROUTINE ATMOSU BY USING A CONSTANT MIXING-RATIO OF      DRIVER.1664
C         3.20E-04                                                      DRIVER.1665
C         BFM VALUES  04/05/75     FOR  NO  DAY                        DRIVER.1666
      DATA  (ANODAY(I),I=1,25) / 1.00E+10,3.40E+09,1.30E+09,5.80E+08,   DRIVER.1667
     *                           7.00E+08,1.75E+09,2.10E+09,1.75E+09,   DRIVER.1668
     * 1.25E+09,8.50E+08,5.10E+08,3.00E+08,1.40E+08,5.50E+07,3.70E+07,  DRIVER.1669
     * 3.30E+07,3.50E+07,4.00E+07,4.80E+07,5.80E+07,6.30E+07,5.70E+07,  DRIVER.1670
     * 4.40E+07,3.60E+07,3.00E+07 /                                     DRIVER.1671
C         BFM VALUES  04/05/75     FOR  NO  NIGHT                      DRIVER.1672
      DATA  (ANONIT(I),I=1,18) /  11*1.00E+00,1.00E+04,1.00E+06,        DRIVER.1673
     *                            8.30E+06,1.65E+07,2.50E+07,3.30E+07,  DRIVER.1674
     * 4.00E+07 /                                                       DRIVER.1675
C         BFM VALUES  04/12/75     FOR  N   DAY                        DRIVER.1676
      DATA  (ANDAY(I),I=1,47) / 9*1.00E+00,1.00E+01,1.00E+02,5.00E+02,  DRIVER.1677
     * 1.80E+03,7.40E+03,2.10E+04,5.20E+04,1.10E+05,2.20E+05,3.70E+05,  DRIVER.1678
     * 6.40E+05,1.00E+06,1.30E+06,2.00E+06,2.70E+06,3.40E+06,4.30E+06,  DRIVER.1679
     * 5.00E+06,5.90E+06,6.50E+06,7.00E+06,7.50E+06,7.90E+06,8.10E+06,  DRIVER.1680
     * 8.30E+06,8.40E+06,8.50E+06,8.50E+06,8.40E+06,8.30E+06,8.20E+06,  DRIVER.1681
     * 8.10E+06,8.00E+06,7.80E+06,7.50E+06,7.30E+06,7.10E+06,6.80E+06 /  DRIVER.1682
C         BFM VALUES  04/12/75     FOR  N   NIGHT                      DRIVER.1683
      DATA  (ANNITE(I),I=1,47)/18*1.00E+00,1.20E+01,1.20E+02,7.00E+02,  DRIVER.1684
     * 3.10E+03,1.10E+04,3.00E+04,7.30E+04,1.60E+05,3.00E+05,4.00E+05,  DRIVER.1685
     * 4.80E+05,5.60E+05,6.30E+05,6.80E+05,7.20E+05,7.50E+05,7.80E+05,  DRIVER.1686
     * 7.90E+05,7.90E+05,7.80E+05,7.70E+05,7.50E+05,7.20E+05,6.90E+05,  DRIVER.1687
     * 6.60E+05,6.30E+05,6.00E+05,5.60E+05,5.10E+05 /                   DRIVER.1688
C         BFM VALUES  01/04/75     FOR  O2(SDG)  DAY                   DRIVER.1689
      DATA  (O2SDGD(I),I=1,47) / 2.60E+06,4.40E+06,2.70E+07,1.25E+08,   DRIVER.1690
     *                           4.90E+08,1.25E+09,2.70E+09,9.00E+09,   DRIVER.1691
     * 1.80E+10,2.70E+10,3.50E+10,2.10E+10,1.50E+10,1.00E+10,6.10E+09,  DRIVER.1692
     * 3.10E+09,2.05E+09,3.60E+09,1.30E+09,3.00E+08,5.60E+07,4.30E+06,  DRIVER.1693
     * 6.20E+05,1.00E+05,1.40E+04,3.30E+03,7.10E+02,2.60E+02,1.00E+02,  DRIVER.1694
     * 4.70E+01,2.30E+01,1.20E+01,15*6.10 /                             DRIVER.1695
C         BFM VALUES  01/04/75     FOR  O2(SDG)  NIGHT                 DRIVER.1696
      DATA  (O2SDGN(I),I=1,47) / 15*3.40,5.80E+02,1.00E+05,8.60E+07,    DRIVER.1697
     *                           2.00E+08,1.40E+08,5.60E+07,4.30E+06,   DRIVER.1698
     * 6.20E+05,1.00E+05,1.40E+04,3.30E+03,7.10E+02,2.60E+02,1.00E+02,  DRIVER.1699
     * 4.70E+01,2.30E+01,1.20E+01,15*6.10 /                             DRIVER.1700
C         BFM VALUES  01/18/75     FOR  O3       DAY                   DRIVER.1701
      DATA  (O3DAY(I),I=1,27) /  8.0E+11,5.7E+11,1.1E+12,2.5E+12,       DRIVER.1702
     *                           4.8E+12,4.3E+12,2.5E+12,1.4E+12,       DRIVER.1703
     *   6.1E+11,2.0E+11,6.7E+10,2.0E+10,7.4E+09,2.1E+09,5.5E+08,       DRIVER.1704
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     *    1.3E+08,6.8E+07,1.2E+08,3.0E+07,2.4E+06,2.5E+05,3.4E+04,          DRIVER.1705
     *    3.7E+03,3.8E+02,4.2E+01,7.3E+00,0.0 /                             DRIVER.1706
C          BEM VALUES  01/18/75     FOR  O3        NIGHT                    DRIVER.1707
      DATA  (O3NIT(I),I=1,27) /  8.0E+11,5.7E+11,1.1E+12,2.5E+12,           DRIVER.1708
     *                           4.8E+12,4.3E+12,2.5E+12,1.4E+12,           DRIVER.1709
     *    6.1E+11,2.0E+11,6.7E+10,2.0E+10,1.3E+10,1.2E+10,4.5E+09,          DRIVER.1710
     *    7.7E+08,6.1E+07,5.8E+08,1.7E+08,2.7E+07,2.7E+06,2.9E+05,          DRIVER.1711
     *    4.0E+04,3.5E+03,1.9E+02,2.4E+01,2.8E+00 /                         DRIVER.1712
C          BEM VALUES  05/10/75     FOR  H2O                                DRIVER.1713
      DATA  (H2ODN(I),I=1,25) /  1.9E+17,2.1E+16,6.0E+14,1.2E+13,           DRIVER.1714
     *                           5.2E+12,3.2E+12,1.2E+12,6.2E+11,           DRIVER.1715
     *    4.3E+11,2.1E+11,8.4E+10,3.6E+10,1.7E+10,9.2E+09,4.4E+09,          DRIVER.1716
     *    1.8E+09,6.5E+08,2.0E+08,4.9E+07,8.4E+06,1.1E+06,1.3E+05,          DRIVER.1717
     *    2.5E+04,8.7E+03,3.3E+03 /                                         DRIVER.1718
C          BEM VALUES  02/14/75     FOR  NO2   DAY                          DRIVER.1719
      DATA  (SNO2D(I),I=1,33) /  2.50E+10,8.30E+09,1.40E+09,1.40E+09,       DRIVER.1720
     *                           1.80E+09,2.40E+09,2.50E+09,1.25E+09,       DRIVER.1721
     *  3.40E+08,7.10E+07,7.80E+06,2.30E+06,7.00E+05,2.60E+05,1.00E+05,      DRIVER.1722
     *  5.00E+04,2.40E+04,1.20E+04,6.40E+03,3.40E+03,1.80E+03,1.10E+03,      DRIVER.1723
     *  6.70E+02,4.30E+02,2.80E+02,1.90E+02,1.40E+02,1.15E+02,9.50E+01,      DRIVER.1724
     *  8.00E+01,7.00E+01,6.00E+01,4.60E+01 /                               DRIVER.1725
C          BEM VALUES  02/14/75     FOR  NO2   NIGHT                        DRIVER.1726
      DATA  (SNO2N(I),I=1,33) /  3.50E+10,1.20E+10,2.70E+09,2.00E+09,       DRIVER.1727
     *                           2.50E+09,4.15E+09,4.55E+09,3.00E+09,       DRIVER.1728
     *  1.60E+09,9.20E+08,5.20E+08,3.00E+08,1.40E+08,5.50E+07,1.20E+07,      DRIVER.1729
     *  1.00E+06,3.00E+04,1.20E+04,6.40E+03,3.40E+03,1.80E+03,1.10E+03,      DRIVER.1730
     *  6.70E+02,4.30E+02,2.80E+02,1.90E+02,1.40E+02,1.15E+02,9.50E+01,      DRIVER.1731
     *  8.00E+01,7.00E+01,6.00E+01,4.60E+01 /                               DRIVER.1732
CCC                                                                         DRIVER.1733
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE NITRIC OXIDE IN     DRIVER.1734
C * * * DAYTIME FOR ALTITUDES BELOW 120. KM.                               DRIVER.1735
CCC                                                                         DRIVER.1736
      ANODAF( BQ ) = EXP((((((((((( AA(13)*BQ + AA(12))*BQ + AA(11))*BQDRIVER.1737
     *              + AA(10))*BQ + AA(9))*BQ + AA(8))*BQ + AA(7))*BQ      DRIVER.1738
     *              + AA(6))*BQ + AA(5))*BQ + AA(4))*BQ + AA(3))*BQ       DRIVER.1739
     *              + AA(2))*BQ + AA(1))                                  DRIVER.1740
CCC                                                                         DRIVER.1741
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE ATOMIC NITROGEN    DRIVER.1742
C * * * IN DAYTIME FOR ALTITUDES ABOVE 40. AND BELOW 230. KM.              DRIVER.1743
CCC                                                                         DRIVER.1744
      ANDAF( BQ )  = EXP(((((((( BB(9)*BQ + BB(8))*BQ + BB(7))*BQ         DRIVER.1745
     *             + BB(6))*BQ + BB(5))*BQ + BB(4))*BQ + BB(3))*BQ        DRIVER.1746
     *             + BB(2))*BQ + BB(1))                                   DRIVER.1747
CCC                                                                         DRIVER.1748
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE ATOMIC NITROGEN    DRIVER.1749
C * * * AT NIGHTTIME FOR ALTITUDES FROM 85. KM TO 230. KM.                 DRIVER.1750
CCC                                                                         DRIVER.1751
      ANNAF( BQ ) = EXP((((((  CC(7)*BQ                                    DRIVER.1752
     *              + CC(6))*BQ + CC(5))*BQ + CC(4))*BQ + CC(3))*BQ       DRIVER.1753
     *              + CC(2))*BQ + CC(1))                                  DRIVER.1754
CCC                                                                         DRIVER.1755
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE O2(1 DELTA)        DRIVER.1756
C * * * IN DAYTIME FOR ALTITUDES BELOW 50.  KM.                           DRIVER.1757
CCC                                                                         DRIVER.1758
      AO2SDF( BQ ) = EXP((((((((((  DD(11)*BQ + DD(10))*BQ + DD(9))*BQ     DRIVER.1759
     *              + DD(8))*BQ + DD(7))*BQ + DD(6))*BQ + DD(5))*BQ       DRIVER.1760
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     *              + DD(4))*BQ + DD(3))*BQ + DD(2))*BQ + DD(1))                DRIVER,1761
CCC                                                                            DRIVER,1762
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE WATER FOR               DRIVER,1763
C * * * DAYTIME OR NIGHTTIME FOR ALTITUDES BELOW 120. KM                        DRIVER,1764
CCC                                                                            DRIVER,1765
      AH2OFF( BQ ) = EXP((((((((((( GG(13)*BQ + GG(12))*BQ + GG(11))*BQDRIVER,1766
     *              + GG(10))*BQ + GG(9))*BQ + GG(8))*BQ + GG(7))*BQ          DRIVER,1767
     *              + GG(6))*BQ + GG(5))*BQ + GG(4))*BQ + GG(3))*BQ           DRIVER,1768
     *              + GG(2))*BQ + GG(1))                                      DRIVER,1769
CCC                                                                            DRIVER,1770
C * * * ARITHMETIC STATEMENT FUNCTION USED TO CALCULATE NO2 FOR               DRIVER,1771
C * * * DAYTIME AT ALTITUDES BELOW 160. KM.                                   DRIVER,1772
CCC                                                                            DRIVER,1773
      AN2OFF( BQ ) = EXP((((((((((( HH(13)*BQ + HH(12))*BQ + HH(11))*BQDRIVER,1774
     *              + HH(10))*BQ + HH(9))*BQ + HH(8))*BQ + HH(7))*BQ          DRIVER,1775
     *              + HH(6))*BQ + HH(5))*BQ + HH(4))*BQ + HH(3))*BQ           DRIVER,1776
     *              + HH(2))*BQ + HH(1))                                      DRIVER,1777
CCC                                                                            DRIVER,1778
      GO TO (100,200), KK                                                      DRIVER,1779
C       INITIALIZATION, CALLED FROM SUBROUTINE ATMOSU DURING ITS               DRIVER,1780
C       INITIALIZATION.                                                        DRIVER,1781
232   100 CONTINUE                                                             DRIVER,1782
232       ALOGTE = ALOG10( EXP(1.0) )                                          DRIVER,1783
C           ATOMIC NITROGEN PROFILE PARAMETERS.                                DRIVER,1784
236       IF( IDORN )  105,110,110                                             DRIVER,1785
C           NIGHTTIME N                                                        DRIVER,1786
242   105 Z1NN = ALTKM(18)                                                     DRIVER,1787
243       Z2NN = ALTKM(47)                                                     DRIVER,1788
245       CALL FITTER(NALTNN,ALTKM(18),ANNITE(18),NDEGNN, 1 , 2 , CC)          DRIVER,1789
254       ANNZ1 = ANNAF( Z1NN )                                                DRIVER,1790
257       ANNZ2 = ANNAF( Z2NN )                                                DRIVER,1791
263       GO TO 115                                                            DRIVER,1792
C           DAYTIME N                                                          DRIVER,1793
263   110 Z1ND = ALTKM(9)                                                      DRIVER,1794
264       Z2ND = ALTKM(47)                                                     DRIVER,1795
266       CALL FITTER(NALTND,ALTKM(9),ANDAY(9),NDEGND, 1 , 2 , BB)             DRIVER,1796
275       ANDZ1 = ANDAF( Z1ND )                                                DRIVER,1797
300       ANDZ2 = ANDAF( Z2ND )                                                DRIVER,1798
304   115 CONTINUE                                                             DRIVER,1799
C           NITRIC OXIDE PROFILE PARAMETERS.                                   DRIVER,1800
C           FOR DAYTIME NO..                                                   DRIVER,1801
C           IF(ZH.LT.Z7ND), WHERE Z7ND = 120 KM, NO = SNI(8) = ANODAF(ZH)      DRIVER,1802
C           WHERE THE POLYNOMIAL COEFFICIENTS AA(I) IN THE ARITHMETIC          DRIVER,1803
C           FUNCTION ANODAF(ZH) ARE DETERMINED BY SUBROUTINE FITTER.           DRIVER,1804
304       CALL FITTER(NALTNO,ALTKM,ANODAY,NDEGNO, 1 , 2 , AA)                  DRIVER,1805
C           SET ALTITUDE VARIABLES AT 115, 120, AND 125 KM.                    DRIVER,1806
313       Z6NO = ALTKM(24)                                                     DRIVER,1807
314       Z7NO = ALTKM(25)                                                     DRIVER,1808
316       Z8NO = ALTKM(26)                                                     DRIVER,1809
C           COMPUTE FIT-FUNCTION VALUES OF NO AT ALTITUDES Z6NO=115 KM         DRIVER,1810
C           AND Z7NO=120 KM.                                                   DRIVER,1811
320       ANOZ6 = ANODAF(Z6NO)                                                 DRIVER,1812
323       ANOZ7 = ANODAF(Z7NO)                                                 DRIVER,1813
C           APPROXIMATE DERIVATIVE OF ALOG(NO) AT ALTITUDE Z7NO=120 KM,        DRIVER,1814
C           DLNOZZ, BY USING THE FIT-FUNCTION VALUES AT ALTITUDES Z6NO=        DRIVER,1815
C           115 KM AND Z7NO=120 KM.                                            DRIVER,1816
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326         DLNO77 = ALOG(ANOZ7/ANOZ6)/(Z7NO-Z6NO)                          DRIVER,1817
      C         SET THE CUBE OF THE 10.7-CM SOLAR FLUX SBAR, SBAR3,          DRIVER,1818
336         SBAR3 = SBAR**3                                                 DRIVER,1819
      C         PRESCRIBE THE DERIVATIVE OF ALOG(NO) AT ALTITUDE Z8NO=125 KM, DRIVER,1820
      C         DLNO8Z, TO BE GIVEN BY                                       DRIVER,1821
337         DLNO8Z = 0.0657*SBAR3/(SBAR3+5.E5) + 0.0764 + 0.0270*DLNO7Z     DRIVER,1822
      C         FOR LATER USE, COMPUTE                                       DRIVER,1823
345         ANOZ8 = ANOZ7*EXP(2.5*(DLNO7Z+DLNO8Z))                          DRIVER,1824
      C         IF(ZH.GE.Z7NO .AND. ZH.LT.Z8NO), THEN                        DRIVER,1825
      C            SNI(8)=ANOZ7*EXP(ZHM120*DLNO7Z + 0.1*ZHM120**2*(DLNO7Z-   DRIVER,1826
      C                 DLNO8Z))                                            DRIVER,1827
      C         WHERE ZHM120=ZH-120.                                         DRIVER,1828
      C         IF(ZH.GE.Z8NO), THEN                                         DRIVER,1829
      C            SNI(8)=ANOZ8*EXP(ZHM125*DLNO8Z)                           DRIVER,1830
      C         WHERE ZHM125=ZH-125 AND ANOZ8=ANOZ7*EXP(2.5*(DLNO7Z+DLNO8Z)), DRIVER,1831
      C         AT NIGHTTIME, NO DIFFERS FROM DAYTIME NO BELOW ALTITUDE Z4NON DRIVER,1832
      C         =85 KM AND ABOVE ALTITUDE Z5NON=100 KM.                      DRIVER,1833
      C         IF(ZH.LT.Z1NON), WHERE Z1NON=50 KM, NO=ANONZ1=ANONITE(11)=1.0,DRIVER,1834
      C         IF(ZH.GE.Z1NON .AND. ZH.LT.Z2NON), WHERE Z2NON=55 KM,        DRIVER,1835
      C            NO=ANONZ2*EXP((ZH-Z2NON)*ANONST)                          DRIVER,1836
      C         WHERE                                                        DRIVER,1837
      C            ANONZ2=ANONIT(12)=1.E4                                    DRIVER,1838
      C            ANONSI=ALOG(ANONZ2/ANONZ1)/(Z2NON-Z1NON)                  DRIVER,1839
      C         IF(ZH.GE.Z2NON .AND. ZH.LT.Z4NON), WHERE Z4NON=85 KM,        DRIVER,1840
      C            SNI(8)=10.**SUM(X(I)*ZM2NON**(9-I)),I=1,9                 DRIVER,1841
      C         WHERE ZM2NON=ZH-Z2NON AND THE NINE COEFFICIENTS X(I) ARE     DRIVER,1842
      C         DETERMINED SO THAT NOT ONLY ALOG10(NO) EQUALS THE NIGHTTIME  DRIVER,1843
      C         VALUES FOR NO AT ZH=55(5)85 KM BUT ALSO THE SLOPE OF         DRIVER,1844
      C         ALOG10(NO) IS CONTINUOUS AT 55 AND 85 KM.                    DRIVER,1845
      C         THE NIGHTTIME CONSTANTS FOR ALTITUDES BELOW 85 KM ARE NOW SET,DRIVER,1846
352         Z1NON=ALTKM(11)                                                 DRIVER,1847
353         Z2NON=ALTKM(12)                                                 DRIVER,1848
354         ANONZ1=ANONIT(11)                                               DRIVER,1849
356         Z4NON = 85.                                                     DRIVER,1850
357         ANONZ2 = ANONIT(12)                                             DRIVER,1851
361         DO 120 I=2,8                                                    DRIVER,1852
370         Z1NON(I) = ALTKM(I+10)                                          DRIVER,1853
371         ANONZI(I) = ANONIT(I+10)                                        DRIVER,1854
372     120 CONTINUE                                                        DRIVER,1855
373         ANONZI(8) = ANONAF( Z1NON(8) )                                  DRIVER,1856
376         ANONSI = ALOG(ANONZI(2)/ANONZ1)/(Z1NON(2)-Z1NON)                DRIVER,1857
406         DLNO2Z = ANONSI*ALOGTE                                          DRIVER,1858
407         X(8)  = DLNO2Z                                                  DRIVER,1859
411         X(9)  = ALOG10(ANONZ2)                                          DRIVER,1860
413         DO 125 I=3,8                                                    DRIVER,1861
421         Z1M2NO(I) = Z1NON(I)-Z1NON(2)                                   DRIVER,1862
423     125 CONTINUE                                                        DRIVER,1863
424         DO 130 I=1,6                                                    DRIVER,1864
427         ZTI2 = Z1M2NO(I+2)                                              DRIVER,1865
430         A(I,7) = ZTI2*ZTI2                                              DRIVER,1866
431         DO 130 J=1,6                                                    DRIVER,1867
435         A(I,7-J) = ZTI2*A(I,8-J)                                        DRIVER,1868
443     130 CONTINUE                                                        DRIVER,1869
446         ZTI8 = Z1M2NO(8)                                                DRIVER,1870
447         A(7,7) = 2.*ZTI8                                                DRIVER,1871
451         DO 135 J=1,6                                                    DRIVER,1872
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MTN
 457          FJ1 = J+1                                                          DRIVER,1873
 461          A(7,7-J) = ZIIB*((FJ1+1.)/FJ1)*A(7,8-J)                            DRIVER,1874
 473      135 CONTINUE                                                           DRIVER,1875
 474          DO 140 I=1,6                                                       DRIVER,1876
 477          A(I,8) = ALOG10(ANONZT(I+2)) - X(8)*ZTM2NO(I+2) - X(9)             DRIVER,1877
 507      140 CONTINUE                                                           DRIVER,1878
 512          ZBNON = ZINON(8)                                                   DRIVER,1879
 513          A(7,8) = ALOGTE * ((((((((((12.*AA(13))*ZBNON                      DRIVER,1880
             *          + 11.*AA(12))*ZBNON + 10.*AA(11))*ZBNON + 9.*AA(10))*ZBNON DRIVER,1881
             *          + 8.*AA(9))*ZBNON + 7.*AA(8))*ZBNON + 6.*AA(7))*ZBNON  DRIVER,1882
             *          + 5.*AA(6))*ZBNON + 4.*AA(5))*ZBNON + 3.*AA(4))*ZBNON  DRIVER,1883
             *          + 2.*AA(3))*ZBNON + AA(2)) - X(8)                      DRIVER,1884
 547          NO = 7                                                             DRIVER,1885
 550          CALL SOLVE(A,X,NO)                                                 DRIVER,1886
      C           IF(ZH.GE.Z5NO), WHERE Z5NO=ALTKM(21)=100 KM,                  DRIVER,1887
      C              ANONIT=ANODAY*((ZH-100.)**2 + 7200.)/(10.*((ZH-100.)**2    DRIVER,1888
      C                                                    + 7200.))            DRIVER,1889
      C           MOLECULAR OXYGEN (SINGLET DELTA G) PROFILE PARAMETERS.        DRIVER,1890
 553          Z02090 = ALTKM(19)                                                 DRIVER,1891
 554          Z02100 = ALTKM(21)                                                 DRIVER,1892
 556          A02090 = O2SDGD(19)                                                DRIVER,1893
 560          B02090 = -ALOG( O2SDGD(22)/A02090 )/(ALTKM(22)-Z02090)             DRIVER,1894
 567          IF( IDORN )  142,150,150                                           DRIVER,1895
 572      142 Z02070 = ALTKM(15)                                                 DRIVER,1896
 573          Z02080 = ALTKM(17)                                                 DRIVER,1897
 575          A02070 = O2SDGN(15)                                                DRIVER,1898
 576          A02080 = O2SDGN(17)                                                DRIVER,1899
 600          B02070 = -ALOG( A02080/A02070 )/(Z02080-Z02070)                    DRIVER,1900
 607          Z(6) = ALOG10( A02080 )                                            DRIVER,1901
 612          DO 144 I=1,4                                                       DRIVER,1902
 616          ZII2 = ALTKM(I+17)-Z02080                                          DRIVER,1903
 620          A(I,5) = ZII2                                                      DRIVER,1904
 621          DO 144 J=1,4                                                       DRIVER,1905
 624          A(I,5-J) = ZII2*A(I,6-J)                                           DRIVER,1906
 634      144 CONTINUE                                                           DRIVER,1907
 637          ZIIB = Z02100-Z02080                                               DRIVER,1908
 641          A(5,5) = 1.0                                                       DRIVER,1909
 642          A(5,6) = -B02090*ALOGTE                                            DRIVER,1910
 645          DO 146 J=1,4                                                       DRIVER,1911
 652          FJ = J                                                             DRIVER,1912
 653          A(5,5-J) = ZIIB*((FJ+1.)/FJ)*A(5,6-J)                              DRIVER,1913
 665      146 CONTINUE                                                           DRIVER,1914
 667          DO 148 I=1,3                                                       DRIVER,1915
 671          A(I,6) = ALOG10( O2SDGN(I+17) ) - Z(6)                             DRIVER,1916
 700      148 CONTINUE                                                           DRIVER,1917
 701          A(4,6) = ALOG10( A02090*EXP(-B02090*(Z02100-Z02090)) ) - Z(6)      DRIVER,1918
 713          NO = 5                                                             DRIVER,1919
 714          CALL SOLVE(A,Z,NO)                                                 DRIVER,1920
 717          GO TO 156                                                          DRIVER,1921
 721      150 Z02050 = ALTKM(11)                                                 DRIVER,1922
 722          Z02075 = ALTKM(16)                                                 DRIVER,1923
 724          A02050 = O2SDGD(11)                                                DRIVER,1924
 725          A02075 = O2SDGD(16)                                                DRIVER,1925
 727          B02050 = -ALOG( A02075/A02050 )/(Z02075-Z02050)                    DRIVER,1926
 736          CALL FITTER(NALT02,ALTKM,O2SDGD,NDG02D, 1 , 2 ,DD)                 DRIVER,1927
 745          Y(6) = ALOG10( A02075 )                                            DRIVER,1928
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 747          Y(5) = -B02050*ALOGTE                                          DRIVER,1929
 752          DO 152 I=1,3                                                   DRIVER,1930
 757          ZII2 = ALTKM(I+16)-Z02075                                      DRIVER,1931
 760          A(I,4) = ZII2*ZII2                                             DRIVER,1932
 761          A(I,5) = ALOG10( O2SOGD(I+16) ) - ZII2*Y(5) - Y(6)             DRIVER,1933
 770          DO 152 J=1,3                                                   DRIVER,1934
 776          A(I,4-J) = ZII2*A(I,5-J)                                       DRIVER,1935
1004      152 CONTINUE                                                       DRIVER,1936
1007          ZII8 = Z02090-Z02075                                           DRIVER,1937
1011          A(4,4) = 2.*ZII8                                               DRIVER,1938
1012          A(4,5) = -B02090*ALOGTE - Y(5)                                 DRIVER,1939
1016          DO 154 J=1,3                                                   DRIVER,1940
1023          FJ = J+1                                                       DRIVER,1941
1025          A(4,4-J) = ZII8*((FJ+1.)/FJ)*A(4,5-J)                          DRIVER,1942
1037      154 CONTINUE                                                       DRIVER,1943
1040          NO = 4                                                         DRIVER,1944
1041          CALL SOLVE(A,Y,NO)                                             DRIVER,1945
1046      156 CONTINUE                                                       DRIVER,1946
          C           O3 (OZONE) PROFILE PARAMETERS.                       DRIVER,1947
1046          Z03D40 = ALTKM( 9)                                             DRIVER,1948
1047          Z03D75 = ALTKM(16)                                             DRIVER,1949
1051          A03D40 = O3DAY( 9)                                             DRIVER,1950
1053          B03D40 = -ALOG( O3DAY(16)/A03D40 )/(Z03D75-Z03D40)             DRIVER,1951
1062          EE(10) = ALOG10( O3DAY( 1) )                                   DRIVER,1952
1065          DO 158 I=1,8                                                   DRIVER,1953
1071          ZII2 = ALTKM(I+1)                                              DRIVER,1954
1072          A(I,9) = ZII2                                                  DRIVER,1955
1074          A(I,10) = ALOG10( O3DAY(I+1) ) - EE(10)                        DRIVER,1956
1101          DO 158 J=1,8                                                   DRIVER,1957
1107          A(I,9-J) = ZII2*A(I,10-J)                                      DRIVER,1958
1115      158 CONTINUE                                                       DRIVER,1959
1120          ZII8 = Z03D40                                                  DRIVER,1960
1121          A(9,9) = 1.0                                                   DRIVER,1961
1123          A(9,10) = -B03D40*ALOGTE                                       DRIVER,1962
1125          DO 160 J=1,8                                                   DRIVER,1963
1133          FJ = J                                                         DRIVER,1964
1134          A(9,9-J) = ZII8*((FJ+1.)/FJ)*A(9,10-J)                         DRIVER,1965
1146      160 CONTINUE                                                       DRIVER,1966
1150          NO = 9                                                         DRIVER,1967
1151          CALL SOLVE(A,EE,NO)                                            DRIVER,1968
1153          IF( IOURN )  162,172,172                                       DRIVER,1969
1156      162 Z03N55 = ALTKM(12)                                             DRIVER,1970
1157          Z03N70 = ALTKM(15)                                             DRIVER,1971
1161          Z03N75 = ALTKM(16)                                             DRIVER,1972
1162          A03N70 = O3NIT(15)                                             DRIVER,1973
1164          B03N70 = -ALOG( O3NIT(16)/A03N70 )/(Z03N75-Z03N70)             DRIVER,1974
1173          V03(6) = ALOG10( A03D40*EXP(-B03D40*(Z03N55-Z03D40)) )         DRIVER,1975
1203          V03(5) = -B03D40*ALOGTE                                        DRIVER,1976
1206          DO 164 I=1,3                                                   DRIVER,1977
1213          ZII2 = ALTKM(I+12) - Z03N55                                    DRIVER,1978
1214          A(I,4) = ZII2*ZII2                                             DRIVER,1979
1215          A(I,5) = ALOG10( O3NIT(I+12) ) - ZII2*V03(5) - V03(6)          DRIVER,1980
1224          DO 164 J=1,3                                                   DRIVER,1981
1232          A(I,4-J) = ZII2*A(I,5-J)                                       DRIVER,1982
1240      164 CONTINUE                                                       DRIVER,1983
1243          ZII8 = Z03N70-Z03N55                                           DRIVER,1984
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1245          A(4,4) = 2.*ZII8                                                  DRIVER,1985
1246          A(4,5) = -B03N70*ALOGTE - V03(5)                                  DRIVER,1986
1252          DO 166 J=1,3                                                      DRIVER,1987
1257          FJ = J+1                                                          DRIVER,1988
1261          A(4,4-J) = ZII8*((FJ+1.)/FJ)*A(4,5-J)                             DRIVER,1989
1273      166 CONTINUE                                                          DRIVER,1990
1274          NO = 4                                                            DRIVER,1991
1275          CALL SOLVE(A,V03,NO)                                              DRIVER,1992
1300          Z03N90 = ALTKM(19)                                                DRIVER,1993
1301          A03N90 = O3NIT(19)                                                DRIVER,1994
1303          B03N90 = -ALOG( O3NIT(22)/A03N90 )/(ALTKM(22)-Z03N90)             DRIVER,1995
1313          W03(6) = ALOG10( O3NIT(16) )                                      DRIVER,1996
1315          W03(5) = -B03N70*ALOGTE                                           DRIVER,1997
1320          DO 168 I=1,3                                                      DRIVER,1998
1325          ZII2 = ALTKM(I+16) - Z03N75                                       DRIVER,1999
1326          A(I,4) = ZII2*ZII2                                                DRIVER,2000
1327          A(I,5) = ALOG10( O3NIT(I+16) ) - ZII2*W03(5) - W03(6)             DRIVER,2001
1336          DO 168 J=1,3                                                      DRIVER,2002
1344          A(I,4-J) = ZII2*A(I,5-J)                                          DRIVER,2003
1352      168 CONTINUE                                                          DRIVER,2004
1355          ZII8 = Z03N90-Z03N75                                              DRIVER,2005
1357          A(4,4) = 2.*ZII8                                                  DRIVER,2006
1360          A(4,5) = -B03N90*ALOGTE - W03(5)                                  DRIVER,2007
1364          DO 170 J=1,3                                                      DRIVER,2008
1371          FJ = J+1                                                          DRIVER,2009
1373          A(4,4-J) = ZII8*((FJ+1.)/FJ)*A(4,5-J)                             DRIVER,2010
1405      170 CONTINUE                                                          DRIVER,2011
1406          NO = 4                                                            DRIVER,2012
1407          CALL SOLVE(A,W03,NO)                                              DRIVER,2013
1412          GO TO 178                                                         DRIVER,2014
1414      172 Z03D90 = ALTKM(19)                                                DRIVER,2015
1415          A03D90 = O3DAY(19)                                                DRIVER,2016
1417          B03D90 = -ALOG( O3DAY(22)/A03D90 )/(ALTKM(22)-Z03D90)             DRIVER,2017
1427          U03(6) = ALOG10( O3DAY(16) )                                      DRIVER,2018
1431          U03(5) = -B03D40*ALOGTE                                           DRIVER,2019
1434          DO 174 I=1,3                                                      DRIVER,2020
1441          ZII2 = ALTKM(I+16) - Z03D75                                       DRIVER,2021
1442          A(I,4) = ZII2*ZII2                                                DRIVER,2022
1443          A(I,5) = ALOG10( O3DAY(I+16) ) - ZII2*U03(5) - U03(6)             DRIVER,2023
1452          DO 174 J=1,3                                                      DRIVER,2024
1460          A(I,4-J) = ZII2*A(I,5-J)                                          DRIVER,2025
1466      174 CONTINUE                                                          DRIVER,2026
1471          ZII8 = Z03D90-Z03D75                                              DRIVER,2027
1473          A(4,4) = 2.*ZII8                                                  DRIVER,2028
1474          A(4,5) = -B03D90*ALOGTE - U03(5)                                  DRIVER,2029
1500          DO 176 J=1,3                                                      DRIVER,2030
1505          FJ = J+1                                                          DRIVER,2031
1507          A(4,4-J) = ZII8*((FJ+1.)/FJ)*A(4,5-J)                             DRIVER,2032
1521      176 CONTINUE                                                          DRIVER,2033
1522          NO = 4                                                            DRIVER,2034
1523          CALL SOLVE(A,U03,NO)                                              DRIVER,2035
1530      178 CONTINUE                                                          DRIVER,2036
          C       FIT COEFFICIENTS FOR NO2 (DAY AND NIGHT).                     DRIVER,2037
1530          CALL FITTER(NKMNO2,ALTKM,SNO2D,NDGNO2, 1 , 2 ,HH)                 DRIVER,2038
1537          HNO21D = ALTKM(29)                                                DRIVER,2039
1540          HNO22D = ALTKM(33)                                                DRIVER,2040
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1542          AN02FD = AN02FF( HN021D )                                          DRIVER,2041
1545          HN02DD = HN021D+HN022D                                             DRIVER,2042
1547          RN021D = AN02FF( HN021D ) / AN02FD                                 DRIVER,2043
1552          FN0255 = AN02FF( 55. ) + AN0DAF( 55. ) - AN0NZ2                    DRIVER,2044
1563          AN0265 = SN02N(14)                                                 DRIVER,2045
1564          HN0255 = ALTKM(12)                                                 DRIVER,2046
1566          HN0265 = ALTKM(14)                                                 DRIVER,2047
1567          HN02DN = HN0255-HN0265                                             DRIVER,2048
1571          RN02FA = FN0255/AN0265                                             DRIVER,2049
1573          AN0282 = AN02FF( 82. )                                             DRIVER,2050
1576          HN0282 = 82.                                                       DRIVER,2051
1577          HN02DA = HN0265-HN0282                                             DRIVER,2052
1600          RN0282 = AN0265/AN0282                                             DRIVER,2053
      C           FIT COEFFICIENTS FOR H2O.                                      DRIVER,2054
1603          CALL FITTER(NKMH2O,ALTKM,H2ODN,NDGH2O, 1 , 2 ,GG)                  DRIVER,2055
1611          H2O120 = AH2OFF( 120. )                                            DRIVER,2056
1615          RETURN                                                             DRIVER,2057
1615        200 CONTINUE                                                         DRIVER,2058
      CCC                                                                        DRIVER,2059
      C           AN ERRONEOUS CONDITION WILL OCCUR IF SPCMIN IS CALLED WITH     DRIVER,2060
      C           KK=2 AND A GIVEN VALUE OF ZH IF ATMOSU HAS NOT BEEN CALLED     DRIVER,2061
      C           FIRST WITH KK=2 AND FOR THE SAME VALUE OF ZH.                  DRIVER,2062
      C           THE VARIABLE ZHFLAG IS USED TO DETECT THIS CONDITION AND       DRIVER,2063
      C           TO MAKE THE REQUIRED CALL TO ATMOSU.                           DRIVER,2064
      C           ZHFLAG IS INITIALIZED TO AN ARBITRARY NEGATIVE VALUE IN        DRIVER,2065
      C           THE INITIALIZATION CALL TO ATMOSU.                             DRIVER,2066
      CCC                                                                        DRIVER,2067
1615          IF( ZH.NE.ZHFLAG )  CALL ATMOSU(2,ZH)                              DRIVER,2068
      C           COMPUTE DENSITY OF N                                           DRIVER,2069
1621          IF( IDORN )  210,215,215                                           DRIVER,2070
      C           NIGHTTIME N                                                    DRIVER,2071
1625        210 IF( ZH-Z2NN )  212,211,211                                       DRIVER,2072
1630        211 SNI(7) = (ANN72/S1Z2N)*SNI(1)                                    DRIVER,2073
1633            GO TO 220                                                      DRIVER,2074
1633        212 IF( ZH-Z1NN )  214,213,213                                       DRIVER,2075
1636        213 SNI(7) = ANNAF( ZH )                                             DRIVER,2076
1641            GO TO 220                                                      DRIVER,2077
1641        214 SNI(7) = ANNZ1                                                   DRIVER,2078
1643            GO TO 220                                                      DRIVER,2079
      C           DAYTIME N                                                      DRIVER,2080
1643        215 IF( ZH-Z2ND )  217,216,216                                       DRIVER,2081
1646        216 SNI(7) = (AND72/S1Z2N)*SNI(1)                                    DRIVER,2082
1651            GO TO 220                                                      DRIVER,2083
1651        217 IF( ZH-Z1ND )  219,218,218                                       DRIVER,2084
1654        218 SNI(7) = ANDAF( ZH )                                             DRIVER,2085
1657            GO TO 220                                                      DRIVER,2086
1657        219 SNI(7) = ANDZ1                                                   DRIVER,2087
1661        220 CONTINUE                                                         DRIVER,2088
      C           COMPUTE DENSITY OF NO                                          DRIVER,2089
1661          IF(ZH-Z7NO) 226,221,221                                            DRIVER,2090
1664        221 IF(ZH-Z8NO) 223,222,222                                          DRIVER,2091
1667        222 ZHMZ8 = ZH-78NO                                                  DRIVER,2092
1671            SNI(8) = ANOZ8*EXP(ZHMZ8*DLNO8Z)                                 DRIVER,2093
1676            GO TO 224                                                      DRIVER,2094
1700        223 ZHMZ7 = ZH - 77NO                                                DRIVER,2095
1702            SNI(8) = ANOZ7*EXP(ZHMZ7*DLNO7Z-0.1*ZHMZ7**2*(DLNO7Z-DLNO8Z))   DRIVER,2096
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1714     224 IF( IDORN.GE.0 ) GO TO 229                                          DRIVER.2097
1717     225 ZHM752 = (ZH-100.)**2                                               DRIVER.2098
1720         SNI(8) = SNI(8)*(ZHMZ52+7200.)/(10.*ZHMZ52+7200.)                   DRIVER.2099
1725         GO TO 229                                                           DRIVER.2100
1725     226 IF( IDORN.GE.0 .OR. ZH.GE.Z4NON ) GO TO 2283                        DRIVER.2101
1736         IF( ZH-Z2NON ) 228,227,227                                          DRIVER.2102
1741     227 ZM2NON = ZH-Z2NON                                                   DRIVER.2103
1742         SNI(8) = 10.**((((((((X(1)*ZM2NON + X(2))*ZM2NON + X(3))*ZM2NON     DRIVER.2104
            *          + X(4))*ZM2NON + X(5))*ZM2NON + X(6))*ZM2NON             DRIVER.2105
            *          + X(7))*ZM2NON + X(8))*ZM2NON + X(9))                    DRIVER.2106
1763         GO TO 229                                                          DRIVER.2107
1764     228 IF( ZH-Z1NON ) 2282,2281,2281                                       DRIVER.2108
1767    2281 ZM2NON = ZH-Z2NON                                                   DRIVER.2109
1771         SNI(8) = ANONZ2*EXP(ZM2NON*ANONSI)                                 DRIVER.2110
1776         GO TO 229                                                          DRIVER.2111
2000    2282 SNI(8) = ANONZ1                                                    DRIVER.2112
2002         GO TO 229                                                          DRIVER.2113
2002    2283 SNI(8) = ANODAF( ZH )                                              DRIVER.2114
2004         IF( IDORN.GE.0 .OR. ZH.LT.100. ) GO TO 229                         DRIVER.2115
2014         GO TO 225                                                          DRIVER.2116
2014     229 CONTINUE                                                           DRIVER.2117
C            COMPUTE DENSITY OF O2(1 DELTA G)                                   DRIVER.2118
2014         IF( ZH.LT.ZO2100 )  GO TO 231                                      DRIVER.2119
2017     230 SNI(13) = AO2090*EXP(-BO2090*(ZH-ZO2090))                          DRIVER.2120
2026         GO TO 238                                                          DRIVER.2121
2030     231 IF( IDORN )  232,235,235                                           DRIVER.2122
C            NIGHTTIME O2(1 DELTA G)                                            DRIVER.2123
2032     232 IF( ZH.GT.ZO2070 )  GO TO 233                                      DRIVER.2124
2036         SNI(13) = AO2070                                                   DRIVER.2125
2037         GO TO 238                                                          DRIVER.2126
2037     233 IF( ZH.GT.ZO2080 )  GO TO 234                                      DRIVER.2127
2043         SNI(13) = AO2070*EXP(-BO2070*(ZH-ZO2070))                          DRIVER.2128
2052         GO TO 238                                                          DRIVER.2129
2054     234 ZHMKM = ZH-ZO2080                                                  DRIVER.2130
2055         SNI(13) = 10.**((((((Z(1)*ZHMKM + Z(2))*ZHMKM + Z(3))*ZHMKM        DRIVER.2131
            *                + Z(4))*ZHMKM + Z(5))*ZHMKM + Z(6))                DRIVER.2132
2071         GO TO 238                                                          DRIVER.2133
C            DAYTIME O2(1 DELTA G)                                              DRIVER.2134
2072     235 IF( ZH.GE.ZO2090 )  GO TO 230                                      DRIVER.2135
2075         IF( ZH.GE.ZO2050 )  GO TO 236                                      DRIVER.2136
2077         SNI(13) = AO2SDF( ZH )                                             DRIVER.2137
2101         GO TO 238                                                          DRIVER.2138
2101     236 IF( ZH.GT.ZO2075 )  GO TO 237                                      DRIVER.2139
2105         SNI(13) = AO2050*EXP(-BO2050*(ZH-ZO2050))                          DRIVER.2140
2114         GO TO 238                                                          DRIVER.2141
2116     237 ZHMKM = ZH-ZO2075                                                  DRIVER.2142
2117         SNI(13) = 10.**((((((Y(1)*ZHMKM + Y(2))*ZHMKM + Y(3))*ZHMKM        DRIVER.2143
            *                + Y(4))*ZHMKM + Y(5))*ZHMKM + Y(6))                DRIVER.2144
2133     238 CONTINUE                                                           DRIVER.2145
C            COMPUTE DENSITY OF O3 (OZONE)                                      DRIVER.2146
2133         IF( ZH.LT.ZO3040 )  GO TO 243                                      DRIVER.2147
2136         IF( IDORN )  239,244,244                                           DRIVER.2148
C            NIGHTTIME O3                                                       DRIVER.2149
2137     239 IF( ZH.LT.ZO3N55 )  GO TO 244                                      DRIVER.2150
2142         IF( ZH.GE.ZO3N70 )  GO TO 240                                      DRIVER.2151
2144         ZHMKM = ZH-ZO3N55                                                  DRIVER.2152
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2145        SNI(14) = 10.**(((((VO3(1)*ZHMKM + VO3(2))*ZHMKM + VO3(3))*ZHMKM   DRIVER.2153
           *                 + VO3(4))*ZHMKM + VO3(5))*ZHMKM + VO3(6))        DRIVER.2154
2161        GO TO 247                                                         DRIVER.2155
2162    240 IF( ZH.GT.ZO3N75 )  GO TO 241                                     DRIVER.2156
2166        SNI(14) = AO3N70*EXP(-BO3N70*(ZH-ZO3N70))                         DRIVER.2157
2175        GO TO 247                                                         DRIVER.2158
2176    241 IF( ZH.GE.ZO3N90 )  GO TO 242                                     DRIVER.2159
2201        ZHMKM = ZH-ZO3N75                                                 DRIVER.2160
2203        SNI(14) = 10.**(((((WO3(1)*ZHMKM + WO3(2))*ZHMKM + WO3(3))*ZHMKM   DRIVER.2161
           *                 + WO3(4))*ZHMKM + WO3(5))*ZHMKM + WO3(6))        DRIVER.2162
2217        GO TO 247                                                         DRIVER.2163
2220    242 SNI(14) = AO3N90*EXP(-BO3N90*(ZH-ZO3N90))                         DRIVER.2164
2227        GO TO 247                                                         DRIVER.2165
      C         IF ZH.LT.40. , BOTH DAY AND NIGHT USE FOLLOWING.            DRIVER.2166
2231    243 SNI(14) = 10.**(((((((((EE(1)*ZH + EE(2))*ZH + EE(3))*ZH        DRIVER.2167
           *          + EE(4))*ZH + EE(5))*ZH + EE(6))*ZH + EE(7))*ZH       DRIVER.2168
           *          + EE(8))*ZH + EE(9))*ZH + EE(10))                     DRIVER.2169
2253        GO TO 247                                                         DRIVER.2170
      C         DAYTIME O3                                                  DRIVER.2171
2254    244 IF( ZH.GT.ZO3D75 )  GO TO 245                                     DRIVER.2172
2260        SNI(14) = AO3D40*EXP(-BO3D40*(ZH-ZO3D40))                         DRIVER.2173
2267        GO TO 247                                                         DRIVER.2174
2270    245 IF( ZH.GE.ZO3D90 )  GO TO 246                                     DRIVER.2175
2273        ZHMKM = ZH-ZO3D75                                                 DRIVER.2176
2275        SNI(14) = 10.**(((((UO3(1)*ZHMKM + UO3(2))*ZHMKM + UO3(3))*ZHMKM   DRIVER.2177
           *                 + UO3(4))*ZHMKM + UO3(5))*ZHMKM + UO3(6))        DRIVER.2178
2311        GO TO 247                                                         DRIVER.2179
2312    246 SNI(14) = AO3D90*EXP(-BO3D90*(ZH-ZO3D90))                         DRIVER.2180
2322    247 CONTINUE                                                          DRIVER.2181
      C         COMPUTE DENSITY OF NO2                                      DRIVER.2182
2322        IF( IDORN )  248,252,252                                          DRIVER.2183
      C         NIGHTTIME NO2                                               DRIVER.2184
2324    248 IF( ZH.GE.HNO255 )  GO TO 250                                     DRIVER.2185
2327        SNI(15) = ANO2FF( ZH ) + ANODAF( ZH ) - SNI(8)                    DRIVER.2186
2335        GO TO 261                                                         DRIVER.2187
2336    250 IF( ZH.GT.HNO265 )  GO TO 251                                     DRIVER.2188
2342        SNI(15) = ANO265 * RNO2FA**((ZH-HNO265)/HNO2DN)                   DRIVER.2189
2350        GO TO 261                                                         DRIVER.2190
2350    251 IF( ZH.GT.HNO282 )  GO TO 252                                     DRIVER.2191
2354        SNI(15) = ANO282 * RNO282**((ZH-HNO282)/HNO2D8)                   DRIVER.2192
2362        GO TO 261                                                         DRIVER.2193
      C         DAYTIME NO2                                                 DRIVER.2194
2362    252 IF( ZH.GT.HNO220 )  GO TO 253                                     DRIVER.2195
2366        SNI(15) = ANO2FF( ZH )                                            DRIVER.2196
2370        GO TO 261                                                         DRIVER.2197
2370    253 SNI(15) = ANO2FD * RNO212**((ZH-HNO220)/HNO2DD)                   DRIVER.2198
2377    261 CONTINUE                                                          DRIVER.2199
      C         COMPUTE DENSITY OF H2O  (DAY OR NIGHT)                      DRIVER.2200
2377        IF( ZH.GE.120. ) GO TO 262                                        DRIVER.2201
2402        SNI(16) = AH2OFF( ZH )                                            DRIVER.2202
2404        GO TO 263                                                         DRIVER.2203
2404    262 SNI(16) = H2O120*EXP(-0.166*(ZH-120.))                            DRIVER.2204
2413    263 CONTINUE                                                          DRIVER.2205
2413    299 RETURN                                                            DRIVER.2206
2414        END                                                               DRIVER.2207
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ZTTOUT

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      SUBROUTINE ZTTOUT                                                 DRIVER,2208
CCC                                                                     DRIVER,2209
C         SUBROUTINE ZTTOUT CONVERTS A GREGORIAN CALENDAR DATE (20 TH   DRIVER,2210
C         CENTURY YEAR IYRS, MONTH IMONS, DAY IDAYS) AND ZONE TIME ZT   DRIVER,2211
C         AT EAST LONGITUDE PLON TO GREGORIAN CALENDAR DATE AND MEAN    DRIVER,2212
C         TIME UT AT GREENWICH.                                         DRIVER,2213
CCC                                                                     DRIVER,2214
C         REVISION 02 (11/18/74) PROVIDES...                            DRIVER,2215
C            1. TEST FOR LEGAL INPUT DATE.                              DRIVER,2216
C     INPUT PARAMETERS                                                  DRIVER,2217
C               IYRS = NUMBER OF THE YEAR IN THE 1900 S (E,G., 1974     DRIVER,2218
C                      BECOMES 74).                                     DRIVER,2219
C              IMONS = NUMBER OF THE MONTH (E,G., FEBRUARY BECOMES 2).  DRIVER,2220
C              IDAYS = DAY OF THE MONTH                                 DRIVER,2221
C                 ZT = ZONE TIME FOR THE 15-DEGREE LONGITUDE INTERVAL   DRIVER,2222
C                      CONTAINING PLON (DECIMAL HRS)                    DRIVER,2223
C               PLON = EAST LONGITUDE OF POINT P (RADIANS)              DRIVER,2224
CCC                                                                     DRIVER,2225
C     OUTPUT PARAMETERS                                                 DRIVER,2226
C               IYRS = A POSSIBLY REVISED VALUE OF THE INPUT PARAMETER, DRIVER,2227
C                      CORRESPONDING TO GREENWICH.                      DRIVER,2228
C              IMONS = A POSSIBLY REVISED VALUE OF THE INPUT PARAMETER, DRIVER,2229
C                      CORRESPONDING TO GREENWICH.                      DRIVER,2230
C              IDAYS = A POSSIBLY REVISED VALUE OF THE INPUT PARAMETER, DRIVER,2231
C                      CORRESPONDING TO GREENWICH.                      DRIVER,2232
C                 UT = UNIVERSAL TIME (DECIMAL HRS)                     DRIVER,2233
CCC                                                                     DRIVER,2234
C     DEFINITION OF DATA                                                DRIVER,2235
C         IDAYMO(I) = DAYS IN THE I TH MONTH OF A NON-LEAP YEAR         DRIVER,2236
CCC                                                                     DRIVER,2237
      COMMON/TIME/  IYRS,IMONS,IDAYS,ZT,PLAT,PLON,UT,GAT                DRIVER,2238
      DIMENSION  IDAYMO(12)                                             DRIVER,2239
      DATA  (IDAYMO(I),I=1,12) / 31,28,31,30,31,30,31,31,30,31,30,31 /  DRIVER,2240
      DATA  PI / 3.141592653590 /                                       DRIVER,2241
CCC                                                                     DRIVER,2242
C         CONVERSION FROM ZONE TIME ZT TO GREENWICH MEAN TIME (I.E.,    DRIVER,2243
C         UNIVERSAL TIME UT) IS DONE BY FIRST FINDING THE TIME ZONE     DRIVER,2244
C         CONTAINING THE LONGITUDE PLON.                                DRIVER,2245
C         N7PTS IS THE INTEGRAL NUMBER OF 7.5-DEGREE INTERVALS IN THE   DRIVER,2246
C         WESTERLY DIRECTION FROM GREENWICH TO THE LONGITUDE OF INTERESTDRIVER,2247
C         PLON.  N7PTS MAY BE 0 OR ANY INTEGER UP TO AND INCLUDING 47,  DRIVER,2248
C         HOWEVER, THE TIME-ZONE NUMBER IZONE IS 0 FOR N7PTS EQUAL TO   DRIVER,2249
C         0 OR 47.  IZONE RANGES FROM 0 TO 23.                          DRIVER,2250
CCC                                                                     DRIVER,2251
C         TEST WHETHER INPUT DATE IS LEGAL.                             DRIVER,2252
      IF( ZT.LT.0.0 .OR. ZT.GE.24. )  GO TO 999                         DRIVER,2253
11    IF( IYRS.LT.1 .OR. IYRS.GT.99 )  GO TO 999                        DRIVER,2254
20    IF( IMONS.LT.1 .OR. IMONS.GT.12 )  GO TO 999                      DRIVER,2255
C         IF YRS IS A LEAP YEAR, SET IDAYMO(2) = 29                     DRIVER,2256
27    LEAP = MOD(IYRS,4)                                                DRIVER,2257
31    IF( LEAP.EQ.0 )  IDAYMO(2) = 29                                   DRIVER,2258
33    IF( IDAYS.LT.1 .OR. IDAYS.GT.IDAYMO(IMONS) )  GO TO 999           DRIVER,2259
44    PI2 = 2.*PI                                                       DRIVER,2260
45    PIO2 = PI/2.                                                      DRIVER,2261
46    RADDEG = PI/180.                                                  DRIVER,2262
50    N7PTS = (PI2-PLON)/(7.5*RADDEG)                                   DRIVER,2263
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      IF( N7PTS-47 )  10,20,20                                          DRIVER,2264
   10 IZONE = (N7PTS+1)/2                                               DRIVER,2265
      GO TO 30                                                          DRIVER,2266
   20 IZONE = 0                                                         DRIVER,2267
   30 ZONE = FLOAT(IZONE)                                               DRIVER,2268
CCC                                                                     DRIVER,2269
C          SHIFT TO CONVENTIONAL ZONE DESCRIPTION, ZD (SEE, E.G.,       DRIVER,2270
C          AMERICAN PRACTICAL NAVIGATOR (ORIGINALLY BY N. BOWDITCH),    DRIVER,2271
C          U.S. NAVY H.O. PUB. NO. 9, P.489, OF 1962 CORRECTED REPRINT  DRIVER,2272
C          EDITION, AVAILABLE FROM U.S. GOV. PRINTING OFFICE),          DRIVER,2273
CCC                                                                     DRIVER,2274
      IF( PLON.GT.PI )  GO TO 35                                        DRIVER,2275
      ZD = ZONE-24.                                                     DRIVER,2276
      GO TO 40                                                          DRIVER,2277
   35 ZD = ZONE                                                         DRIVER,2278
   40 UT = ZT+ZD                                                        DRIVER,2279
C          MUST SHIFT TO NEXT DAY IF(UT.GE.24.)                         DRIVER,2280
      IF( UT.GE.24. )  GO TO 50                                         DRIVER,2281
C          MUST SHIFT TO PREVIOUS DAY IF(UT.LT.0.)                      DRIVER,2282
      IF( UT.LT.0.0 )  GO TO 45                                         DRIVER,2283
C          NO SHIFT IS NECESSARY IF(UT.GE.0.0 .AND. UT.LT.24.)          DRIVER,2284
      GO TO 60                                                          DRIVER,2285
   45 UT = UT+24.                                                       DRIVER,2286
      IDAYS = IDAYS-1                                                   DRIVER,2287
C          CORRECT MONTH AND YEAR IF NECESSARY, DUE TO CHANGING THE DATE DRIVER,2288
C          IN CONVERTING TO UT.                                         DRIVER,2289
C          CORRECT IDAYS AND IMONS IF MONTH DECREASED AT GREENWICH       DRIVER,2290
      IF( IDAYS.GE.1 )  GO TO 60                                        DRIVER,2291
      IDAYS = IDAYMO(IMONS-1)                                           DRIVER,2292
      IMONS = IMONS-1                                                   DRIVER,2293
C          CORRECT IMONS AND IYRS IF YEAR DECREASED AT GREENWICH        DRIVER,2294
      IF( IMONS.GE.1 )  GO TO 60                                        DRIVER,2295
      IMONS = 12                                                        DRIVER,2296
      IYRS = IYRS-1                                                     DRIVER,2297
      GO TO 60                                                          DRIVER,2298
   50 UT = UT-24.                                                       DRIVER,2299
      IDAYS = IDAYS+1                                                   DRIVER,2300
C          CORRECT MONTH AND YEAR IF NECESSARY, DUE TO CHANGING THE DATE DRIVER,2301
C          IN CONVERTING TO UT.                                         DRIVER,2302
C          IF YRS IS A LEAP YEAR, SET IDAYMO(2) = 29                    DRIVER,2303
      LEAP = MOD(IYRS,4)                                                DRIVER,2304
      IF(  LEAP.EQ.0  )  IDAYMO(2) = 29                                 DRIVER,2305
C          CORRECT IDAYS AND IMONS IF MONTH INCREASED AT GREENWICH       DRIVER,2306
      IF( IDAYS.LE.IDAYMO(IMONS) )  GO TO 60                            DRIVER,2307
      IDAYS = 1                                                         DRIVER,2308
      IMONS = IMONS+1                                                   DRIVER,2309
C          CORRECT IMONS AND IYRS IF YEAR INCREASED AT GREENWICH        DRIVER,2310
      IF( IMONS.LE.12 )  GO TO 60                                       DRIVER,2311
      IMONS = 1                                                         DRIVER,2312
      IYRS = IYRS+1                                                     DRIVER,2313
   60 RETURN                                                            DRIVER,2314
  999 WRITE(6,777)                                                      DRIVER,2315
  777 FORMAT (40H0  * * * ILLEGAL DATE INPUTTED * * *     )             DRIVER,2316
      CALL EXIT                                                         DRIVER,2317
      END                                                               DRIVER,2318
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CHEMQ

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      SUBROUTINE CHEMQ(QDELAY,ENPQ,OPQ,ENEQ)                                DRIVER,2319
C                                                                           DRIVER,2320
C     STEADY-STATE IONIZATION FOR THE E- AND F-REGION                       DRIVER,2321
C                                                                           DRIVER,2322
C     THE FOLLOWING EQUATION SET IS SOLVED                                  DRIVER,2323
C                                                                           DRIVER,2324
C          0 = -ALPHAR*(N+)*(E) - BETAN*(N+) - K*(O)*(N+) + QN              DRIVER,2325
C                                                                           DRIVER,2326
C          0 = -ALPHAR*(O+)*(E) - BETAO*(O+) + K*(O)*(N+) + QO              DRIVER,2327
C                                                                           DRIVER,2328
C          0 = -ALPHAO*(M+)*(E) + BETAN*(N+) + BETAO*(O+) + QM              DRIVER,2329
C                                                                           DRIVER,2330
C          INPUT FROM CALL SEQUENCE                                         DRIVER,2331
C     QDELAY = DELAYED RADIATION ION PRODUCTION RATE (CM-3*SEC-1)           DRIVER,2332
C          OUTPUTS TO CALL SEQUENCE                                         DRIVER,2333
C     ENPQ   = STEADY-STATE CONCENTRATION OF (N+) (CM-3)                    DRIVER,2334
C     OPQ    = STEADY-STATE CONCENTRATION OF (O+)  (CM-3)                   DRIVER,2335
C     ENEQ   = STEADY-STATE CONCENTRATION OF ELECTRONS (CM-3)               DRIVER,2336
C          INPUTS FROM SPECQ COMMON                                         DRIVER,2337
C     SPECIES CONCENTRATIONS, CN2 = (N2), CO2 = (O2), ... , CNP = (N+),     DRIVER,2338
C          ETC. (CM-3)                                                      DRIVER,2339
C     TV     = NITROGEN VIBRATION TEMPERATURE (DEG K)                       DRIVER,2340
C     TE     = ELECTRON, OXYGEN EXCITATION TEMPERATURE (DEG K)              DRIVER,2341
C     TG     = GAS TEMPERATURE (DEG K)                                      DRIVER,2342
C                                                                           DRIVER,2343
      COMMON /SPECQ / CN2,CO2,CNO,CN4S,CN2D,CO,CNP,COP,CENE,TV,TE,TG        DRIVER,2344
C                                                                           DRIVER,2345
      CMP = CENE + COP + CNP                                                DRIVER,2346
10    CAT=2.*(CN2+CO2+CNO)+CN4S+CN2D+CO                                     DRIVER,2347
C          REACTION RATES                                                   DRIVER,2348
C          ATOMIC ION RECOMBINATION                                         DRIVER,2349
20    ALPHAR=RATE(11,TE)+RATE(12,TE)*CENE+1.5E-07*SQRT(CENE)/(TE**3)        DRIVER,2350
C          MOLECULAR ION RECOMBINATION                                      DRIVER,2351
36    ALPHAO=RATE(13,TE)+RATE(14,TE)                                        DRIVER,2352
C          (N+) LOSS                                                        DRIVER,2353
46    XNPO=RATE(5,TG)*CO                                                    DRIVER,2354
51    BETAN=RATE(4,TG)*CN2+(RATE(1,TG)+RATE(2,TG))*CO2+RATE(5,TG)*CNO+      DRIVER,2355
     1 XNPO                                                                 DRIVER,2356
C          (O+) LOSS                                                        DRIVER,2357
74    BETAO=RATE(10,TV)*CN2+RATE(9,TG)*CO2                                  DRIVER,2358
C          ION PRODUCTION RATES                                             DRIVER,2359
110   QM=2.*(CN2+CO2+CNO)/CAT*QDELAY                                        DRIVER,2360
114   QN=(CN4S+CN2D)/CAT*QDELAY                                             DRIVER,2361
117   QO=CO/CAT*QDELAY                                                      DRIVER,2362
121   QA=QN+QO                                                              DRIVER,2363
123   ATERM=SQRT(QA*ALPHAR)                                                 DRIVER,2364
127   QO1=QO+XNPO*QN/(BETAN+ATERM)                                          DRIVER,2365
C          FRACTION FN = (N+)/(A+), FO = (O+)/(A+)                          DRIVER,2366
133   FN=(QN*(BETAO+ATERM))/((QN*(BETAO+ATERM))+QO1*(BETAN+ATERM))          DRIVER,2367
140   FO=1.-FN                                                              DRIVER,2368
C          EFFECTIVE ATOMIC ION LOSS RATE                                   DRIVER,2369
142   BETAAR=FN*BETAN+FO*BETAO                                              DRIVER,2370
C          EQUILIBRIUM ATOMIC ION CONCENTRATIONS                            DRIVER,2371
145   R=0.5*BETAAR/ALPHAR                                                   DRIVER,2372
147   A=QA/ALPHAR                                                           DRIVER,2373
150   IF(R*R-1000.*A)10,11,11                                               DRIVER,2374
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156       10 APQ=-B+SQRT(B*B+A)                                                DRIVER.2375
164          GO TO 12                                                          DRIVER.2376
167       11 APQ=0.5*A/B                                                       DRIVER.2377
172       12 ENPQ=FN*APQ                                                       DRIVER.2378
174          DPQ=FD*APQ                                                        DRIVER.2379
      C           EQUILIBRIUM ELECTRON DENSITY                                DRIVER.23A0
175          ENEQ=(0.5*APQ)+SQRT((0.5*APQ)**2+(QM+RETBAR*APQ)/ALPHAD)         DRIVER.23A1
      C                                                                       DRIVER.23A2
210          RETURN                                                          DRIVER.23A3
211          END                                                             DRIVER.23A4
```

TEST VALUES READ IN

NALTS = 130

I	ALTS(I),KM									
1	0.00	2	5.00	3	10.00	4	15.00	5	20.00	6	25.00
7	30.00	8	35.00	9	40.00	10	45.00	11	50.00	12	55.00
13	56.00	14	57.00	15	58.00	16	59.00	17	60.00	18	61.00
19	62.00	20	63.00	21	64.00	22	65.00	23	66.00	24	67.00
25	68.00	26	69.00	27	70.00	28	71.00	29	72.00	30	73.00
31	74.00	32	75.00	33	76.00	34	77.00	35	78.00	36	79.00
37	80.00	38	81.00	39	82.00	40	83.00	41	84.00	42	85.00
43	86.00	44	87.00	45	88.00	46	89.00	47	90.00	48	95.00
49	100.00	50	101.00	51	102.00	52	103.00	53	104.00	54	105.00
55	106.00	56	107.00	57	108.00	58	109.00	59	110.00	60	111.00
61	112.00	62	113.00	63	114.00	64	115.00	65	116.00	66	117.00
67	118.00	68	119.00	69	119.99	70	120.00	71	121.00	72	122.00
73	123.00	74	124.00	75	125.00	76	130.00	77	135.00	78	140.00
79	145.00	80	150.00	81	160.00	82	170.00	83	180.00	84	190.00
85	200.00	86	220.00	87	240.00	88	260.00	89	280.00	90	300.00
91	320.00	92	340.00	93	360.00	94	380.00	95	400.00	96	420.00
97	440.00	98	460.00	99	480.00	100	500.00	101	520.00	102	540.00
103	560.00	104	580.00	105	600.00	106	620.00	107	640.00	108	660.00
109	680.00	110	700.00	111	720.00	112	740.00	113	760.00	114	780.00
115	800.00	116	820.00	117	840.00	118	860.00	119	880.00	120	900.00
121	920.00	122	940.00	123	960.00	124	980.00	125	1000.00	126	1040.00
127	1080.00	128	1120.00	129	1160.00	130	1200.00				

IYRS = 77 IMONS = 9 IDAYS = 1
ZT = 1.2000E+01 HRS GCO = 5.5000E+01 DEG GLO = 2.3500E+02 DEG

INITIALIZATION CALL

TIF = 1.444019E+03 TAU = 1.480683E+02

IYRS = 77 IMONS = 9 IDAYS = 1
ZT = 1.2000E+01 HRS GCO = 9.5993E-01 RAD GLO = 4.1015E+00 RAD

IDOWN = 1 UT = 2.0000E+01 GAT = 1.9994E+01 PLAT = 6.1087E-01 PLON = 4.1015E+00

HL = 11.661 SBAR = 157.572

ALT	N2 1/CC N 1/CC PRESSURE DYNES/CM**2	O2 1/CC NO 1/CC FRHSEQ	O 1/CC NO2 1/CC DENSITY GRAMS/CC	AR 1/CC O2(1DG) 1/CC DEN SC HT KM	HE 1/CC O3 1/CC TEMP DEG K	CO2 1/CC H2O 1/CC E TEMP DEG K	E 1/CC E 1/CC	O+ 1/CC O+ 1/CC	M+ 1/CC M+ 1/CC	QDEF 1/(CC SEC) N+ 1/CC
0.00	1.982E+19	5.442E+18	9.958E+02	2.287E+17	1.175E+15	8.132E+15	0.	0.	0.	1.815E+02
	9.799E-01	9.803E+09	2.619E+10	2.601E+06	8.000E+11	1.866E+17	0.	0.	0.	0.
	1.013E+06	-0.	1.222E-03	9.075E+00	2.888E+02	2.888E+02				
5.00	1.204E+19	3.258E+18	6.104E+03	1.390E+17	7.141E+14	4.941E+15	0.	0.	0.	9.307E+01
	9.799E-01	3.849E+09	6.902E+09	4.390E+06	5.700E+11	2.411E+16	0.	0.	0.	0.
	5.426E+05	-3.804E-05	7.425E-04	9.617E+00	2.545E+02	2.545E+02				
10.00	6.638E+18	1.784E+18	2.525E+04	7.659E+16	3.936E+14	2.723E+15	0.	0.	0.	4.773E+01
	9.799E-01	9.985E+08	1.783E+09	2.726E+07	1.100E+12	3.976E+14	0.	0.	0.	0.
	2.654E+05	-1.205E-04	4.092E-04	7.453E+00	2.259E+02	2.259E+02				
15.00	3.209E+18	8.880E+17	1.479E+05	3.702E+16	1.903E+14	1.316E+15	0.	0.	0.	2.447E+01
	9.799E-01	6.648E+08	1.259E+09	1.221E+08	2.500E+12	2.065E+13	0.	0.	0.	0.
	1.222E+05	-2.416E-04	1.978E-04	6.488E+00	2.151E+02	2.151E+02				
20.00	1.453E+18	3.931E+17	1.090E+06	1.677E+16	8.616E+13	5.961E+14	0.	0.	0.	1.255E+01
	9.799E-01	8.869E+08	1.772E+09	5.089E+08	4.800E+12	4.511E+12	0.	0.	0.	0.
	5.538E+04	-4.104E-04	8.958E-05	6.212E+00	2.153E+02	2.153E+02				
25.00	6.500E+17	1.758E+17	7.822E+06	7.500E+15	3.854E+13	2.667E+14	0.	0.	0.	6.435E+00
	9.799E-01	1.398E+09	2.597E+09	1.198E+09	4.300E+12	2.250E+12	0.	0.	0.	0.
	2.548E+04	-6.353E-04	4.007E-05	6.253E+00	2.211E+02	2.211E+02				
30.00	2.952E+17	7.988E+16	4.709E+07	3.406E+15	1.750E+13	1.211E+14	0.	0.	0.	3.300E+00
	9.799E-01	1.851E+09	3.416E+09	2.790E+09	2.500E+12	1.406E+12	0.	0.	0.	0.
	1.200E+04	-9.232E-04	1.820E-05	6.434E+00	2.297E+02	2.297E+02				
35.00	1.377E+17	3.724E+16	2.295E+08	1.588E+15	8.163E+12	5.648E+13	0.	0.	0.	1.692E+00
	9.799E-01	1.846E+09	1.176E+09	8.843E+09	1.400E+12	8.036E+11	0.	0.	0.	0.
	5.843E+03	-1.281E-03	8.487E-06	6.686E+00	2.398E+02	2.398E+02				
40.00	6.426E+16	1.793E+16	9.113E+08	7.644E+14	3.929E+12	2.719E+13	0.	0.	0.	8.677E-01
	9.799E-01	1.424E+09	3.225E+08	1.811E+10	6.100E+11	3.957E+11	0.	0.	0.	0.
	2.937E+03	-1.711E-03	4.085E-06	7.005E+00	2.504E+02	2.504E+02				
45.00	3.307E+16	8.946E+15	2.928E+09	3.816E+14	1.961E+12	1.357E+13	0.	0.	0.	4.450E-01
	1.111E+01	9.057E+08	6.280E+07	2.696E+10	1.823E+11	1.797E+11	0.	0.	0.	0.
	1.520E+03	-2.205E-03	2.039E-06	7.399E+00	2.596E+02	2.596E+02				
50.00	1.715E+16	4.640E+15	7.399E+09	1.979E+14	1.017E+12	7.037E+12	0.	0.	0.	2.282E-01
	8.427E+01	5.025E+08	1.134E+07	3.500E+10	5.450E+10	8.158E+10	0.	0.	0.	0.
	8.015E+02	-2.724E-03	1.057E-06	7.837E+00	2.640E+02	2.640E+02				
55.00	9.198E+15	2.488E+15	1.436E+10	1.061E+14	5.454E+11	3.773E+12	0.	0.	0.	1.170E-01
	4.855E+02	2.551E+08	2.355E+06	2.155E+10	1.629E+10	3.848E+10	0.	0.	0.	0.
	4.239E+02	-3.204E-03	5.671E-07	8.178E+00	2.604E+02	2.604E+02				
58.00	8.141E+15	2.202E+15	1.589E+10	9.394E+13	4.827E+11	3.340E+12	0.	0.	0.	1.024E-01
	4.648E+02	2.215E+08	1.770E+06	1.956E+10	1.279E+10	3.326E+10	0.	0.	0.	0.
	3.726E+02	-3.290E-03	5.019E-07	8.215E+00	2.585E+02	2.585E+02				
57.00	7.210E+15	1.950E+15	1.741E+10	8.319E+13	4.275E+11	2.958E+12	0.	0.	0.	8.958E-02
	8.991E+02	1.921E+08	1.346E+06	1.775E+10	1.005E+10	2.877E+10	0.	0.	0.	0.
	3.272E+02	-3.371E-03	4.445E-07	8.234E+00	2.564E+02	2.564E+02				
58.00	6.386E+15	1.727E+15	1.889E+10	7.368E+13	3.786E+11	2.620E+12	0.	0.	0.	7.837E-02
	1.204E+03	1.667E+08	1.034E+06	1.611E+10	7.892E+09	2.490E+10	0.	0.	0.	0.
	2.870E+02	-3.448E-03	3.937E-07	8.241E+00	2.539E+02	2.539E+02				
59.00	5.655E+15	1.530E+15	2.033E+10	6.526E+13	3.353E+11	2.320E+12	0.	0.	0.	6.857E-02
	1.596E+03	1.448E+08	8.043E+05	1.462E+10	6.199E+09	2.156E+10	0.	0.	0.	0.
	2.514E+02	-3.520E-03	3.487E-07	8.228E+00	2.512E+02	2.512E+02				

60.00	5.007E+15	1.354E+15	2.170E+10	5.777E+13	2.969E+11	2.054E+12	0.	0.	0.	6.000E-02
	2.098E+03	1.259E+08	6.325E+05	1.327E+10	4.868E+09	1.867E+10	0.	0.	0.	0.
	2.200E+02	-3.588E-03	3.087E-07	8.196E+00	2.482E+02	2.482E+02				
61.00	4.430E+15	1.198E+15	2.299E+10	5.112E+13	2.627E+11	1.818E+12	0.	0.	0.	7.723E-02
	2.731E+03	1.098E+08	5.031E+05	1.205E+10	3.824E+09	1.617E+10	0.	0.	0.	0.
	1.921E+02	-3.651E-03	2.732E-07	8.147E+00	2.450E+02	2.450E+02				
62.00	3.917E+15	1.060E+15	2.421E+10	4.519E+13	2.322E+11	1.607E+12	0.	0.	0.	9.940E-02
	3.526E+03	9.702E+07	4.045E+05	1.093E+10	3.003E+09	1.399E+10	0.	0.	0.	0.
	1.675E+02	-3.711E-03	2.415E-07	8.080E+00	2.416E+02	2.416E+02				
63.00	3.459E+15	9.358E+14	2.534E+10	3.991E+13	2.051E+11	1.419E+12	0.	0.	0.	1.279E-01
	4.515E+03	8.431E+07	3.287E+05	9.923E+09	2.359E+09	1.209E+10	0.	0.	0.	0.
	1.457E+02	-3.768E-03	2.132E-07	7.994E+00	2.380E+02	2.380E+02				
64.00	3.050E+15	8.250E+14	2.642E+10	3.519E+13	1.808E+11	1.251E+12	0.	0.	0.	1.647E-01
	5.735E+03	7.438E+07	2.697E+05	9.006E+09	1.853E+09	1.044E+10	0.	0.	0.	0.
	1.265E+02	-3.818E-03	1.880E-07	7.897E+00	2.344E+02	2.344E+02				
65.00	2.685E+15	7.262E+14	2.745E+10	3.098E+13	1.592E+11	1.101E+12	0.	0.	0.	2.120E-01
	7.229E+03	6.600E+07	2.235E+05	8.174E+09	1.455E+09	8.999E+09	0.	0.	0.	0.
	1.096E+02	-3.868E-03	1.655E-07	7.785E+00	2.307E+02	2.307E+02				
66.00	2.359E+15	6.380E+14	2.845E+10	2.721E+13	1.399E+11	9.676E+11	0.	0.	0.	2.728E-01
	9.044E+03	5.894E+07	1.868E+05	7.419E+09	1.143E+09	7.743E+09	0.	0.	0.	0.
	9.475E+01	-3.915E-03	1.454E-07	7.662E+00	2.270E+02	2.270E+02				
67.00	2.068E+15	5.593E+14	2.946E+10	2.386E+13	1.226E+11	8.483E+11	0.	0.	0.	3.512E-01
	1.124E+04	5.302E+07	1.574E+05	6.733E+09	8.977E+08	6.649E+09	0.	0.	0.	0.
	8.172E+01	-3.960E-03	1.275E-07	7.530E+00	2.233E+02	2.233E+02				
68.00	1.808E+15	4.892E+14	3.050E+10	2.087E+13	1.072E+11	7.419E+11	0.	0.	0.	4.520E-01
	1.386E+04	4.807E+07	1.336E+05	6.111E+09	7.051E+08	5.696E+09	0.	0.	0.	0.
	7.030E+01	-4.004E-03	1.115E-07	7.393E+00	2.196E+02	2.196E+02				
69.00	1.578E+15	4.267E+14	3.162E+10	1.820E+13	9.354E+10	6.472E+11	0.	0.	0.	5.818E-01
	1.699E+04	4.197E+07	1.141E+05	5.546E+09	5.538E+08	4.867E+09	0.	0.	0.	0.
	6.034E+01	-4.048E-03	9.726E-08	7.251E+00	2.161E+02	2.161E+02				
70.00	1.372E+15	3.712E+14	3.285E+10	1.584E+13	8.138E+10	5.630E+11	0.	0.	0.	7.488E-01
	2.069E+04	4.059E+07	9.808E+04	5.030E+09	4.349E+08	4.146E+09	0.	0.	0.	0.
	5.166E+01	-4.091E-03	8.461E-08	7.108E+00	2.127E+02	2.127E+02				
71.00	1.191E+15	3.220E+14	3.423E+10	1.374E+13	7.059E+10	4.884E+11	0.	0.	0.	9.638E-01
	2.504E+04	3.784E+07	8.471E+04	4.569E+09	3.416E+08	3.521E+09	0.	0.	0.	0.
	4.412E+01	-4.135E-03	7.340E-08	6.965E+00	2.094E+02	2.094E+02				
72.00	1.030E+15	2.786E+14	3.583E+10	1.188E+13	6.106E+10	4.225E+11	0.	0.	0.	1.241E+00
	3.013E+04	3.563E+07	7.348E+04	4.147E+09	2.683E+08	2.980E+09	0.	0.	0.	0.
	3.760E+01	-4.181E-03	6.349E-08	6.824E+00	2.063E+02	2.063E+02				
73.00	8.881E+14	2.402E+14	3.770E+10	1.025E+13	5.266E+10	3.644E+11	0.	0.	0.	1.597E+00
	3.605E+04	3.390E+07	6.397E+04	3.763E+09	2.107E+08	2.512E+09	0.	0.	0.	0.
	3.194E+01	-4.228E-03	5.475E-08	6.687E+00	2.033E+02	2.033E+02				
74.00	7.634E+14	2.065E+14	3.990E+10	8.811E+12	4.528E+10	3.133E+11	0.	0.	0.	2.055E+00
	4.289E+04	3.260E+07	5.584E+04	3.416E+09	1.655E+08	2.110E+09	0.	0.	0.	0.
	2.711E+01	-4.278E-03	4.708E-08	6.556E+00	2.006E+02	2.006E+02				
75.00	6.564E+14	1.771E+14	4.250E+10	7.553E+12	3.881E+10	2.686E+11	0.	0.	0.	2.645E+00
	5.077E+04	3.168E+07	4.885E+04	3.100E+09	1.300E+08	1.764E+09	0.	0.	0.	0.
	2.295E+01	-4.330E-03	4.036E-08	6.430E+00	1.981E+02	1.981E+02				
76.00	5.595E+14	1.513E+14	4.558E+10	6.456E+12	3.317E+10	2.295E+11	0.	0.	0.	3.405E+00
	5.979E+04	3.111E+07	4.281E+04	2.719E+09	1.012E+08	1.467E+09	0.	0.	0.	0.
	1.939E+01	-4.388E-03	3.449E-08	6.311E+00	1.957E+02	1.957E+02				
77.00	4.768E+14	1.290E+14	4.924E+10	5.502E+12	2.827E+10	1.956E+11	0.	0.	0.	4.383E+00
	7.007E+04	3.087E+07	3.755E+04	2.343E+09	8.090E+07	1.214E+09	0.	0.	0.	0.
	1.635E+01	-4.447E-03	2.940E-08	6.200E+00	1.937E+02	1.937E+02				
78.00	4.052E+14	1.096E+14	5.359E+10	4.676E+12	2.403E+10	1.662E+11	0.	0.	0.	5.641E+00
	8.173E+04	3.093E+07	3.294E+04	2.019E+09	6.961E+07	9.991E+08	0.	0.	0.	0.
	1.374E+01	-4.511E-03	2.498E-08	6.094E+00	1.918E+02	1.918E+02				
79.00	3.435E+14	9.289E+13	5.836E+10	3.963E+12	2.037E+10	1.409E+11	0.	0.	0.	7.261E+00
	9.490E+04	3.128E+07	2.893E+04	1.997E+09	6.574E+07	8.169E+08	0.	0.	0.	0.
	1.157E+01	-4.581E-03	2.118E-08	6.002E+00	1.902E+02	1.902E+02				

80.00	2.904E+14	7.853E+13	8.489E+10	3.351E+12	1.722E+10	1.191E+11	0.	0.	0.	9.345E+00
	1.097E+05	3.191E+07	2.539E+04	2.050E+09	6.800E+07	8.633E+08	0.	0.	0.	0.
	9.710E+00	-4.458E-03	1.790E-08	5.916E+00	1.889E+02	1.889E+02				
81.00	2.450E+14	6.623E+13	7.213E+10	2.826E+12	1.452E+10	1.005E+11	0.	0.	0.	1.203E+01
	1.263E+05	3.281E+07	2.227E+04	2.243E+09	7.563E+07	5.345E+08	0.	0.	0.	0.
	8.143E+00	-4.757E-03	1.510E-08	5.838E+00	1.878E+02	1.878E+02				
82.00	2.062E+14	5.573E+13	8.067E+10	2.379E+12	1.223E+10	8.459E+10	0.	0.	0.	1.548E+01
	1.448E+05	3.397E+07	1.952E+04	2.560E+09	8.771E+07	4.273E+08	0.	0.	0.	0.
	6.822E+00	-4.824E-03	1.271E-08	5.770E+00	1.869E+02	1.869E+02				
83.00	1.732E+14	4.681E+13	9.070E+10	1.999E+12	1.027E+10	7.104E+10	0.	0.	0.	1.993E+01
	1.650E+05	3.538E+07	1.710E+04	2.901E+09	1.022E+08	3.385E+08	0.	0.	0.	0.
	5.713E+00	-4.918E-03	1.068E-08	5.710E+00	1.863E+02	1.863E+02				
84.00	1.453E+14	3.925E+13	1.024E+11	1.676E+12	8.614E+09	5.960E+10	0.	0.	0.	2.565E+01
	1.882E+05	3.702E+07	1.496E+04	3.353E+09	1.148E+08	2.656E+08	0.	0.	0.	0.
	4.782E+00	-5.019E-03	8.956E-09	5.659E+00	1.859E+02	1.859E+02				
85.00	1.217E+14	3.285E+13	1.160E+11	1.404E+12	7.213E+09	4.991E+10	0.	0.	0.	3.302E+01
	2.133E+05	3.889E+07	1.308E+04	3.600E+09	1.200E+08	2.063E+08	0.	0.	0.	0.
	4.002E+00	-5.127E-03	7.500E-09	5.614E+00	1.858E+02	1.858E+02				
86.00	1.018E+14	2.748E+13	1.317E+11	1.174E+12	6.033E+09	4.174E+10	0.	0.	0.	4.249E+01
	2.410E+05	4.085E+07	1.142E+04	3.562E+09	1.132E+08	1.585E+08	0.	0.	0.	0.
	3.349E+00	-5.238E-03	6.273E-09	5.582E+00	1.859E+02	1.859E+02				
87.00	8.503E+13	2.293E+13	1.496E+11	9.811E+11	5.042E+09	3.488E+10	0.	0.	0.	5.470E+01
	2.713E+05	4.318E+07	9.972E+03	3.187E+09	9.464E+07	1.203E+08	0.	0.	0.	0.
	2.804E+00	-5.367E-03	5.242E-09	5.556E+00	1.862E+02	1.862E+02				
88.00	7.100E+13	1.912E+13	1.697E+11	8.192E+11	4.210E+09	2.913E+10	0.	0.	0.	7.040E+01
	3.045E+05	4.553E+07	8.699E+03	2.565E+09	7.014E+07	9.023E+07	0.	0.	0.	0.
	2.349E+00	-5.500E-03	4.377E-09	5.538E+00	1.867E+02	1.867E+02				
89.00	5.926E+13	1.593E+13	1.921E+11	6.837E+11	3.514E+09	2.431E+10	0.	0.	0.	9.062E+01
	3.406E+05	4.796E+07	7.587E+03	1.881E+09	4.706E+07	6.681E+07	0.	0.	0.	0.
	1.969E+00	-5.641E-03	3.653E-09	5.528E+00	1.875E+02	1.875E+02				
90.00	4.945E+13	1.327E+13	2.166E+11	5.706E+11	2.932E+09	2.029E+10	1.353E+04	4.245E-04	1.353E+04	1.166E+02
	3.798E+05	5.040E+07	6.616E+03	1.300E+09	3.000E+07	4.881E+07	1.353E+04	4.245E-04	1.353E+04	4.335E-11
	1.652E+00	-5.792E-03	3.049E-09	5.525E+00	1.884E+02	1.884E+02				
95.00	2.010E+13	5.262E+12	3.521E+11	2.320E+11	1.192E+09	8.248E+09	3.679E+04	3.155E-02	3.679E+04	8.295E+02
	6.277E+05	6.051E+07	3.368E+03	1.937E+08	3.128E+06	8.310E+06	3.679E+04	3.155E-02	3.679E+04	2.964E-09
	7.015E-01	-6.689E-03	1.239E-09	5.613E+00	1.958E+02	1.958E+02				
100.00	8.381E+12	2.058E+12	4.225E+11	9.670E+10	4.969E+08	3.438E+09	1.000E+05	1.691E+00	1.000E+05	5.810E+03
	9.733E+05	6.204E+07	1.793E+03	2.886E+07	3.261E+05	1.075E+06	1.000E+05	1.691E+00	1.000E+05	1.690E-07
	3.124E-01	-7.863E-03	5.167E-10	5.834E+00	2.066E+02	2.066E+02				
101.00	7.066E+12	1.702E+12	4.191E+11	8.153E+10	4.190E+08	2.875E+09	1.020E+05	2.486E+00	1.020E+05	5.964E+03
	1.055E+06	6.115E+07	1.594E+03	1.972E+07	2.075E+05	7.031E+05	1.020E+05	2.486E+00	1.020E+05	2.584E-07
	2.676E-01	-8.139E-03	4.356E-10	5.889E+00	2.092E+02	2.092E+02				
102.00	5.967E+12	1.409E+12	4.097E+11	6.885E+10	3.538E+08	2.377E+09	1.039E+05	3.592E+00	1.039E+05	6.117E+03
	1.141E+06	5.993E+07	1.421E+03	1.348E+07	1.320E+05	4.605E+05	1.039E+05	3.592E+00	1.039E+05	3.924E-07
	2.299E-01	-8.431E-03	3.679E-10	5.945E+00	2.120E+02	2.120E+02				
103.00	5.047E+12	1.168E+12	3.947E+11	5.824E+10	2.993E+08	1.950E+09	1.060E+05	5.098E+00	1.060E+05	6.265E+03
	1.232E+06	5.845E+07	1.272E+03	9.209E+06	8.399E+04	3.028E+05	1.060E+05	5.098E+00	1.060E+05	5.921E-07
	1.980E-01	-8.742E-03	3.112E-10	6.002E+00	2.151E+02	2.151E+02				
104.00	4.276E+12	9.693E+11	3.750E+11	4.934E+10	2.536E+08	1.593E+09	1.080E+05	7.112E+00	1.080E+05	6.408E+03
	1.327E+06	5.677E+07	1.142E+03	6.293E+06	5.344E+04	2.007E+05	1.080E+05	7.112E+00	1.080E+05	8.879E-07
	1.710E-01	-9.075E-03	2.636E-10	6.061E+00	2.185E+02	2.185E+02				
105.00	3.629E+12	8.058E+11	3.517E+11	4.187E+10	2.152E+08	1.300E+09	1.101E+05	9.756E+00	1.101E+05	6.543E+03
	1.427E+06	5.493E+07	1.029E+03	4.300E+06	3.400E+04	1.344E+05	1.101E+05	9.756E+00	1.101E+05	1.324E-06
	1.481E-01	-9.431E-03	2.237E-10	6.119E+00	2.223E+02	2.223E+02				

106.00	3.084E+12	6.713E+11	3.259E+11	3.558E+10	1.829E+08	1.062E+09	1.122E+05	1.317E+01	1.122E+05	6.667E+03
	1.531E+06	5.299E+07	9.301E+02	2.938E+06	2.163E+04	9.165E+04	1.122E+05	1.317E+01	1.122E+05	1.963E-06
	1.287E-01	-9.816E-03	1.901E-10	6.177E+00	2.265E+02	2.265E+02				
107.00	2.625E+12	5.607E+11	2.988E+11	3.029E+10	1.556E+08	8.684E+08	1.143E+05	1.750E+01	1.143E+05	6.778E+03
	1.640E+06	5.100E+07	8.435E+02	2.008E+06	1.376E+04	6.359E+04	1.143E+05	1.750E+01	1.143E+05	2.896E-06
	1.123E-01	-1.023E-02	1.618E-10	6.234E+00	2.313E+02	2.313E+02				
108.00	2.238E+12	4.696E+11	2.714E+11	2.582E+10	1.327E+08	7.119E+08	1.165E+05	2.292E+01	1.165E+05	6.874E+03
	1.753E+06	4.899E+07	7.675E+02	1.372E+06	8.757E+03	4.512E+04	1.165E+05	2.292E+01	1.165E+05	4.248E-06
	9.822E-02	-1.069E-02	1.379E-10	6.290E+00	2.358E+02	2.358E+02				
109.00	1.910E+12	3.945E+11	2.444E+11	2.204E+10	1.133E+08	5.845E+08	1.187E+05	2.963E+01	1.186E+05	6.952E+03
	1.870E+06	4.700E+07	7.004E+02	9.376E+05	5.572E+03	3.283E+04	1.187E+05	2.963E+01	1.186E+05	6.197E-06
	8.626E-02	-1.119E-02	1.178E-10	6.347E+00	2.430E+02	2.430E+02				
110.00	1.633E+12	3.323E+11	2.187E+11	1.884E+10	9.681E+07	4.800E+08	1.209E+05	3.783E+01	1.209E+05	7.010E+03
	1.992E+06	4.504E+07	6.410E+02	6.407E+05	3.545E+03	2.457E+04	1.209E+05	3.783E+01	1.209E+05	8.989E-06
	7.605E-02	-1.174E-02	1.007E-10	6.404E+00	2.501E+02	2.501E+02				
111.00	1.398E+12	2.808E+11	1.946E+11	1.613E+10	8.287E+07	3.937E+08	1.231E+05	4.776E+01	1.231E+05	7.047E+03
	2.117E+06	4.311E+07	5.881E+02	4.378E+05	2.255E+03	1.893E+04	1.231E+05	4.776E+01	1.231E+05	1.296E-05
	6.732E-02	-1.234E-02	8.617E-11	6.468E+00	2.581E+02	2.581E+02				
112.00	1.198E+12	2.380E+11	1.724E+11	1.383E+10	7.105E+07	3.219E+08	1.254E+05	5.967E+01	1.254E+05	7.061E+03
	2.247E+06	4.124E+07	5.409E+02	2.992E+05	1.435E+03	1.502E+04	1.254E+05	5.967E+01	1.254E+05	1.856E-05
	5.986E-02	-1.302E-02	7.388E-11	6.542E+00	2.672E+02	2.672E+02				
113.00	1.029E+12	2.023E+11	1.522E+11	1.187E+10	6.102E+07	2.619E+08	1.277E+05	7.382E+01	1.277E+05	7.053E+03
	2.380E+06	3.941E+07	4.985E+02	2.044E+05	9.130E+02	1.225E+04	1.277E+05	7.382E+01	1.277E+05	2.640E-05
	5.345E-02	-1.376E-02	6.345E-11	6.626E+00	2.774E+02	2.774E+02				
114.00	8.858E+11	1.725E+11	1.341E+11	1.022E+10	5.252E+07	2.117E+08	1.301E+05	8.966E+01	1.300E+05	7.024E+03
	2.517E+06	3.763E+07	4.603E+02	1.397E+05	5.809E+02	1.025E+04	1.301E+05	8.966E+01	1.300E+05	3.726E-05
	4.796E-02	-1.458E-02	5.461E-11	6.721E+00	2.888E+02	2.888E+02				
115.00	7.644E+11	1.478E+11	1.180E+11	8.821E+09	4.533E+07	1.700E+08	1.324E+05	1.076E+02	1.323E+05	6.980E+03
	2.658E+06	3.592E+07	4.257E+02	9.546E+04	3.696E+02	8.734E+03	1.324E+05	1.076E+02	1.323E+05	5.215E-05
	4.323E-02	-1.548E-02	4.713E-11	6.826E+00	3.013E+02	3.013E+02				
116.00	6.623E+11	1.272E+11	1.038E+11	7.642E+09	3.927E+07	1.357E+08	1.348E+05	1.278E+02	1.347E+05	6.927E+03
	2.802E+06	3.430E+07	3.941E+02	6.523E+04	2.351E+02	7.517E+03	1.348E+05	1.278E+02	1.347E+05	7.233E-05
	3.914E-02	-1.644E-02	4.083E-11	6.941E+00	3.146E+02	3.146E+02				
117.00	5.769E+11	1.103E+11	9.144E+10	6.656E+09	3.420E+07	1.078E+08	1.373E+05	1.501E+02	1.371E+05	6.879E+03
	2.949E+06	3.281E+07	3.653E+02	4.457E+04	1.496E+02	6.452E+03	1.373E+05	1.501E+02	1.371E+05	9.928E-05
	3.560E-02	-1.745E-02	3.557E-11	7.067E+00	3.283E+02	3.283E+02				
118.00	5.064E+11	9.663E+10	8.071E+10	5.843E+09	3.003E+07	8.584E+07	1.397E+05	1.741E+02	1.396E+05	6.854E+03
	3.098E+06	3.152E+07	3.389E+02	3.046E+04	9.519E+01	5.429E+03	1.397E+05	1.741E+02	1.396E+05	1.346E-04
	3.250E-02	-1.844E-02	3.122E-11	7.202E+00	3.414E+02	3.414E+02				
119.00	4.494E+11	8.579E+10	7.156E+10	5.186E+09	2.665E+07	6.893E+07	1.422E+05	1.988E+02	1.420E+05	6.877E+03
	3.251E+06	3.052E+07	3.146E+02	2.081E+04	6.056E+01	4.382E+03	1.422E+05	1.988E+02	1.420E+05	1.800E-04
	2.978E-02	-1.934E-02	2.771E-11	7.349E+00	3.524E+02	3.524E+02				
119.99	4.053E+11	7.767E+10	6.397E+10	4.677E+09	2.404E+07	5.660E+07	1.447E+05	2.228E+02	1.445E+05	6.983E+03
	3.403E+06	2.998E+07	2.924E+02	1.428E+04	3.871E+01	3.310E+03	1.447E+05	2.228E+02	1.445E+05	2.359E-04
	2.737E-02	-2.001E-02	2.499E-11	7.503E+00	3.593E+02	3.593E+02				
120.00	4.050E+11	7.760E+10	6.390E+10	4.673E+09	2.401E+07	5.650E+07	1.447E+05	2.231E+02	1.445E+05	6.985E+03
	3.405E+06	2.998E+07	2.922E+02	1.422E+04	3.853E+01	3.299E+03	1.447E+05	2.230E+02	1.445E+05	2.365E-04
	2.735E-02	-9.028E-06	2.497E-11	7.505E+00	3.593E+02	3.593E+02				
121.00	3.556E+11	6.730E+10	5.823E+10	3.954E+09	2.311E+07	4.721E+07	1.473E+05	2.331E+02	1.471E+05	6.027E+03
	3.561E+06	2.897E+07	2.714E+02	9.719E+03	2.452E+01	2.794E+03	1.473E+05	2.331E+02	1.471E+05	2.730E-04
	2.514E-02	-9.748E-06	2.193E-11	7.888E+00	3.753E+02	4.312E+02				
122.00	3.141E+11	5.875E+10	5.330E+10	3.371E+09	2.228E+07	3.978E+07	1.499E+05	2.656E+02	1.496E+05	5.724E+03
	3.720E+06	2.811E+07	2.523E+02	6.641E+03	1.560E+01	2.367E+03	1.499E+05	2.656E+02	1.496E+05	3.419E-04
	2.319E-02	-1.044E-05	1.938E-11	8.269E+00	3.910E+02	4.700E+02				
123.00	2.790E+11	5.159E+10	4.899E+10	2.894E+09	2.152E+07	3.374E+07	1.525E+05	3.055E+02	1.522E+05	5.532E+03
	3.879E+06	2.738E+07	2.345E+02	4.558E+03	9.924E+00	2.005E+03	1.525E+05	3.055E+02	1.522E+05	4.306E-04
	2.147E-02	-1.123E-05	1.722E-11	8.650E+00	4.065E+02	5.033E+02				

124.00	2.490E+11	4.555E+10	4.520E+10	2.501E+09	2.082E+07	2.884E+07	1.551E+05	3.523E+02	1.548E+05	5.400E+03
	4.040E+06	2.677E+07	2.181E+02	3.101E+03	6.314E+00	1.698E+03	1.551E+05	3.522E+02	1.548E+05	5.414E+04
	1.993E+02	-1.199E+05	1.537E+11	9.029E+00	4.217E+02	5.335E+02				
125.00	2.233E+11	4.042E+10	4.184E+10	2.173E+09	2.017E+07	2.479E+07	1.578E+05	4.060E+02	1.574E+05	5.305E+03
	4.201E+06	2.629E+07	2.029E+02	3.119E+03	4.017E+00	1.438E+03	1.578E+05	4.059E+02	1.574E+05	6.779E+04
	1.856E+02	-1.275E+05	1.379E+11	9.407E+00	4.367E+02	5.617E+02				
130.00	1.370E+11	2.364E+10	2.965E+10	1.155E+09	1.755E+07	1.255E+07	1.716E+05	8.011E+02	1.708E+05	5.133E+03
	5.006E+06	2.422E+07	1.438E+02	3.158E+02	4.189E+01	6.273E+02	1.716E+05	8.010E+02	1.708E+05	1.930E+03
	1.344E+02	-1.673E+05	8.496E+12	1.128E+01	5.084E+02	6.852E+02				
135.00	9.041E+10	1.496E+10	2.218E+10	6.728E+08	1.563E+07	7.007E+06	1.862E+05	1.487E+03	1.847E+05	5.213E+03
	5.779E+06	2.231E+07	1.081E+02	4.705E+01	4.367E+02	2.735E+02	1.862E+05	1.487E+03	1.847E+05	4.834E+03
	1.018E+02	-2.087E+05	5.635E+12	1.312E+01	5.749E+02	7.914E+02				
140.00	6.287E+10	1.003E+10	1.726E+10	4.185E+08	1.417E+07	4.197E+06	2.015E+05	2.512E+03	1.990E+05	5.426E+03
	6.480E+06	2.056E+07	8.997E+01	7.010E+00	4.553E+03	1.193E+02	2.015E+05	2.512E+03	1.990E+05	1.087E+02
	7.962E+03	-2.511E+05	3.944E+12	1.493E+01	6.366E+02	8.866E+02				
145.00	4.548E+10	7.012E+09	1.382E+10	2.737E+08	1.301E+07	2.651E+06	2.175E+05	4.046E+03	2.135E+05	5.725E+03
	7.081E+06	1.898E+07	8.210E+01	1.044E+00	4.747E+04	5.201E+01	2.175E+05	4.044E+03	2.135E+05	2.231E+02
	6.381E+03	-2.938E+05	2.874E+12	1.670E+01	6.939E+02	9.734E+02				
150.00	3.394E+10	5.072E+09	1.133E+10	1.860E+08	1.206E+07	1.746E+06	2.343E+05	6.262E+03	2.280E+05	6.087E+03
	7.564E+06	1.745E+07	7.403E+01	1.556E+01	4.949E+05	2.268E+01	2.343E+05	6.259E+03	2.280E+05	4.248E+02
	5.212E+03	-3.366E+05	2.162E+12	1.844E+01	7.470E+02	1.053E+03				
160.00	2.026E+10	2.862E+09	8.017E+09	9.379E+07	1.061E+07	8.310E+05	2.698E+05	1.364E+04	2.561E+05	6.936E+03
	8.177E+06	1.482E+07	4.638E+01	3.455E+03	5.380E+07	4.312E+00	2.698E+05	1.363E+04	2.561E+05	1.282E+01
	3.432E+03	-4.207E+05	1.314E+12	2.179E+01	8.419E+02	1.195E+03				
170.00	1.294E+10	1.738E+09	5.965E+09	5.149E+07	9.535E+06	4.334E+05	3.076E+05	2.681E+04	2.808E+05	7.860E+03
	8.410E+06	1.258E+07	3.330E+01	7.669E+05	5.848E+09	8.198E+01	3.076E+05	2.678E+04	2.808E+05	3.209E+01
	2.641E+03	-5.015E+05	8.563E+13	2.498E+01	9.237E+02	1.319E+03				
180.00	8.478E+09	1.112E+09	4.600E+09	3.005E+07	8.708E+06	2.412E+05	3.474E+05	4.836E+04	2.991E+05	8.736E+03
	8.417E+06	1.068E+07	2.391E+01	1.703E+06	6.357E+11	1.559E+01	3.474E+05	4.831E+04	2.991E+05	6.972E+01
	1.981E+03	-5.775E+05	5.870E+13	2.802E+01	9.942E+02	1.427E+03				
190.00	6.032E+09	7.404E+08	3.643E+09	1.834E+07	8.046E+06	1.409E+05	3.886E+05	8.077E+04	3.078E+05	9.425E+03
	8.314E+06	9.064E+06	1.717E+01	3.780E+08	6.910E+13	2.964E+02	3.885E+05	8.064E+04	3.078E+05	1.352E+00
	1.521E+03	-6.482E+05	6.180E+13	3.089E+01	1.055E+03	1.523E+03				
200.00	4.310E+09	5.079E+08	2.945E+09	1.160E+07	7.501E+06	8.543E+04	4.304E+05	1.254E+05	3.049E+05	9.797E+03
	8.121E+06	7.694E+06	1.233E+01	8.391E+10	7.512E+15	5.636E+03	4.302E+05	1.252E+05	3.050E+05	2.368E+00
	1.190E+03	-7.129E+05	3.065E+13	3.362E+01	1.107E+03	1.607E+03				
220.00	2.339E+09	2.553E+08	2.013E+09	5.004E+06	6.647E+06	3.410E+04	5.127E+05	2.472E+05	2.655E+05	9.332E+03
	7.300E+06	5.545E+06	8.354E+00	4.135E+13	8.876E+19	2.037E+04	5.123E+05	2.466E+05	2.657E+05	5.348E+00
	7.599E+04	-8.239E+05	1.762E+13	3.865E+01	1.192E+03	1.751E+03				
240.00	1.340E+09	1.386E+08	1.435E+09	2.321E+06	5.998E+06	1.470E+04	5.875E+05	3.869E+05	2.006E+05	7.577E+03
	5.205E+06	3.996E+06	3.276E+00	2.038E+16	1.049E+22	7.366E+06	5.867E+05	3.858E+05	2.009E+05	7.291E+00
	5.063E+04	-9.104E+05	1.081E+13	4.319E+01	1.255E+03	1.867E+03				
260.00	8.028E+08	7.821E+07	1.052E+09	1.131E+06	5.480E+06	6.884E+03	6.476E+05	5.101E+05	1.374E+05	5.442E+03
	3.110E+06	2.880E+06	1.689E+00	1.004E+19	1.239E+26	2.663E+07	6.463E+05	5.086E+05	1.377E+05	6.804E+00
	3.482E+04	-9.735E+05	6.945E+14	4.731E+01	1.301E+03	1.963E+03				
280.00	4.931E+08	4.384E+07	7.876E+08	5.708E+05	5.049E+06	3.155E+03	6.865E+05	5.973E+05	8.925E+04	3.598E+03
	1.910E+06	2.075E+06	8.705E+01	4.950E+23	1.464E+30	9.627E+09	6.849E+05	5.955E+05	8.946E+04	5.666E+00
	2.455E+04	-1.015E+06	4.626E+14	5.110E+01	1.337E+03	2.044E+03				
300.00	3.091E+08	2.578E+07	5.981E+08	2.956E+05	4.681E+06	1.532E+03	7.000E+05	6.434E+05	5.662E+04	2.251E+03
	1.197E+06	1.498E+06	4.488E+01	2.439E+26	1.730E+34	3.481E+10	6.980E+05	6.413E+05	5.678E+04	4.354E+00
	1.765E+04	-1.037E+06	3.169E+14	5.461E+01	1.363E+03	2.113E+03				
320.00	1.947E+08	1.582E+07	4.592E+08	1.581E+05	4.360E+06	7.592E+02	6.334E+05	5.978E+05	3.555E+04	1.244E+03
	7.418E+05	1.078E+06	2.313E+01	1.202E+29	2.045E+38	1.258E+11	6.315E+05	5.959E+05	3.565E+04	2.892E+00
	1.290E+04	-1.042E+06	2.221E+14	5.790E+01	1.383E+03	2.173E+03				
300.00	1.266E+08	9.338E+06	3.555E+08	8.371E+04	4.074E+06	3.825E+02	5.731E+05	5.506E+05	2.246E+04	6.941E+02
	4.905E+05	7.767E+05	1.193E+01	5.925E+33	2.416E+42	4.549E+13	5.714E+05	5.489E+05	2.253E+04	1.908E+00
	9.563E+05	-1.033E+04	1.586E+14	6.100E+01	1.398E+03	2.227E+03				

360.00	8.229E+07	5.714E+06	2.770E+08	4.543E+04	3.817E+06	1.952E+02	5.186E+05	5.043E+05	1.431E+04	3.917E+02
	3.187E+05	5.597E+05	4.148E-02	2.920E-36	2.855E-46	1.645E-14	5.170E+05	5.027E+05	1.435E+04	1.255E+00
	7.174E-05	-1.011E-04	1.152E-14	6.394E+01	1.409E+03	2.275E+03				
380.00	5.387E+07	3.525E+06	2.169E+08	2.489E+04	3.583E+06	1.007E+02	4.692E+05	4.600E+05	9.191E+03	2.234E+02
	2.087E+05	4.034E+05	3.169E-02	1.439E-39	3.373E-50	5.946E-16	4.679E+05	4.586E+05	9.218E+03	8.239E-01
	5.437E-05	-9.792E-05	8.481E-15	6.672E+01	1.417E+03	2.319E+03				
400.00	3.548E+07	2.189E+06	1.705E+08	1.375E+04	3.368E+06	5.238E+01	4.246E+05	4.186E+05	5.953E+03	1.287E+02
	1.374E+05	2.907E+05	1.634E-02	7.092E-43	3.986E-54	2.150E-17	4.234E+05	4.174E+05	5.970E+03	5.409E-01
	4.159E-05	-9.401E-05	8.321E-15	6.936E+01	1.424E+03	2.359E+03				
420.00	2.349E+07	1.367E+06	1.348E+08	7.648E+03	3.171E+06	2.746E+01	3.842E+05	3.803E+05	3.888E+03	7.492E+01
	9.100E+04	2.095E+05	8.423E-03	3.495E-46	4.710E-58	7.772E-19	3.831E+05	3.792E+05	3.899E+03	3.553E-01
	3.207E-05	-8.955E-05	4.762E-15	7.186E+01	1.428E+03	2.397E+03				
440.00	1.562E+07	8.584E+05	1.065E+08	4.279E+03	2.988E+06	1.449E+01	3.476E+05	3.451E+05	2.559E+03	4.400E+01
	6.052E+04	1.510E+05	4.342E-03	1.723E-49	5.565E-62	2.810E-20	3.467E+05	3.442E+05	2.566E+03	2.337E-01
	2.490E-05	-8.473E-05	3.621E-15	7.421E+01	1.432E+03	2.432E+03				
460.00	1.043E+07	5.412E+05	8.446E+07	2.407E+03	2.817E+06	7.687E+00	3.145E+05	3.128E+05	1.697E+03	2.607E+01
	4.040E+04	1.088E+05	2.238E-03	8.490E-53	6.576E-66	1.016E-21	3.138E+05	3.121E+05	1.701E+03	1.540E-01
	1.947E-05	-7.970E-05	2.777E-15	7.642E+01	1.435E+03	2.466E+03				
480.00	6.988E+06	3.428E+05	6.715E+07	1.361E+03	2.659E+06	4.101E+00	2.846E+05	2.835E+05	1.133E+03	1.556E+01
	2.707E+04	7.840E+04	1.154E-03	4.184E-56	7.770E-70	3.672E-23	2.840E+05	2.828E+05	1.135E+03	1.017E-01
	1.530E-05	-7.458E-05	2.145E-15	7.851E+01	1.437E+03	2.498E+03				
500.00	4.697E+06	2.176E+05	5.349E+07	7.724E+02	2.511E+06	2.198E+00	2.575E+05	2.568E+05	7.609E+02	9.359E+00
	1.819E+04	5.650E+04	5.949E-04	2.062E-59	9.181E-74	1.328E-24	2.570E+05	2.562E+05	7.625E+02	6.734E-02
	1.210E-05	-6.949E-05	1.668E-15	8.046E+01	1.439E+03	2.528E+03				
520.00	3.166E+06	1.387E+05	4.269E+07	4.403E+02	2.372E+06	1.183E+00	2.330E+05	2.325E+05	5.140E+02	5.667E+00
	1.226E+04	4.072E+04	3.067E-04	1.016E-62	1.085E-77	4.800E-26	2.326E+05	2.321E+05	5.150E+02	4.470E-02
	9.615E-06	-6.450E-05	1.304E-15	8.231E+01	1.440E+03	2.558E+03				
540.00	2.140E+06	8.870E+04	3.412E+07	2.520E+02	2.243E+06	6.399E-01	2.108E+05	2.105E+05	3.491E+02	3.454E+00
	8.289E+03	2.934E+04	1.581E-04	5.008E-66	1.282E-81	1.735E-27	2.105E+05	2.101E+05	3.497E+02	2.976E-02
	7.677E-06	-5.967E-05	1.026E-15	8.405E+01	1.441E+03	2.587E+03				
560.00	1.450E+06	5.688E+04	2.732E+07	1.447E+02	2.121E+06	3.474E-01	1.908E+05	1.905E+05	2.382E+02	2.117E+00
	5.618E+03	2.115E+04	8.149E-05	2.468E-69	1.515E-85	6.273E-29	1.905E+05	1.903E+05	2.386E+02	1.987E-02
	6.159E-06	-5.505E-05	8.104E-16	8.569E+01	1.442E+03	2.614E+03				
580.00	9.855E+05	3.658E+04	2.190E+07	8.341E+01	2.007E+06	1.893E-01	1.726E+05	1.725E+05	1.632E+02	1.306E+00
	3.817E+03	1.524E+04	4.201E-05	1.216E-72	1.790E-89	2.268E-30	1.724E+05	1.722E+05	1.635E+02	1.332E-02
	4.964E-06	-5.066E-05	6.431E-16	8.727E+01	1.442E+03	2.641E+03				
600.00	6.712E+05	2.359E+04	1.759E+07	4.825E+01	1.899E+06	1.036E-01	1.562E+05	1.561E+05	1.123E+02	8.101E-01
	2.600E+03	1.098E+04	2.166E-05	5.995E-76	2.115E-93	8.199E-32	1.560E+05	1.559E+05	1.125E+02	8.958E-03
	4.020E-06	-4.652E-05	5.124E-16	8.879E+01	1.443E+03	2.667E+03				
620.00	4.583E+05	1.524E+04	1.414E+07	2.800E+01	1.798E+06	5.688E-02	1.413E+05	1.412E+05	7.757E+01	5.055E-01
	1.775E+03	7.914E+03	1.116E-05	2.955E-79	2.499E-97	2.964E-33	1.412E+05	1.411E+05	7.766E+01	6.049E-03
	3.270E-06	-4.263E-05	4.098E-16	9.027E+01	1.443E+03	2.693E+03				
640.00	3.136E+05	9.892E+03	1.139E+07	1.630E+01	1.703E+06	3.134E-02	1.279E+05	1.278E+05	5.375E+01	3.173E-01
	1.215E+03	5.703E+03	8.755E-06	1.456E-82	2.953-101	1.072E-34	1.278E+05	1.277E+05	5.381E+01	4.102E-03
	2.672E-06	-3.900E-05	3.289E-16	9.173E+01	1.443E+03	2.718E+03				
660.00	2.151E+05	6.430E+03	9.180E+06	9.521E+00	1.614E+06	1.733E-02	1.157E+05	1.157E+05	3.737E+01	2.004E-01
	8.331E+02	4.110E+03	2.967E-06	7.176E-86	3.489-105	3.874E-36	1.156E+05	1.156E+05	3.740E+01	2.794E-03
	2.195E-06	-3.562E-05	2.649E-16	9.318E+01	1.443E+03	2.742E+03				
680.00	1.478E+05	4.190E+03	7.410E+06	5.579E+00	1.530E+06	9.619E-03	1.047E+05	1.047E+05	2.605E+01	1.275E-01
	5.726E+02	2.962E+03	1.530E-06	3.537E-89	4.123-109	1.401E-37	1.046E+05	1.046E+05	2.608E+01	1.913E-03
	1.812E-06	-3.247E-05	2.141E-16	9.466E+01	1.443E+03	2.766E+03				
700.00	1.018E+05	2.738E+03	5.989E+06	3.279E+00	1.450E+06	5.356E-03	9.473E+04	9.472E+04	1.822E+01	8.166E-02
	3.945E+02	2.134E+03	7.885E-07	1.743E-92	4.872-113	5.064E-39	9.469E+04	9.467E+04	1.823E+01	1.317E-03
	1.504E-06	-2.956E-05	1.736E-16	9.617E+01	1.444E+03	2.790E+03				
720.00	7.030E+04	1.793E+03	4.847E+06	1.933E+00	1.375E+06	2.993E-03	8.572E+04	8.571E+04	1.277E+01	5.274E-02
	2.723E+02	1.538E+03	4.065E-07	8.590E-96	5.756-117	1.831E-40	8.569E+04	8.568E+04	1.278E+01	9.117E-04
	1.255E-06	-2.687E-05	1.413E-16	9.774E+01	1.444E+03	2.813E+03				

740.00	4.864E+04	1.177E+03	3.927E+06	1.143E+00	1.305E+06	1.478E-03	7.756E+04	7.755E+04	8.975E+00	3.438E-02
	1.884E+02	1.108E+03	2.095E-07	4.233E-99	6.802-121	6.619E-42	7.754E+04	7.754E+04	8.981E+00	6.356E-04
	1.053E-06	-2.438E-05	1.153E-16	9.940E+01	1.444E+03	2.836E+03				
760.00	3.372E+04	7.745E+02	3.185E+06	6.779E-01	1.238E+06	9.435E-04	7.018E+04	7.017E+04	6.322E+00	2.263E-02
	1.306E+02	7.988E+02	1.080E-07	2.086-102	8.037-125	2.393E-43	7.017E+04	7.017E+04	6.326E+00	4.465E-04
	8.887E-07	-2.209E-05	9.447E-17	1.012E+02	1.444E+03	2.858E+03				
780.00	2.342E+04	5.109E+02	2.587E+06	4.033E-01	1.175E+06	5.323E-04	6.350E+04	6.350E+04	4.464E+00	1.507E-02
	9.077E+01	5.757E+02	5.569E-08	1.028-105	9.497-129	8.651E-45	6.350E+04	6.350E+04	4.467E+00	3.164E-04
	7.548E-07	-1.997E-05	7.766E-17	1.030E+02	1.444E+03	2.880E+03				
800.00	1.631E+04	3.378E+02	2.104E+06	2.406E-01	1.116E+06	3.013E-04	5.746E+04	5.746E+04	3.159E+00	1.016E-02
	6.316E+01	4.149E+02	2.871E-08	5.068-109	1.122-132	3.128E-46	5.746E+04	5.746E+04	3.161E+00	2.264E-04
	6.451E-07	-1.802E-05	6.408E-17	1.051E+02	1.444E+03	2.902E+03				
820.00	1.137E+04	2.238E+02	1.712E+06	1.439E-01	1.060E+06	1.711E-04	5.199E+04	5.199E+04	2.240E+00	6.942E-03
	4.406E+01	2.990E+02	1.480E-08	2.497-112	1.326-136	1.131E-47	5.200E+04	5.200E+04	2.241E+00	1.638E-04
	5.550E-07	-1.622E-05	5.308E-17	1.073E+02	1.444E+03	2.923E+03				
840.00	7.950E+03	1.487E+02	1.396E+06	8.637E-02	1.007E+06	9.748E-05	4.704E+04	4.704E+04	1.592E+00	4.812E-03
	3.079E+01	2.154E+02	7.629E-09	1.231-115	1.567-140	4.088E-49	4.705E+04	4.705E+04	1.593E+00	1.201E-04
	4.806E-07	-1.457E-05	4.415E-17	1.098E+02	1.444E+03	2.944E+03				
860.00	5.568E+03	9.898E+01	1.139E+06	5.197E-02	9.572E+05	5.570E-05	4.257E+04	4.257E+04	1.133E+00	3.385E-03
	2.157E+01	1.553E+02	3.933E-09	6.066-119	1.851-144	1.478E-50	4.258E+04	4.258E+04	1.134E+00	8.938E-05
	4.190E-07	-1.305E-05	3.688E-17	1.125E+02	1.444E+03	2.965E+03				
880.00	3.907E+03	6.604E+01	9.301E+05	3.136E-02	9.100E+05	3.193E-05	3.852E+04	3.852E+04	8.087E-01	2.419E-03
	1.513E+01	1.119E+02	2.027E-09	2.990-122	2.188-148	5.343E-52	3.853E+04	3.853E+04	8.091E-01	6.767E-05
	3.676E-07	-1.165E-05	3.094E-17	1.155E+02	1.444E+03	2.985E+03				
900.00	2.747E+03	4.416E+01	7.606E+05	1.898E-02	8.653E+05	1.836E-05	3.485E+04	3.485E+04	5.781E-01	1.755E-03
	1.064E+01	8.063E+01	1.045E-09	1.473-125	2.585-152	1.932E-53	3.486E+04	3.486E+04	5.783E-01	5.225E-05
	3.247E-07	-1.037E-05	2.609E-17	1.189E+02	1.444E+03	3.005E+03				
920.00	1.935E+03	2.960E+01	6.227E+05	1.151E-02	8.231E+05	1.059E-05	3.153E+04	3.153E+04	4.140E-01	1.292E-03
	7.495E+00	5.811E+01	5.388E-10	7.261-129	3.054-156	6.983E-55	3.155E+04	3.154E+04	4.142E-01	4.125E-05
	2.886E-07	-9.202E-06	2.210E-17	1.226E+02	1.444E+03	3.025E+03				
940.00	1.366E+03	1.988E+01	5.103E+05	7.006E-03	7.831E+05	6.125E-06	2.853E+04	2.853E+04	2.971E-01	9.648E-04
	5.290E+00	4.188E+01	2.778E-10	3.578-132	3.609-160	2.525E-56	2.854E+04	2.854E+04	2.972E-01	3.341E-05
	2.581E-07	-8.134E-06	1.883E-17	1.267E+02	1.444E+03	3.045E+03				
960.00	9.658E+02	1.338E+01	4.187E+05	4.274E-03	7.453E+05	3.553E-06	2.582E+04	2.582E+04	2.135E-01	7.298E-04
	3.741E+00	3.018E+01	1.432E-10	1.764-135	4.264-164	9.127E-58	2.583E+04	2.583E+04	2.137E-01	2.783E-05
	2.322E-07	-7.162E-06	1.612E-17	1.313E+02	1.444E+03	3.064E+03				
980.00	6.842E+02	9.027E+00	3.439E+05	2.615E-03	7.095E+05	2.068E-06	2.336E+04	2.336E+04	1.538E-01	5.586E-04
	2.650E+00	2.175E+01	7.381E-11	8.692-139	5.039-168	3.300E-59	2.337E+04	2.337E+04	1.539E-01	2.393E-05
	2.101E-07	-6.281E-06	1.388E-17	1.364E+02	1.444E+03	3.083E+03				
1000.00	4.857E+02	6.103E+00	2.827E+05	1.604E-03	6.755E+05	1.207E-06	2.114E+04	2.114E+04	1.109E-01	4.320E-04
	1.881E+00	1.567E+01	3.805E-11	4.284-142	5.954-172	1.193E-60	2.115E+04	2.115E+04	1.110E-01	2.128E-05
	1.911E-07	-5.486E-06	1.202E-17	1.420E+02	1.444E+03	3.102E+03				
1040.00	2.461E+02	2.807E+00	1.918E+05	6.082E-04	6.130E+05	4.147E-07	1.731E+04	1.731E+04	5.806E-02	2.651E-04
	9.531E-01	8.139E+00	1.011E-11	1.040-148	8.313-180	1.559E-63	1.731E+04	1.731E+04	5.809E-02	1.876E-05
	1.605E-07	-4.129E-06	9.180E-18	1.550E+02	1.444E+03	3.140E+03				
1080.00	1.256E+02	1.302E+00	1.306E+05	2.330E-04	5.568E+05	1.441E-07	1.417E+04	1.417E+04	3.059E-02	1.670E-04
	4.864E-01	4.227E+00	2.687E-12	2.527-155	1.161-187	2.038E-66	1.417E+04	1.417E+04	3.062E-02	1.901E-05
	1.371E-07	-3.054E-06	7.176E-18	1.705E+02	1.444E+03	3.176E+03				
1120.00	6.455E+01	6.087E-01	8.930E+04	9.022E-05	5.063E+05	5.067E-08	1.160E+04	1.160E+04	1.623E-02	1.072E-04
	2.500E-01	2.195E+00	7.142E-13	6.138-162	1.621-195	2.664E-69	1.160E+04	1.160E+04	1.625E-02	2.162E-05
	1.188E-07	-2.220E-06	5.741E-18	1.887E+02	1.444E+03	3.212E+03				
1160.00	3.342E+01	2.869E-01	6.131E+04	3.528E-05	4.609E+05	1.801E-08	9.498E+03	9.498E+03	8.673E-03	6.961E-05
	1.294E-01	1.140E+00	1.898E-13	1.491-168	2.263-203	3.482E-72	9.500E+03	9.500E+03	8.684E-03	2.666E-05
	1.041E-07	-1.588E-06	4.694E-18	2.093E+02	1.444E+03	3.247E+03				
1200.00	1.742E+01	1.363E-01	4.226E+04	1.394E-05	4.199E+05	6.473E-09	7.776E+03	7.776E+03	4.665E-03	4.559E-05
	6.748E-02	5.921E-01	5.044E-14	3.621-175	3.159-211	4.550E-75	7.778E+03	7.778E+03	4.673E-03	3.450E-05
	9.214E-08	-1.120E-06	3.914E-18	2.322E+02	1.444E+03	3.281E+03				

END OF TEST PROBLEM

TEST VALUES READ IN

NALTS = 130

I	ALTS(I),KM											
1	0.00	2	5.00	3	10.00	4	15.00	5	20.00	6	25.00	
7	30.00	8	35.00	9	40.00	10	45.00	11	50.00	12	55.00	
13	56.00	14	57.00	15	58.00	16	59.00	17	60.00	18	61.00	
19	62.00	20	63.00	21	64.00	22	65.00	23	66.00	24	67.00	
25	68.00	26	69.00	27	70.00	28	71.00	29	72.00	30	73.00	
31	74.00	32	75.00	33	76.00	34	77.00	35	78.00	36	79.00	
37	80.00	38	81.00	39	82.00	40	83.00	41	84.00	42	85.00	
43	86.00	44	87.00	45	88.00	46	89.00	47	90.00	48	95.00	
49	100.00	50	101.00	51	102.00	52	103.00	53	104.00	54	105.00	
55	106.00	56	107.00	57	108.00	58	109.00	59	110.00	60	111.00	
61	112.00	62	113.00	63	114.00	64	115.00	65	116.00	66	117.00	
67	118.00	68	119.00	69	119.99	70	120.00	71	121.00	72	122.00	
73	123.00	74	124.00	75	125.00	76	130.00	77	135.00	78	140.00	
79	145.00	80	150.00	81	160.00	82	170.00	83	180.00	84	190.00	
85	200.00	86	220.00	87	240.00	88	260.00	89	280.00	90	300.00	
91	320.00	92	340.00	93	360.00	94	380.00	95	400.00	96	420.00	
97	440.00	98	460.00	99	480.00	100	500.00	101	520.00	102	540.00	
103	560.00	104	580.00	105	600.00	106	620.00	107	640.00	108	660.00	
109	680.00	110	700.00	111	720.00	112	740.00	113	760.00	114	780.00	
115	800.00	116	820.00	117	840.00	118	860.00	119	880.00	120	900.00	
121	920.00	122	940.00	123	960.00	124	980.00	125	1000.00	126	1040.00	
127	1080.00	128	1120.00	129	1160.00	130	1200.00					

IYRS = 77 IMONS = 9 IDAYS = 2
ZT = 0. HRS GCD = 5.5000E+01 DEG GLO = 2.3500E+02 DEG

INITIALIZATION CALL

TIF = 1.043924E+03 TAU = 2.384721E-02

IYRS = 77 IMONS = 9 IDAYS = 2
ZT = 0. HRS GCD = 9.5993E-01 RAD GLO = 4.1015E+00 RAD

IDORN = -1 UT = 8.0000E+00 GAT = 7.9966E+00 PLAT = 6.1087E-01 PLON = 4.1015E+00

HL = 23.663 SHAR = 157.717

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	M+ 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	M+ 1/CC	N+ 1/CC
	PRESSURE DYNES/CM**2	REMSED	DENSITY GRAMS/CC	DEN SC HT KM	TEMP DEG K	E TEMP DEG K				
0.00	1.982E+19	5.362E+18	1.100E+00	2.287E+17	1.175E+15	8.132E+15	0.	0.	0.	1.815E+02
	1.026E+00	1.000E+00	3.599E+10	3.400E+00	8.000E+11	1.866E+17	0.	0.	0.	0.
	1.013E+06	-0.	1.222E-03	9.075E+00	2.888E+02	2.888E+02				
5.00	1.204E+19	3.258E+18	1.100E+00	1.390E+17	7.141E+14	4.941E+15	0.	0.	0.	9.307E+01
	1.026E+00	1.000E+00	1.075E+10	3.400E+00	5.700E+11	2.411E+16	0.	0.	0.	0.
	5.026E+05	-3.808E-05	7.425E-04	9.617E+00	2.545E+02	2.545E+02				
10.00	8.638E+18	1.796E+18	1.100E+00	7.659E+16	3.936E+14	2.723E+15	0.	0.	0.	4.773E+01
	1.026E+00	1.000E+00	2.781E+09	3.400E+00	1.100E+12	3.976E+14	0.	0.	0.	0.
	2.654E+05	-1.205E-04	4.092E-04	7.453E+00	2.259E+02	2.259E+02				
15.00	3.209E+18	8.680E+17	1.100E+00	3.702E+16	1.903E+14	1.316E+15	0.	0.	0.	2.447E+01
	1.026E+00	1.000E+00	1.924E+09	3.400E+00	2.500E+12	2.065E+13	0.	0.	0.	0.
	1.222E+05	-2.414E-04	1.978E-04	6.488E+00	2.151E+02	2.151E+02				
20.00	1.453E+18	3.931E+17	1.100E+00	1.677E+16	8.616E+13	5.961E+14	0.	0.	0.	1.255E+01
	1.026E+00	1.000E+00	2.658E+09	3.400E+00	4.800E+12	4.511E+12	0.	0.	0.	0.
	5.538E+04	-4.104E-04	8.958E-05	6.212E+00	2.153E+02	2.153E+02				
25.00	6.500E+17	1.758E+17	1.100E+00	7.500E+15	3.854E+13	2.667E+14	0.	0.	0.	6.435E+00
	1.026E+00	1.000E+00	3.995E+09	3.400E+00	4.300E+12	2.250E+12	0.	0.	0.	0.
	2.544E+04	-6.353E-04	4.007E-05	6.253E+00	2.211E+02	2.211E+02				
30.00	2.952E+17	7.988E+16	1.100E+00	3.406E+15	1.750E+13	1.211E+14	0.	0.	0.	3.300E+00
	1.026E+00	1.000E+00	4.267E+09	3.400E+00	2.500E+12	1.406E+12	0.	0.	0.	0.
	1.200E+04	-9.232E-04	1.820E-05	6.434E+00	2.297E+02	2.297E+02				
35.00	1.377E+17	3.724E+16	1.100E+00	1.588E+15	8.163E+12	5.648E+13	0.	0.	0.	1.692E+00
	1.026E+00	1.000E+00	3.022E+09	3.400E+00	1.400E+12	8.036E+11	0.	0.	0.	0.
	5.843E+03	-1.281E-03	8.487E-06	6.686E+00	2.398E+02	2.398E+02				
40.00	6.624E+16	1.793E+16	1.100E+00	7.646E+14	3.929E+12	2.719E+13	0.	0.	0.	8.677E-01
	1.026E+00	1.000E+00	1.746E+09	3.400E+00	6.100E+11	3.957E+11	0.	0.	0.	0.
	2.937E+03	-1.711E-03	4.085E-06	7.005E+00	2.504E+02	2.504E+02				
45.00	3.307E+16	8.946E+15	1.100E+00	3.816E+14	1.961E+12	1.357E+13	0.	0.	0.	4.450E-01
	1.026E+00	1.000E+00	9.685E+08	3.400E+00	1.823E+11	1.797E+11	0.	0.	0.	0.
	1.520E+03	-2.205E-03	2.039E-06	7.399E+00	2.596E+02	2.596E+02				
50.00	1.715E+16	4.640E+15	1.100E+00	1.979E+14	1.017E+12	7.037E+12	0.	0.	0.	2.282E-01
	1.026E+00	1.000E+00	5.139E+08	3.400E+00	5.459E+10	8.158E+10	0.	0.	0.	0.
	8.015E+02	-2.724E-03	1.057E-06	7.837E+00	2.640E+02	2.640E+02				
55.00	9.198E+15	2.488E+15	1.100E+00	1.061E+14	5.454E+11	3.773E+12	0.	0.	0.	1.170E-01
	1.026E+00	1.000E+04	2.574E+08	3.400E+00	1.629E+10	3.848E+10	0.	0.	0.	0.
	4.239E+02	-3.204E-03	5.671E-07	8.178E+00	2.684E+02	2.684E+02				
58.00	8.141E+15	2.202E+15	1.100E+00	9.394E+13	4.827E+11	3.340E+12	0.	0.	0.	1.024E-01
	1.026E+00	4.517E+04	2.206E+08	3.400E+00	1.364E+10	3.326E+10	0.	0.	0.	0.
	3.726E+02	-3.290E-03	5.019E-07	8.215E+00	2.585E+02	2.585E+02				
57.00	7.210E+15	1.950E+15	1.100E+00	8.319E+13	4.275E+11	2.958E+12	0.	0.	0.	8.958E-02
	1.026E+00	1.284E+05	1.891E+08	3.400E+00	1.261E+10	2.877E+10	0.	0.	0.	0.
	3.272E+02	-3.371E-03	4.445E-07	8.234E+00	2.564E+02	2.564E+02				
58.00	6.388E+15	1.727E+15	1.100E+00	7.368E+13	3.784E+11	2.620E+12	0.	0.	0.	7.837E-02
	1.026E+00	2.844E+05	1.620E+08	3.400E+00	1.241E+10	2.490E+10	0.	0.	0.	0.
	2.870E+02	-3.448E-03	3.937E-07	8.241E+00	2.539E+02	2.539E+02				
59.00	5.655E+15	1.530E+15	1.100E+00	6.524E+13	3.353E+11	2.320E+12	0.	0.	0.	6.857E-02
	1.026E+00	5.529E+05	1.388E+08	3.400E+00	1.263E+10	2.156E+10	0.	0.	0.	0.
	2.514E+02	-3.520E-03	3.487E-07	8.228E+00	2.512E+02	2.512E+02				

60.00	5.007E+15	1.354E+15	1.100E+00	5.777E+13	2.969E+11	2.054E+12	0.	0.	0.	6.000E-02
	1.026E+00	1.000E+06	1.190E+08	3.400E+00	1.300E+10	1.867E+10	0.	0.	0.	0.
	2.200E+02	-3.588E-03	3.087E-07	8.194E+00	2.482E+02	2.482E+02				
61.00	4.430E+15	1.198E+15	4.149E+00	5.112E+13	2.627E+11	1.818E+12	0.	0.	0.	5.681E-02
	1.026E+00	1.717E+06	1.020E+08	3.400E+00	1.334E+10	1.617E+10	0.	0.	0.	0.
	1.921E+02	-3.651E-03	2.732E-07	8.147E+00	2.450E+02	2.450E+02				
62.00	3.917E+15	1.060E+15	1.565E+01	4.519E+13	2.322E+11	1.607E+12	0.	0.	0.	5.379E-02
	1.026E+00	2.739E+06	8.739E+07	3.400E+00	1.348E+10	1.399E+10	0.	0.	0.	0.
	1.675E+02	-3.711E-03	2.415E-07	8.080E+00	2.416E+02	2.416E+02				
63.00	3.459E+15	9.356E+14	5.904E+01	3.991E+13	2.051E+11	1.419E+12	0.	0.	0.	5.094E-02
	1.026E+00	4.302E+06	7.489E+07	3.400E+00	1.334E+10	1.209E+10	0.	0.	0.	0.
	1.457E+02	-3.766E-03	2.132E-07	7.996E+00	2.380E+02	2.380E+02				
64.00	3.050E+15	8.250E+14	2.227E+02	3.519E+13	1.808E+11	1.251E+12	0.	0.	0.	4.823E-02
	1.026E+00	6.187E+06	6.418E+07	3.400E+00	1.284E+10	1.044E+10	0.	0.	0.	0.
	1.265E+02	-3.818E-03	1.880E-07	7.897E+00	2.344E+02	2.344E+02				
65.00	2.685E+15	7.262E+14	8.401E+02	3.098E+13	1.592E+11	1.101E+12	0.	0.	0.	4.567E-02
	1.026E+00	8.300E+06	5.500E+07	3.400E+00	1.200E+10	8.999E+09	0.	0.	0.	0.
	1.094E+02	-3.868E-03	1.655E-07	7.785E+00	2.307E+02	2.307E+02				
66.00	2.359E+15	6.380E+14	3.169E+03	2.721E+13	1.399E+11	9.676E+11	0.	0.	0.	4.324E-02
	1.026E+00	1.042E+07	3.447E+07	3.400E+00	1.084E+10	7.743E+09	0.	0.	0.	0.
	9.475E+01	-3.915E-03	1.454E-07	7.662E+00	2.270E+02	2.270E+02				
67.00	2.068E+15	5.593E+14	1.195E+04	2.388E+13	1.226E+11	8.483E+11	0.	0.	0.	4.094E-02
	1.026E+00	1.233E+07	2.160E+07	3.400E+00	9.418E+09	6.649E+09	0.	0.	0.	0.
	8.172E+01	-3.960E-03	1.275E-07	7.530E+00	2.233E+02	2.233E+02				
68.00	1.808E+15	4.892E+14	4.509E+04	2.087E+13	1.072E+11	7.419E+11	0.	0.	0.	3.877E-02
	1.026E+00	1.395E+07	1.354E+07	3.400E+00	7.822E+09	5.696E+09	0.	0.	0.	0.
	7.030E+01	-4.004E-03	1.115E-07	7.393E+00	2.196E+02	2.196E+02				
69.00	1.578E+15	4.267E+14	1.701E+05	1.820E+13	9.354E+10	6.472E+11	0.	0.	0.	3.671E-02
	1.026E+00	1.530E+07	8.485E+06	3.400E+00	6.145E+09	4.867E+09	0.	0.	0.	0.
	6.034E+01	-4.044E-03	9.726E-08	7.251E+00	2.161E+02	2.161E+02				
70.00	1.372E+15	3.712E+14	6.416E+05	1.584E+13	8.138E+10	5.630E+11	0.	0.	0.	3.476E-02
	1.026E+00	1.650E+07	5.317E+06	3.400E+00	4.500E+09	4.146E+09	0.	0.	0.	0.
	5.166E+01	-4.081E-03	8.461E-08	7.108E+00	2.127E+02	2.127E+02				
71.00	1.191E+15	3.220E+14	2.420E+06	1.374E+13	7.059E+10	4.884E+11	0.	0.	0.	3.291E-02
	1.026E+00	1.772E+07	3.332E+06	9.513E+00	3.161E+09	3.521E+09	0.	0.	0.	0.
	4.412E+01	-4.135E-03	7.340E-08	6.965E+00	2.094E+02	2.094E+02				
72.00	1.030E+15	2.786E+14	9.129E+06	1.188E+13	6.106E+10	4.225E+11	0.	0.	0.	3.116E-02
	1.026E+00	1.912E+07	2.088E+06	2.662E+01	2.221E+09	2.980E+09	0.	0.	0.	0.
	3.760E+01	-4.181E-03	6.349E-08	6.824E+00	2.063E+02	2.063E+02				
73.00	8.881E+14	2.402E+14	3.444E+07	1.025E+13	5.266E+10	3.644E+11	0.	0.	0.	2.951E-02
	1.026E+00	2.079E+07	1.309E+06	7.448E+01	1.560E+09	2.512E+09	0.	0.	0.	0.
	3.196E+01	-4.228E-03	5.475E-08	6.687E+00	2.033E+02	2.033E+02				
74.00	7.656E+14	2.065E+14	1.299E+08	8.811E+12	4.528E+10	3.133E+11	0.	0.	0.	2.794E-02
	1.026E+00	2.277E+07	8.203E+05	2.084E+02	1.096E+09	2.110E+09	0.	0.	0.	0.
	2.711E+01	-4.278E-03	4.708E-08	6.556E+00	2.006E+02	2.006E+02				
75.00	6.548E+14	1.771E+14	4.900E+08	7.553E+12	3.881E+10	2.686E+11	0.	0.	0.	2.645E-02
	1.026E+00	2.500E+07	5.141E+05	5.831E+02	7.700E+08	1.764E+09	0.	0.	0.	0.
	2.295E+01	-4.330E-03	4.036E-08	6.430E+00	1.981E+02	1.981E+02				
76.00	5.595E+14	1.513E+14	1.675E+09	6.456E+12	3.317E+10	2.295E+11	0.	0.	0.	2.505E-02
	1.026E+00	2.732E+07	3.222E+05	1.632E+03	4.326E+08	1.467E+09	0.	0.	0.	0.
	1.939E+01	-4.386E-03	3.449E-08	6.311E+00	1.957E+02	1.957E+02				
77.00	4.768E+14	1.290E+14	4.647E+09	5.502E+12	2.827E+10	1.956E+11	0.	0.	0.	2.372E-02
	1.026E+00	2.948E+07	2.019E+05	4.565E+03	2.008E+08	1.214E+09	0.	0.	0.	0.
	1.655E+01	-4.447E-03	2.940E-08	6.200E+00	1.937E+02	1.937E+02				
78.00	4.052E+14	1.096E+14	1.043E+10	4.676E+12	2.403E+10	1.662E+11	0.	0.	0.	2.246E-02
	1.026E+00	3.122E+07	1.265E+05	1.277E+04	1.022E+08	9.991E+08	0.	0.	0.	0.
	1.374E+01	-4.511E-03	2.498E-08	6.096E+00	1.918E+02	1.918E+02				

79.00	3.435E+14	9.289E+13	1.923E+10	3.963E+12	2.037E+10	1.409E+11	0.	0.	0.	2.126E-02
	1.02AE+00	3.23AE+07	7.930E+04	3.574E+04	6.725E+07	A.169E+08	0.	0.	0.	0.
	1.157E+01	-4.581E-03	2.118E-0A	4.002E+00	1.902E+02	1.902E+02				
A0.00	2.904E+14	7.A53E+13	3.000E+10	3.351E+12	1.722E+10	1.191E+11	0.	0.	0.	2.013E-02
	1.02AE+00	3.300E+07	4.970E+04	1.000E+05	6.100E+07	A.633E+0A	0.	0.	0.	0.
	9.710E+00	-4.A5AE-03	1.790E-0A	5.916E+00	1.889E+02	1.889E+02				
A1.00	2.450E+14	6.A23E+13	4.114E+10	2.A26E+12	1.452E+10	1.005E+11	0.	0.	0.	1.906E-02
	1.02AE+00	3.332E+07	3.115E+04	1.100E+0A	7.52AE+07	5.345E+08	0.	0.	0.	0.
	A.143E+00	-4.737E-03	1.510E-0A	5.83AE+00	1.87AE+02	1.878E+02				
A2.00	2.062E+14	5.573E+13	5.174E+10	2.379E+12	1.223E+10	A.459E+10	0.	0.	0.	1.805E-02
	1.02AE+00	3.377E+07	1.952E+04	6.231E+06	1.177E+0A	4.273E+08	0.	0.	0.	0.
	A.A22E+00	-4.A24E-03	1.271E-0A	5.770E+00	1.869E+02	1.869E+02				
A3.00	1.732E+14	4.A81E+13	A.220E+10	1.999E+12	1.027E+10	7.106E+10	0.	0.	0.	1.709E-02
	1.02AE+00	3.480E+07	1.710E+04	2.11AE+07	2.08AE+0A	3.385E+08	0.	0.	0.	0.
	5.713E+00	-4.91AE-03	1.06AE-0A	5.710E+00	1.A63E+02	1.A63E+02				
A4.00	1.453E+14	3.925E+13	7.415E+10	1.676E+12	A.614E+09	5.960E+10	0.	0.	0.	1.618E-02
	1.02AE+00	3.A64E+07	1.496E+04	4.907E+07	3.703E+0A	2.656E+08	0.	0.	0.	0.
	4.782E+00	-5.019E-03	A.95AE-09	5.A59E+00	1.859E+02	1.859E+02				
A5.00	1.217E+14	3.285E+13	9.000E+10	1.404E+12	7.213E+09	4.991E+10	0.	0.	0.	1.532E-02
	1.02AE+00	3.A89E+07	1.30AE+04	A.A00E+07	5.A00E+0A	2.063E+0A	0.	0.	0.	0.
	4.002E+00	-5.127E-03	7.500E-09	5.61AE+00	1.85AE+02	1.85AE+02				
A6.00	1.01AE+14	2.74AE+13	1.124E+11	1.174E+12	6.033E+09	4.174E+10	0.	0.	0.	1.451E-02
	1.733E+00	4.095E+07	1.142E+04	1.237E+0A	7.24AE+0A	1.585E+08	0.	0.	0.	0.
	3.349E+00	-5.243E-03	A.273E-09	5.562E+00	1.859E+02	1.859E+02				
A7.00	A.503E+13	2.293E+13	1.440E+11	9.A11E+11	5.042E+09	3.488E+10	0.	0.	0.	1.374E-02
	2.A8AE+00	4.31AE+07	9.972E+03	1.553E+0A	A.A19E+0A	1.203E+0A	0.	0.	0.	0.
	2.A04E+00	-5.367E-03	5.242E-09	5.556E+00	1.A62E+02	1.A62E+02				
A8.00	7.100E+13	1.912E+13	1.A25E+11	A.192E+11	4.210E+09	2.913E+10	0.	0.	0.	1.301E-02
	4.74AE+00	4.553E+07	A.A99E+03	1.783E+0A	4.A5AE+0A	9.023E+07	0.	0.	0.	0.
	2.349E+00	-5.500E-03	4.377E-09	5.53AE+00	1.A67E+02	1.A67E+02				
A9.00	5.92AE+13	1.593E+13	2.158E+11	A.A37E+11	3.514E+09	2.431E+10	0.	0.	0.	1.232E-02
	7.703E+00	4.796E+07	7.5A7E+03	1.927E+0A	2.A66E+0A	A.A81E+07	0.	0.	0.	0.
	1.969E+00	-5.A41E-03	3.A53E-09	5.52AE+00	1.A75E+02	1.A75E+02				
90.00	4.945E+13	1.327E+13	2.166E+11	5.706E+11	2.932E+09	2.029E+10	1.353E+02	4.245E-0A	1.353E+02	1.166E-02
	1.233E+01	5.040E+07	A.A16E+03	2.000E+0A	1.700E+0A	4.A81E+07	1.353E+02	4.245E-0A	1.353E+02	1.521E-19
	1.A52E+00	-5.792E-03	3.049E-09	5.525E+00	1.A84E+02	1.A84E+02				
95.00	2.010E+13	5.262E+12	3.521E+11	2.320E+11	1.192E+09	A.24AE+09	3.679E+02	3.155E-06	3.679E+02	8.295E-02
	1.06AE+02	A.051E+07	3.36AE+03	1.400E+0A	2.031E+07	A.310E+06	3.679E+02	3.155E-06	3.679E+02	5.081E-17
	7.015E-01	-A.A89E-03	1.239E-09	5.613E+00	1.95AE+02	1.95AE+02				
100.00	A.381E+12	2.056E+12	4.225E+11	9.A70E+10	4.969E+0A	3.43AE+09	1.000E+03	1.691E-04	1.000E+03	5.810E-01
	A.757E+02	A.204E+07	1.793E+03	2.A86E+07	2.427E+06	1.075E+06	1.000E+03	1.691E-04	1.000E+03	1.175E-14
	3.124E-01	-7.A63E-03	5.167E-10	5.A34E+00	2.066E+02	2.066E+02				
101.00	7.06AE+12	1.702E+12	4.191E+11	A.153E+10	4.190E+0A	2.A75E+09	1.000E+03	2.393E-04	1.000E+03	5.740E-01
	9.43AE+02	A.107E+07	1.594E+03	1.972E+07	1.587E+06	7.031E+05	1.000E+03	2.393E-04	1.000E+03	2.226E-14
	2.67AE-01	-A.139E-03	4.356E-10	5.A89E+00	2.092E+02	2.092E+02				
102.00	5.967E+12	1.409E+12	4.097E+11	A.A85E+10	3.53AE+0A	2.377E+09	1.001E+03	3.330E-04	1.001E+03	5.671E-01
	1.303E+03	5.963E+07	1.421E+03	1.348E+07	1.03AE+06	4.A05E+05	1.001E+03	3.330E-04	1.001E+03	4.155E-14
	3.299E-01	-A.431E-03	3.A79E-10	5.945E+00	2.120E+02	2.120E+02				
103.00	5.047E+12	1.19AE+12	3.947E+11	5.A24E+10	2.993E+0A	1.950E+09	1.002E+03	4.559E-04	1.002E+03	5.602E-01
	1.77AE+03	5.780E+07	1.272E+03	9.209E+06	A.784E+05	3.02AE+05	1.002E+03	4.559E-04	1.002E+03	7.645E-14
	1.980E-01	-A.742E-03	3.112E-10	A.002E+00	2.151E+02	2.151E+02				
104.00	4.27AE+12	9.693E+11	3.750E+11	4.934E+10	2.536E+0A	1.593E+09	1.004E+03	A.140E-04	1.004E+03	5.532E-01
	2.401E+03	5.565E+07	1.142E+03	A.293E+06	4.435E+05	2.007E+05	1.004E+03	A.140E-04	1.004E+03	1.387E-13
	1.710E-01	-9.075E-03	2.A3AE-10	A.061E+00	2.185E+02	2.185E+02				
105.00	3.A29E+12	A.05AE+11	3.517E+11	4.187E+10	2.152E+0A	1.300E+09	1.005E+03	A.140E-04	1.005E+03	5.459E-01
	3.20AE+03	5.327E+07	1.029E+03	4.300E+06	2.900E+05	1.34AE+05	1.005E+03	A.140E-04	1.005E+03	2.484E-13
	1.481E-01	-9.431E-03	2.237E-10	A.119E+00	2.223E+02	2.223E+02				

106.00	3.084E+12	6.713E+11	3.259E+11	3.55AE+10	1.829E+08	1.062E+09	1.00AE+03	1.063E-03	1.00AE+03	5.382E-01
	4.240E+03	5.072E+07	9.301E+02	2.93AE+06	1.896E+05	9.165E+04	1.00AE+03	1.063E-03	1.00AE+03	4.390E-13
	1.287E-01	-9.81AE-03	1.901E-10	6.177E+00	2.265E+02	2.265E+02				
107.00	2.525E+12	5.607E+11	2.98AE+11	3.029E+10	1.556E+08	8.685E+08	1.011E+03	1.36AE-03	1.011E+03	5.300E-01
	5.547E+03	4.80AE+07	8.435E+02	2.00AE+06	1.240E+05	6.359E+04	1.011E+03	1.36AE-03	1.011E+03	7.660E-13
	1.123E-01	-1.023E-02	1.81AE-10	6.234E+00	2.313E+02	2.313E+02				
108.00	2.258E+12	4.696E+11	2.714E+11	2.582E+10	1.327E+08	7.120E+08	1.014E+03	1.73AE-03	1.014E+03	5.211E-01
	7.184E+03	4.540E+07	7.675E+02	1.372E+06	8.106E+04	4.512E+04	1.014E+03	1.73AE-03	1.014E+03	1.320E-12
	9.822E-02	-1.069E-02	1.379E-10	6.290E+00	2.36AE+02	2.36AE+02				
109.00	1.910E+12	3.945E+11	2.444E+11	2.204E+10	1.133E+08	5.845E+08	1.01AE+03	2.180E-03	1.01AE+03	5.116E-01
	9.210E+03	4.272E+07	7.004E+02	9.37AE+05	5.300E+04	3.283E+04	1.01AE+03	2.180E-03	1.01AE+03	2.246E-12
	8.62AE-02	-1.119E-02	1.178E-10	6.347E+00	2.430E+02	2.430E+02				
110.00	1.633E+12	3.323E+11	2.187E+11	1.88AE+10	9.681E+07	4.800E+08	1.022E+03	2.705E-03	1.022E+03	5.013E-01
	1.169E+04	4.009E+07	6.410E+02	6.407E+05	3.465E+04	2.457E+04	1.022E+03	2.705E-03	1.022E+03	3.775E-12
	7.605E-02	-1.174E-02	1.007E-10	6.404E+00	2.501E+02	2.501E+02				
111.00	1.39AE+12	2.80AE+11	1.946E+11	1.613E+10	8.287E+07	3.937E+08	1.027E+03	3.322E-03	1.027E+03	4.901E-01
	1.471E+04	3.753E+07	5.881E+02	4.37AE+05	2.266E+04	1.893E+04	1.027E+03	3.322E-03	1.027E+03	6.262E-12
	6.732E-02	-1.234E-02	8.617E-11	6.467E+00	2.581E+02	2.581E+02				
112.00	1.19AE+12	2.380E+11	1.724E+11	1.383E+10	7.105E+07	3.219E+08	1.032E+03	4.042E-03	1.032E+03	4.782E-01
	1.83AE+04	3.505E+07	5.409E+02	2.992E+05	1.481E+04	1.502E+04	1.032E+03	4.042E-03	1.032E+03	1.026E-11
	5.98AE-02	-1.302E-02	7.38AE-11	6.540E+00	2.672E+02	2.672E+02				
113.00	1.02AE+12	2.023E+11	1.522E+11	1.187E+10	6.102E+07	2.619E+08	1.03AE+03	4.874E-03	1.03AE+03	4.656E-01
	2.263E+04	3.26AE+07	4.985E+02	2.044E+05	9.685E+03	1.225E+04	1.03AE+03	4.874E-03	1.03AE+03	1.657E-11
	5.845E-02	-1.376E-02	6.345E-11	6.622E+00	2.774E+02	2.774E+02				
114.00	8.85AE+11	1.725E+11	1.341E+11	1.022E+10	5.252E+07	2.117E+08	1.044E+03	5.777E-03	1.044E+03	4.526E-01
	2.770E+04	3.039E+07	4.603E+02	1.397E+05	6.332E+03	1.025E+04	1.044E+03	5.777E-03	1.044E+03	2.642E-11
	4.796E-02	-1.45AE-02	5.461E-11	6.714E+00	2.88AE+02	2.88AE+02				
115.00	7.644E+11	1.47AE+11	1.180E+11	8.821E+09	4.533E+07	1.700E+08	1.050E+03	6.771E-03	1.050E+03	4.393E-01
	3.362E+04	2.82AE+07	4.257E+02	9.546E+04	4.140E+03	8.734E+03	1.050E+03	6.771E-03	1.050E+03	4.152E-11
	4.82AE-02	-1.54AE-02	4.713E-11	6.815E+00	3.013E+02	3.013E+02				
116.00	6.82AE+11	1.272E+11	1.038E+11	7.642E+09	3.927E+07	1.357E+08	1.057E+03	7.865E-03	1.057E+03	4.264E-01
	4.045E+04	2.621E+07	3.941E+02	6.523E+04	2.707E+03	7.517E+03	1.057E+03	7.865E-03	1.057E+03	6.429E-11
	3.914E-02	-1.64AE-02	4.083E-11	6.92AE+00	3.146E+02	3.146E+02				
117.00	5.76AE+11	1.103E+11	9.144E+10	6.65AE+09	3.420E+07	1.079E+08	1.065E+03	9.045E-03	1.065E+03	4.146E-01
	4.82AE+04	2.435E+07	3.655E+02	4.457E+04	1.770E+03	6.452E+03	1.065E+03	9.045E-03	1.065E+03	9.797E-11
	3.560E-02	-1.745E-02	3.557E-11	7.046E+00	3.283E+02	3.283E+02				
118.00	5.05AE+11	9.66AE+10	8.071E+10	5.84AE+09	3.003E+07	8.58AE+07	1.073E+03	1.02AE-02	1.073E+03	4.048E-01
	5.716E+04	2.272E+07	3.389E+02	3.046E+04	1.157E+03	5.429E+03	1.073E+03	1.028E-02	1.073E+03	1.467E-10
	3.250E-02	-1.84AE-02	3.122E-11	7.17AE+00	3.414E+02	3.414E+02				
119.00	4.49AE+11	8.579E+10	7.156E+10	5.186E+09	2.665E+07	6.89?E+07	1.082E+03	1.152E-02	1.082E+03	3.984E-01
	6.71AE+04	2.155E+07	3.146E+02	2.081E+04	7.566E+02	4.382E+03	1.082E+03	1.152E-02	1.082E+03	2.155E-10
	2.97AE-02	-1.934E-02	2.771E-11	7.315E+00	3.524E+02	3.524E+02				
119.99	4.053E+11	7.767E+10	6.397E+10	4.677E+09	2.404E+07	5.660E+07	1.091E+03	1.268E-02	1.091E+03	3.974E-01
	7.819E+04	2.035E+07	2.924E+02	1.428E+04	4.96AE+02	3.310E+03	1.091E+03	1.268E-02	1.091E+03	3.085E-10
	2.737E-02	-2.001E-02	2.499E-11	7.462E+00	3.593E+02	3.593E+02				
120.00	4.050E+11	7.760E+10	6.390E+10	4.673E+09	2.401E+07	5.650E+07	1.091E+03	1.269E-02	1.091E+03	3.974E-01
	7.831E+04	2.034E+07	2.922E+02	1.422E+04	4.947E+02	3.299E+03	1.091E+03	1.269E-02	1.091E+03	3.096E-10
	2.735E-02	-9.177E-06	2.497E-11	7.464E+00	3.593E+02	3.593E+02				
121.00	3.550E+11	6.727E+10	5.820E+10	3.952E+09	2.310E+07	4.719E+07	1.101E+03	1.498E-02	1.101E+03	3.872E-01
	9.065E+04	1.907E+07	2.714E+02	9.719E+03	3.235E+02	2.794E+03	1.101E+03	1.498E-02	1.101E+03	4.468E-10
	2.514E-02	-9.821E-06	2.192E-11	7.872E+00	3.755E+02	3.755E+02				
122.00	3.139E+11	5.872E+10	5.328E+10	3.370E+09	2.227E+07	3.976E+07	1.111E+03	1.758E-02	1.111E+03	3.786E-01
	1.042E+05	1.794E+07	2.523E+02	6.541E+03	2.115E+02	2.367E+03	1.111E+03	1.758E-02	1.111E+03	6.343E-10
	2.319E-02	-1.04AE-05	1.937E-11	8.270E+00	3.912E+02	3.912E+02				
123.00	2.78AE+11	5.158E+10	4.89AE+10	2.89AE+09	2.152E+07	3.375E+07	1.122E+03	2.052E-02	1.122E+03	3.714E-01
	1.189E+05	1.694E+07	2.345E+02	4.538E+03	1.383E+02	2.005E+03	1.122E+03	2.052E-02	1.122E+03	8.870E-10
	2.147E-02	-1.111E-05	1.721E-11	8.683E+00	4.066E+02	4.066E+02				

124.00	2.491E+11	4.557E+10	4.521E+10	2.501E+09	2.082E+07	2.885E+07	1.133E+03	2.383E-02	1.133E+03	3.655E-01
	1.349E+05	1.606E+07	2.181E+02	3.101E+03	9.041E+01	1.698E+03	1.133E+03	2.383E-02	1.133E+03	1.223E-09
	1.993E-02	-1.175E-05	1.538E-11	9.084E+00	4.216E+02	4.216E+02				
125.00	2.236E+11	4.047E+10	4.188E+10	2.175E+09	2.019E+07	2.482E+07	1.145E+03	2.757E-02	1.145E+03	3.608E-01
	1.520E+05	1.529E+07	2.029E+02	2.119E+03	5.911E+01	1.438E+03	1.145E+03	2.757E-02	1.145E+03	1.665E-09
	1.856E-02	-1.239E-05	1.381E-11	9.484E+00	4.362E+02	4.362E+02				
130.00	1.379E+11	2.380E+10	2.987E+10	1.162E+09	1.763E+07	1.263E+07	1.215E+03	5.433E-02	1.215E+03	3.511E-01
	2.524E+05	1.211E+07	1.438E+02	3.158E+02	7.063E+00	6.273E+02	1.215E+03	5.433E-02	1.215E+03	6.570E-09
	1.343E-02	-1.551E-05	8.552E-12	1.144E+01	5.044E+02	5.044E+02				
135.00	9.157E+10	1.514E+10	2.252E+10	6.800E+08	1.579E+07	7.077E+06	1.302E+03	1.012E-01	1.302E+03	3.601E-01
	3.682E+05	9.668E+06	1.081E+02	4.705E+01	8.439E-01	2.735E+02	1.302E+03	1.011E-01	1.302E+03	2.073E-08
	1.013E-02	-1.848E-05	5.708E-12	1.333E+01	5.648E+02	5.648E+02				
140.00	6.401E+10	1.019E+10	1.765E+10	4.241E+08	1.439E+07	4.246E+06	1.409E+03	1.820E-01	1.409E+03	3.854E-01
	4.833E+05	7.801E+06	8.997E+01	7.010E+00	1.008E-01	1.193E+02	1.409E+03	1.820E-01	1.409E+03	5.541E-08
	7.880E-03	-2.126E-05	4.016E-12	1.514E+01	6.184E+02	6.184E+02				
145.00	4.647E+10	7.145E+09	1.424E+10	2.773E+08	1.329E+07	2.679E+06	1.540E+03	3.206E-01	1.540E+03	4.275E-01
	5.836E+05	6.369E+06	8.210E+01	1.044E+00	1.205E-02	5.201E+01	1.540E+03	3.206E-01	1.540E+03	1.309E-07
	6.266E-03	-2.384E-05	2.939E-12	1.688E+01	6.659E+02	6.659E+02				
150.00	3.474E+10	5.169E+09	1.175E+10	1.880E+08	1.240E+07	1.756E+06	1.699E+03	5.583E-01	1.699E+03	4.893E-01
	6.606E+05	5.260E+06	7.403E+01	1.556E+01	1.440E-03	2.268E+01	1.699E+03	5.582E-01	1.699E+03	2.823E-07
	5.070E-03	-2.620E-05	2.215E-12	1.854E+01	7.081E+02	7.081E+02				
160.00	2.069E+10	2.899E+09	8.391E+09	9.348E+07	1.102E+07	8.216E+05	2.124E+03	1.668E+00	2.123E+03	6.948E-01
	7.459E+05	3.707E+06	4.638E+01	3.455E-03	2.055E-05	4.312E+00	2.124E+03	1.668E+00	2.123E+03	1.103E-06
	3.449E-03	-3.029E-05	1.346E-12	2.161E+01	7.787E+02	7.787E+02				
170.00	1.309E+10	1.735E+09	6.272E+09	5.011E+07	1.001E+07	4.162E+05	2.743E+03	4.878E+00	2.739E+03	1.081E+00
	7.700E+05	2.710E+06	3.330E+01	7.669E-05	2.934E-07	8.198E-01	2.743E+03	4.877E+00	2.739E+03	3.821E-06
	2.437E-03	-3.357E-05	8.712E-13	2.438E+01	8.342E+02	8.342E+02				
180.00	8.451E+09	1.086E+09	4.837E+09	2.828E+07	9.210E+06	2.228E+05	3.647E+03	1.440E+01	3.633E+03	1.811E+00
	7.893E+05	2.042E+06	2.391E+01	1.703E-06	4.189E-09	1.559E-01	3.647E+03	1.439E+01	3.633E+03	1.269E-05
	1.769E-03	-3.611E-05	5.897E-13	2.686E+01	8.781E+02	8.781E+02				
190.00	5.862E+09	7.021E+08	3.814E+09	1.656E+07	8.562E+06	1.240E+05	4.971E+03	4.321E+01	4.927E+03	3.220E+00
	7.577E+05	1.574E+06	1.717E+01	3.780E-08	5.981E-11	2.964E-02	4.971E+03	4.320E+01	4.927E+03	4.144E-05
	1.311E-03	-3.799E-05	4.125E-13	2.910E+01	9.126E+02	9.126E+02				
200.00	4.069E+09	4.648E+08	3.057E+09	9.963E+06	8.018E+06	7.108E+04	6.913E+03	1.313E+02	6.782E+03	5.986E+00
	7.289E+05	1.236E+06	1.233E+01	8.391E-10	8.539E-13	5.636E-03	6.913E+03	1.313E+02	6.782E+03	1.320E-04
	9.875E-04	-3.928E-05	2.959E-13	3.111E+01	9.399E+02	9.399E+02				
220.00	2.051E+09	2.137E+08	2.032E+09	3.814E+06	7.138E+06	2.480E+04	1.394E+04	1.194E+03	1.274E+04	2.178E+01
	5.915E+05	7.936E+05	6.354E+00	4.135E-13	1.741E-16	2.037E-04	1.394E+04	1.193E+03	1.274E+04	1.119E-03
	5.820E-04	-4.040E-05	1.611E-13	3.462E+01	9.785E+02	9.785E+02				
240.00	1.076E+09	1.026E+08	1.391E+09	1.537E+06	6.437E+06	9.125E+03	2.870E+04	8.778E+03	1.992E+04	6.841E+01
	3.748E+05	5.282E+05	3.276E+00	2.038E-16	3.548E-20	7.366E-06	2.870E+04	8.775E+03	1.992E+04	5.831E-03
	3.569E-04	-3.995E-05	9.261E-14	3.764E+01	1.003E+03	1.003E+03				
260.00	5.787E+08	5.064E+07	9.700E+08	6.386E+05	5.851E+06	3.473E+03	5.786E+04	3.829E+04	1.957E+04	1.335E+02
	2.016E+05	3.598E+05	1.689E+00	1.004E-19	7.231E-24	2.663E-07	5.785E+04	3.828E+04	1.958E+04	1.506E-02
	2.257E-04	-3.834E-05	5.546E-14	4.036E+01	1.018E+03	1.018E+03				
280.00	3.166E+08	2.544E+07	6.843E+08	2.710E+05	5.345E+06	1.352E+03	1.097E+05	9.737E+04	1.230E+04	1.576E+02
	1.102E+05	2.488E+05	8.705E-01	4.950E-23	1.474E-27	9.627E-09	1.097E+05	9.735E+04	1.231E+04	2.287E-02
	1.464E-04	-3.590E-05	3.430E-14	4.290E+01	1.027E+03	1.027E+03				
300.00	1.750E+08	1.294E+07	4.867E+08	1.167E+05	4.898E+06	5.350E+02	1.883E+05	1.819E+05	6.445E+03	1.410E+02
	8.094E+04	1.739E+05	4.488E-01	2.439E-26	3.004E-31	3.481E-10	1.882E+05	1.818E+05	6.448E+03	2.572E-02
	9.496E-05	-3.292E-05	2.180E-14	4.531E+01	1.033E+03	1.033E+03				
320.00	9.758E+07	6.648E+06	3.481E+08	5.084E+04	4.498E+06	2.142E+02	2.838E+05	2.806E+05	3.256E+03	1.071E+02
	3.399E+04	1.224E+05	2.313E-01	1.202E-29	6.124E-35	1.258E-11	2.837E+05	2.804E+05	3.257E+03	2.412E-02
	6.543E-05	-2.964E-05	1.417E-14	4.763E+01	1.037E+03	1.037E+03				
340.00	5.477E+07	3.437E+06	2.501E+08	2.234E+04	4.138E+06	8.658E+01	3.667E+05	3.650E+05	1.655E+03	7.029E+01
	1.908E+04	8.664E+04	1.193E-01	5.925E-33	1.248E-38	4.549E-13	3.666E+05	3.649E+05	1.656E+03	1.925E-02
	4.484E-05	-2.627E-05	9.403E-15	4.984E+01	1.040E+03	1.040E+03				

360.00	3.091E+07	1.789E+06	1.802E+08	9.885E+03	3.810E+06	3.527E+01	4.000E+05	3.991E+05	8.545E+02	3.968E+01
	1.077E+04	6.155E+04	6.148E-02	2.920E-36	2.544E-42	1.645E-14	4.000E+05	3.991E+05	8.548E+02	1.301E-02
	3.116E-05	-2.297E-05	6.347E-15	5.194E+01	1.041E+03	1.041E+03				
380.00	1.752E+07	9.354E+05	1.303E+08	4.402E+03	3.512E+06	1.447E+01	3.619E+05	3.615E+05	4.483E+02	1.892E+01
	6.103E+03	4.384E+04	3.169E-02	1.439E-39	5.186E-46	5.946E-16	3.620E+05	3.615E+05	4.485E+02	7.299E-03
	2.191E-05	-1.985E-05	4.350E-15	5.390E+01	1.042E+03	1.042E+03				
400.00	9.976E+06	4.915E+05	9.442E+07	1.972E+03	3.239E+06	5.973E+00	3.275E+05	3.273E+05	2.389E+02	9.198E+00
	3.474E+03	3.130E+04	1.634E-02	7.092E-43	1.057E-49	2.150E-17	3.277E+05	3.274E+05	2.390E+02	4.134E-03
	1.557E-05	-1.699E-05	3.020E-15	5.572E+01	1.043E+03	1.043E+03				
420.00	5.700E+06	2.594E+05	6.858E+07	8.878E+02	2.990E+06	2.480E+00	2.963E+05	2.962E+05	1.291E+02	4.560E+00
	1.985E+03	2.238E+04	8.423E-03	3.495E-46	2.154E-53	7.772E-19	2.966E+05	2.965E+05	1.292E+02	2.367E-03
	1.117E-05	-1.443E-05	2.121E-15	5.740E+01	1.043E+03	1.043E+03				
440.00	3.269E+06	1.375E+05	4.991E+07	4.018E+02	2.761E+06	1.036E+00	2.681E+05	2.681E+05	7.068E+01	2.308E+00
	1.139E+03	1.603E+04	4.342E-03	1.723E-49	4.391E-57	2.810E-20	2.684E+05	2.685E+05	7.070E+01	1.374E-03
	8.079E-06	-1.217E-05	1.504E-15	5.894E+01	1.043E+03	1.043E+03				
460.00	1.881E+06	7.312E+04	3.640E+07	1.827E+02	2.551E+06	4.347E+01	2.426E+05	2.426E+05	3.911E+01	1.197E+00
	6.552E+02	1.149E+04	2.238E-03	8.490E-53	8.951E-61	1.016E-21	2.433E+05	2.432E+05	3.913E+01	8.093E-04
	5.894E-06	-1.021E-05	1.076E-15	6.037E+01	1.044E+03	1.044E+03				
480.00	1.088E+06	3.905E+04	2.660E+07	8.351E+01	2.359E+06	1.834E+01	2.195E+05	2.195E+05	2.186E+01	6.381E-01
	3.783E+02	8.243E+03	1.154E-03	4.184E-56	1.824E-64	3.672E-23	2.204E+05	2.204E+05	2.187E+01	4.859E-04
	4.335E-06	-8.525E-06	7.750E-16	6.170E+01	1.044E+03	1.044E+03				
500.00	6.293E+05	2.093E+04	1.948E+07	3.834E+01	2.182E+06	7.781E+00	1.986E+05	1.986E+05	1.233E+01	3.521E-01
	2.192E+02	5.918E+03	5.949E-04	2.062E-59	3.719E-68	1.328E-24	1.997E+05	1.997E+05	1.234E+01	2.984E-04
	3.215E-06	-7.092E-06	5.623E-16	6.296E+01	1.044E+03	1.044E+03				
520.00	3.657E+05	1.126E+04	1.428E+07	1.768E+01	2.019E+06	3.317E+00	1.797E+05	1.797E+05	7.015E+00	2.025E-01
	1.274E+02	4.251E+03	3.067E-04	1.016E-62	7.580E-72	4.800E-26	1.810E+05	1.810E+05	7.017E+00	1.886E-04
	2.404E-06	-5.880E-06	4.105E-16	6.420E+01	1.044E+03	1.044E+03				
540.00	2.132E+05	6.080E+03	1.050E+07	8.193E+00	1.869E+06	1.421E+00	1.626E+05	1.626E+05	4.021E+00	1.222E-01
	7.427E+01	3.055E+03	1.581E-04	5.008E-66	1.545E-75	1.735E-27	1.640E+05	1.640E+05	4.022E+00	1.234E-04
	1.814E-06	-4.861E-06	3.015E-16	6.543E+01	1.044E+03	1.044E+03				
560.00	1.247E+05	3.295E+03	7.727E+06	3.813E+00	1.731E+06	6.119E+03	1.472E+05	1.471E+05	2.321E+00	7.776E-02
	4.344E+01	2.196E+03	8.149E-05	2.468E-69	3.149E-79	6.273E-29	1.485E+05	1.485E+05	2.322E+00	8.429E-05
	1.382E-06	-4.006E-06	2.228E-16	6.670E+01	1.044E+03	1.044E+03				
580.00	7.317E+04	1.792E+03	5.698E+06	1.782E+00	1.604E+06	2.648E+03	1.331E+05	1.331E+05	1.349E+00	5.213E-02
	2.548E+01	1.580E+03	4.201E-05	1.216E-72	6.419E-83	2.268E-30	1.345E+05	1.345E+05	1.350E+00	6.047E-05
	1.063E-06	-3.292E-06	1.655E-16	6.805E+01	1.044E+03	1.044E+03				
600.00	4.306E+04	9.778E+02	4.209E+06	8.367E+01	1.487E+06	1.151E+03	1.205E+05	1.205E+05	7.899E-01	3.667E-02
	1.500E+01	1.136E+03	2.166E-05	5.995E-76	1.308E-86	8.199E-32	1.218E+05	1.218E+05	7.907E-01	4.581E-05
	8.273E-07	-2.696E-06	1.238E-16	6.953E+01	1.044E+03	1.044E+03				
620.00	2.542E+04	5.355E+02	3.115E+06	3.946E+01	1.379E+06	5.028E-04	1.090E+05	1.090E+05	4.655E-01	2.687E-02
	8.852E+00	8.178E+02	1.116E-05	2.955E-79	2.667E-90	2.964E-33	1.102E+05	1.102E+05	4.662E-01	3.677E-05
	6.515E-07	-2.200E-06	9.313E-17	7.117E+01	1.044E+03	1.044E+03				
640.00	1.505E+04	2.943E+02	2.309E+06	1.868E+01	1.280E+06	2.207E-04	9.864E+04	9.864E+04	2.762E-01	2.034E-02
	5.241E+00	5.888E+02	5.755E-06	1.456E-82	5.436E-94	1.072E-34	9.970E+04	9.970E+04	2.768E-01	3.137E-05
	5.194E-07	-1.788E-06	7.057E-17	7.304E+01	1.044E+03	1.044E+03				
660.00	8.935E+03	1.622E+02	1.715E+06	8.866E+02	1.188E+06	9.732E-05	8.925E+04	8.925E+04	1.650E-01	1.576E-02
	3.112E+00	4.238E+02	2.967E-06	7.176E-86	1.108E-97	3.874E-36	9.019E+04	9.019E+04	1.656E-01	2.856E-05
	4.194E-07	-1.446E-06	5.387E-17	7.520E+01	1.044E+03	1.044E+03				
680.00	5.322E+03	8.976E+01	1.275E+06	4.244E-02	1.103E+06	4.311E-05	8.076E+04	8.076E+04	9.929E-02	1.243E-02
	1.854E+00	3.049E+02	1.530E-06	3.537E-89	2.258-101	1.401E-37	8.158E+04	8.158E+04	9.981E-02	2.789E-05
	3.436E-07	-1.163E-06	4.147E-17	7.771E+01	1.044E+03	1.044E+03				
700.00	3.179E+03	4.983E+01	9.502E+05	2.035E-02	1.025E+06	1.919E-05	7.307E+04	7.307E+04	6.020E-02	9.918E-03
	1.107E+00	2.196E+02	7.885E-07	1.743E-92	4.603-105	5.064E-39	7.379E+04	7.379E+04	6.066E-02	2.935E-05
	2.851E-07	-9.300E-07	3.221E-17	8.066E+01	1.044E+03	1.044E+03				
720.00	1.904E+03	2.775E+01	7.092E+05	9.803E-03	9.525E+05	8.580E-06	6.612E+04	6.612E+04	3.678E-02	7.978E-03
	6.633E-01	1.581E+02	4.065E-07	8.590E-96	9.382-109	1.831E-40	6.674E+04	6.674E+04	3.719E-02	3.326E-05
	2.398E-07	-7.381E-07	2.526E-17	8.412E+01	1.044E+03	1.044E+03				

740.00	1.144E+03	1.551E+01	5.301E+05	4.740E-03	8.856E+05	3.853E-06	5.983E+04	5.983E+04	2.266E-02	6.453E-03
	3.985E-01	1.139E+02	2.095E-07	4.233E-99	1.912-112	6.619E-42	6.036E+04	6.036E+04	2.302E-02	4.033E-05
	2.042E+07	-5.812E-07	2.002E-17	8.818E+01	1.044E+03	1.044E+03				
760.00	6.894E+02	8.694E+00	3.969E+05	2.302E-03	8.238E+05	1.739E-06	5.413E+04	5.413E+04	1.408E-02	5.239E-03
	2.401E-01	8.201E+01	1.080E-07	2.086-102	3.898-114	2.393E-43	5.460E+04	5.460E+04	1.440E-02	5.166E-05
	1.760E-07	-4.538E-07	1.605E-17	9.294E+01	1.044E+03	1.044E+03				
780.00	4.164E+02	4.890E+00	2.977E+05	1.122E-03	7.665E+05	7.879E-07	4.898E+04	4.898E+04	8.829E-03	4.263E-03
	1.451E-01	5.907E+01	5.569E-08	1.028-105	7.945-120	8.651E-45	4.938E+04	4.938E+04	9.111E-03	6.891E-05
	1.534E-07	-3.510E-07	1.302E-17	9.848E+01	1.044E+03	1.044E+03				
800.00	2.524E+02	2.759E+00	2.236E+05	5.493E-04	7.136E+05	3.586E-07	4.432E+04	4.432E+04	5.589E-03	3.475E-03
	8.791E-02	4.255E+01	2.871E-08	5.068-109	1.619-123	3.128E-46	4.467E+04	4.467E+04	5.836E-03	9.449E-05
	1.351E-07	-2.889E-07	1.070E-17	1.049E+02	1.044E+03	1.044E+03				
820.00	1.534E+02	1.562E+00	1.682E+05	2.699E-04	6.646E+05	1.640E-07	4.010E+04	4.010E+04	3.573E-03	2.836E-03
	5.342E-02	3.066E+01	1.480E-08	2.497-112	3.301-127	1.131E-47	4.040E+04	4.040E+04	3.790E-03	1.318E-04
	1.201E-07	-2.039E-07	8.894E-18	1.122E+02	1.044E+03	1.044E+03				
840.00	9.345E+01	8.869E-01	1.269E+05	1.332E-04	6.191E+05	7.528E-08	3.629E+04	3.629E+04	2.307E-03	2.317E-03
	3.255E-02	2.209E+01	7.629E-09	1.231-115	6.728-131	4.088E-49	3.654E+04	3.654E+04	2.497E-03	1.858E-04
	1.075E-07	-1.532E-07	7.488E-18	1.205E+02	1.044E+03	1.044E+03				
860.00	5.710E+01	5.052E-01	9.568E+04	6.596E-05	5.771E+05	3.472E-08	3.283E+04	3.283E+04	1.505E-03	1.893E-03
	1.989E-02	1.591E+01	3.933E-09	6.066-119	1.371-134	1.478E-50	3.305E+04	3.305E+04	1.672E-03	2.632E-04
	9.697E-08	-1.140E-07	6.380E-18	1.297E+02	1.044E+03	1.044E+03				
880.00	3.498E+01	2.887E-01	7.233E+04	3.280E-05	5.380E+05	1.608E-08	2.971E+04	2.971E+04	9.921E-04	1.548E-03
	1.218E-02	1.148E+01	2.027E-09	2.990-122	2.795-138	5.343E-52	2.990E+04	2.990E+04	1.138E-03	3.737E-04
	8.798E-08	-8.404E-08	5.499E-18	1.398E+02	1.044E+03	1.044E+03				
900.00	2.149E+01	1.655E-01	5.476E+04	1.637E-05	5.019E+05	7.478E-09	2.688E+04	2.688E+04	6.608E-04	1.266E-03
	7.484E-03	8.261E+00	1.045E-09	1.473-125	5.698-142	1.932E-53	2.705E+04	2.705E+04	7.889E-04	5.306E-04
	8.023E-08	-8.144E-08	4.791E-18	1.507E+02	1.044E+03	1.044E+03				
920.00	1.324E+01	9.512E-02	4.152E+04	8.202E-06	4.683E+05	3.493E-09	2.432E+04	2.432E+04	4.446E-04	1.035E-03
	4.610E-03	5.952E+00	5.388E-10	7.261-129	1.161-145	6.983E-55	2.446E+04	2.446E+04	5.575E-04	7.525E-04
	7.348E-08	-8.461E-08	4.216E-18	1.623E+02	1.044E+03	1.044E+03				
940.00	8.174E+00	5.485E-02	3.153E+04	4.125E-06	4.371E+05	1.638E-09	2.201E+04	2.201E+04	3.021E-04	8.468E-04
	2.847E-03	4.289E+00	2.778E-10	3.578-132	2.367-149	2.525E-56	2.213E+04	2.213E+04	4.022E-04	1.065E-03
	6.755E-08	-8.217E-08	3.743E-18	1.743E+02	1.044E+03	1.044E+03				
960.00	5.062E+00	3.173E-02	2.398E+04	2.083E-06	4.082E+05	7.714E-10	1.991E+04	1.991E+04	2.072E-04	6.928E-04
	1.763E-03	3.091E+00	1.432E-10	1.764-135	4.825-153	9.127E-58	2.002E+04	2.002E+04	2.966E-04	1.505E-03
	6.229E-08	-2.307E-08	3.350E-18	1.865E+02	1.044E+03	1.044E+03				
980.00	3.142E+00	1.841E-02	1.826E+04	1.055E-06	3.813E+05	3.648E-10	1.802E+04	1.802E+04	1.434E-04	5.668E-04
	1.094E-03	2.227E+00	7.381E-11	8.892-139	9.835-157	3.300E-59	1.811E+04	1.811E+04	2.242E-04	2.120E-03
	5.759E-08	-1.847E-08	3.020E-18	1.987E+02	1.044E+03	1.044E+03				
1000.00	1.956E+00	1.071E-02	1.393E+04	5.367E-07	3.563E+05	1.732E-10	1.630E+04	1.630E+04	1.001E-04	4.638E-04
	6.812E-04	1.605E+00	3.805E-11	4.284-142	2.005-160	1.193E-60	1.638E+04	1.638E+04	1.741E-04	2.979E-03
	5.337E-08	-1.171E-08	2.739E-18	2.107E+02	1.044E+03	1.044E+03				
1040.00	7.636E-01	3.457E-03	8.142E+03	1.404E-07	3.115E+05	3.952E-11	1.335E+04	1.335E+04	4.991E-05	3.109E-04
	2.660E-04	8.337E-01	1.011E-11	1.040-148	8.328-168	1.559E-63	1.341E+04	1.341E+04	1.156E-04	5.833E-03
	4.607E-08	-5.877E-09	2.287E-18	2.332E+02	1.044E+03	1.044E+03				
1080.00	3.012E-01	1.264E-03	4.785E+03	3.724E-08	2.727E+05	9.163E-12	1.093E+04	1.093E+04	2.555E-05	2.080E-04
	1.049E-04	4.330E-01	2.687E-12	2.527-155	3.460-175	2.038E-66	1.097E+04	1.097E+04	8.956E-05	1.129E-02
	4.000E-08	-2.930E-09	1.940E-18	2.528E+02	1.044E+03	1.044E+03				
1120.00	1.200E-01	4.415E-04	2.829E+03	1.002E-08	2.391E+05	2.158E-12	8.948E+03	8.948E+03	1.336E-05	1.393E-04
	4.178E-05	2.249E-01	7.142E-13	6.138-162	1.438-182	2.664E-69	8.978E+03	8.978E+03	8.212E-05	2.159E-02
	3.487E-08	-1.457E-09	1.865E-18	2.693E+02	1.044E+03	1.044E+03				
1140.00	4.825E-02	1.560E-04	1.682E+03	2.735E-09	2.100E+05	5.159E-13	7.326E+03	7.326E+03	7.115E-06	9.331E-05
	1.681E-05	1.168E-01	1.898E-13	1.491-168	5.972-190	3.482E-72	7.347E+03	7.347E+03	8.745E-05	4.082E-02
	3.050E-08	-7.258E-10	1.440E-18	2.827E+02	1.044E+03	1.044E+03				
1200.00	1.960E-02	5.574E-05	1.005E+03	7.564E-10	1.844E+05	1.253E-13	5.998E+03	5.998E+03	3.843E-06	6.251E-05
	6.825E-06	6.070E-02	5.044E-14	3.621-175	2.481-197	4.550E-75	6.013E+03	6.013E+03	1.034E-04	7.622E-02
	2.675E-08	-3.621E-10	1.254E-18	2.936E+02	1.044E+03	1.044E+03				

END OF TEST PROBLEM

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