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INVESTIGATION OF THE EFFECT OF ATMOSPHERIC DUST
ON THE DETERMINATION OF TOTAL OZONE FROM THE
EARTH'S ULTRAVIOLET REFLECTIVITY MEASUREMENTS;

TECHNICAL REPORT: I

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Prepared by

J. V. Dave

International Business Machines Corporation
Federal Systems Division
18100 Frederick Pike
Gaithersburg, Maryland 20760

for

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

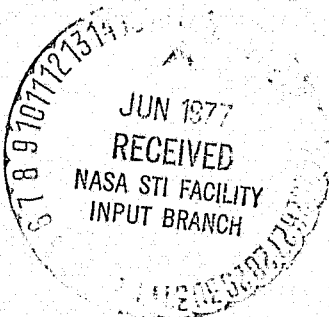


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Abstract

In this first technical report for the investigation of the effect of atmospheric dust on the estimation of total ozone from the earth's ultraviolet reflectivity measurements, we will describe two computer algorithms developed for this investigation. These algorithms can be used for computing the azimuth-independent component of the intensity of the monochromatic radiation emerging at the top a pseudo-spherical (see ¶4 of §I) atmosphere with arbitrary vertical distribution of ozone, and with any arbitrary height-distribution of up to two different kinds of aerosol. This atmospheric model is assumed to rest on a surface obeying Lambert's law of reflection.

I. INTRODUCTION

Ozone is perhaps the single most critical minor stratospheric constituent because its vertical distribution directly affects the deposition of energy in the stratosphere, while its total amount determines the ultraviolet radiation reaching the biosphere. Within the past decade, under the concern of increasing pollutant concentrations due to accelerated industrial and technological development, the stability of the stratospheric ozone layer has been questioned repeatedly. Because of this, considerable attention is being given currently to the problem of reliable and continuous measurement of atmospheric ozone on a global scale.

One of the techniques well suited for this purpose is a thorough analysis of the measurements of the earth's ultraviolet reflectivity. An accurate monitoring of this quantity on a global scale has been underway for the last six years, by Dr. Heath and his associates at NASA with the help of the Backscatter Ultraviolet double monochromator (BUV) aboard the NIMBUS-IV satellite. A more sophisticated version of this BUV experiment has been also accepted for the NIMBUS-G satellite under the leadership of Dr. D. F. Heath. This forthcoming experiment referred to as SBUV/TOMS (Solar and Backscatter Ultraviolet/Total Ozone Mapping System) is expected to be operational sometime during the calendar-year period 1977-1978.

The foundation of the analytic procedure currently used by the BUV team for estimating total ozone in a unit column from the reflectivity



measurements of the earth-atmosphere system underneath, is a set of computed quantities [Mateer, Heath, and Krueger, 1971]. This set of quantities is computed after taking into account all orders of scattering, and following a modification of the procedure discussed by Dave [1964]. These computations are performed for nonhomogeneous pseudo-spherical models of the terrestrial atmosphere with different distributions of ozone, but without any aerosols or water-droplets. In this current BUV analytic procedure, contributions to the outgoing radiation due to scattering and/or absorption by aerosol are only approximately accounted for through the concept of the effective surface albedo which may or may not be equal to the reflectivity of the real, underlying surface. Accuracy and the confidence level of this current BUV analytic procedure can be considerably enhanced by using simulated measurements of the reflectivity of the earth-atmosphere system (with different compositions) in the current ozone-estimation program, and comparing the estimated total ozone and effective surface albedo with the actual input parameters. Such a numerical experiment requires computation of the backscattered radiation for a multitude of cases arrived at after combining various input parameters such as wavelength, solar zenith angle, ground reflectivity, ozone amount, and composition, size-distribution as well as height-distribution characteristics of aerosols.

The purpose of this first technical report is to describe a set of computer algorithms (FORTRAN IV language) specially developed for evaluating the azimuth-independent component of the intensity of scattered

radiation emerging at the top of a pseudo-spherical atmospheric model with an arbitrary vertical distribution of ozone, and with arbitrary height-distributions of up to two different kinds of aerosols. The model is assumed to rest on a Lambert ground of reflectivity R . By pseudo-spherical, we mean that the sphericity of the atmosphere is only partly accounted for; viz., by computing attenuation suffered by the incoming solar radiation for the actual spherical case [see Eqs. (21), (22)] and by correcting the nadir angle of observation for the satellite's altitude above the underlying ground.

Computer requirements and the basic information needed for running these algorithms on an IBM 370 computer under VM-CMS are given in the §II of this report. In §III, we have described, in some detail, the method of the direct numerical solution of the Spherical Harmonics Approximation to the radiative transfer equation which is used by us for computing the emergent radiation after including all orders of scattering within the atmospheric model. Further information of help in understanding the mechanics of the actual computational procedures, is given in §IV. Listing of the actual FORTRAN statements, as well as input for, and output from a test run are given in §VII, VIII, and IX, respectively.

In a second Technical Report with the same title as this one, we propose to describe the results of a critical analysis of the ozone-estimation procedure currently being used by the BUV team. This analysis will be performed by making use of simulated measurements at five wavelengths (viz., 0.3125, 0.3175, 0.3312, 0.3398, and 0.3800 μm), and along

the local nadir direction, for atmospheric models without any aerosols or water droplets. The recommendations resulting from this analysis will be used to develop a new procedure for the analysis of the simulated measurements along the local nadir direction for the SBUV/TOMS configuration where an additional measurement at $0.3600\ \mu\text{m}$ will also be available.

In Technical Report III, we propose to investigate the effect of changes in atmospheric aerosol characteristics on the estimated total ozone, and on the estimated effective surface albedo, for both the BUV (viz., five wavelength) and the SBUV/TOMS (viz., six wavelength) configurations. This effect will be investigated for both configurations by making use of simulated measurements along the local nadir direction obtained with the help of algorithms described in the following sections.

II. OPERATING INSTRUCTIONS

Computations of the azimuth-independent component of intensity of the scattered radiation emerging at the top of a pseudo-spherical atmosphere with any arbitrary vertical distribution of ozone and/or aerosols by making use of the procedure discussed in §III and IV, require use of two algorithms, viz., SITAA, and SITBB. The first program (SITAA) is used for generating a dataset which is repeatedly used by the second program (SITBB). As such, the program SITAA has to be executed only once. These programs written in the FORTRAN IV language were developed, debugged, tested, and executed via an IBM 2741 Communication Terminal

attached to an IBM 370/145 computer running under VM-CMS, and using the FORTRAN H extended, optimizer level 2, compiler. A 3-megabyte virtual machine with an attached 3330 disk space of 40 cylinders was used for this purpose.

2.1 File Definition Statements: A total of seven datafiles with the corresponding file definition statements listed below, are required during execution of the program SITBB for a given atmospheric model. They are used in the direct-access mode.

```
FI 11 DISK FILE FT11F001 A4 (XTENT 101 RECFM F LRECL 10000 BLKSIZE 10000
FI 12 DISK FILE FT12F001 A4 (XTENT 101 RECFM F LRECL 10000 BLKSIZE 10000
FI 13 DISK FILE FT13F001 A4 (XTENT 101 RECFM F LRECL 2200 BLKSIZE 2200
FI 14 DISK FILE FT14F001 A4 (XTENT 101 RECFM F LRECL 2200 BLKSIZE 2200
FI 15 DISK FILE FT15F001 A4 (XTENT 101 RECFM F LRECL 2004 BLKSIZE 2004
FI 16 DISK FILE FT16F001 A4 (XTENT 200 RECFM F LRECL 8720 BLKSIZE 8720
FI 17 DISK FILE FT17F001 A4 (XTENT 128 RECFM F LRECL 20000 BLKSIZE 20000
```

All datafiles are created under the A4 mode, and using a fixed format (RECFM F). The file number 11 contains 101 records (XTENT 101) of 10000 byte length each. For the simulated access methods under CMS (filemode A4), this file occupies a total of 1263 blocks of 800 byte length each. Similarly the files 12 through 17 occupy 1263, 278, 278, 254, 2180, and 3200 blocks, respectively.

These file definition statements must be executed before asking for the running of the main program.

The quantities stored in these datafiles will be described at the appropriate time in §IV.

2.2 Program SITAA: This program is used to compute, and to store on the disk as DISK FILE FT15F001, values of the integral

$$\int_0^1 \exp(-\tau/\mu) P_\ell(\mu) d\mu$$

for values of the parameters τ and ℓ given by $\tau = 0.00 (0.01) 5.00$, and $\ell = 0 (1) 100$, respectively. Values of this integral for all 501 values of the parameter τ but for a given value of the subscript ℓ , are stored as the record no. $(\ell + 1)$ in the datafile no. 15. This integral appears in Eq. (20).

Input to this program consists of the values of the zeros of $P_\ell(\mu)$ [values of μ (to 7 places after the decimal point) at which $P_\ell(\mu)$ is closest to zero for the given value of ℓ] arranged in increasing order of μ for a given ℓ , and then in the increasing order of the subscript ℓ (see §VII). The format for punching this information on cards is 5F10.7, 16X, I4.

Values of the above-mentioned integral are also obtained as an output in the printed form if, and only if, computations are completed for all desired values of the subscript ℓ .

2.3 Input for SITBB: Beside the dataset on the disk file no. 15 described in the preceding section, there are four additional sets of input to this program. The first set is related to input of the following

parameters:

<u>Parameter Name</u>	<u>Punched Card Format</u>
NMOD, NBLR	2I10
I, GTH(I), PRTH(I), OZOTH(I), STDUST(I), and TPDUST(I)	I5, OP2F10.2, OPF10.5, 1P2E11.2
TEMA, TEMB	2F10.5

The parameter NMOD represents the atmospheric model number. Each atmospheric model for which computations are to be performed should be assigned a unique number between 1 and 200. This is because all scattered-radiation information for this model required for further investigation, is stored as record no. NMOD in the datafile no. 16.

The second parameter NBLR represents the number of basic layers into which a given atmospheric model is divided. This parameter should be greater than zero, and less than or equal to 32.

The third input parameter I represents the serial number of a basic layer in the model, with I=1 corresponding to the topmost layer. The input parameters GTH(I), PRTH(I), OZOTH(I), STDUST(I), and TPDUST(I) represent geometric thickness (km), pressure thickness (mb), ozone thickness (atm-cm), number of particles (in a one sq. cm. column of a layer) for a kind of aerosol to be referred to as the stratospheric aerosol, and number of particles for another kind of aerosol to be referred to as the tropospheric aerosol in the I-th layer, respectively. The last two input parameters of this first set of input are the tempor-

ary constants TEMA and TEMB. They act as scalar multipliers to the input values of STDUST(I) and TPDUST(I), respectively.

The second set of input consists of a single card punched with the format 15, 3F10.4. It contains the quantities ILDA (serial number of the wavelength), ALDA [wavelength of the monochromatic radiation for which computations are to be performed (in μm)], TAUBSR [Rayleigh scattering optical thickness of the standard terrestrial atmosphere at sea-level for the wavelength ALDA (λ)], and OZABS (absorption coefficient of one atm-cm of ozone to the base e).

If there are any particles of the stratospheric aerosols, the program calls for a third set of input consisting of the following quantities:

<u>Quantity</u>	<u>Format</u>
BLDA, TITB(5), TITB(6), NMXST, BSCAST, BABSST, TITB(9), TITB(10), and TITB(11)	OP3F10.5, I5, 1P2E15.5, 3A4
COFAS(L) five values per card, and LM	1P5E13.5, I5

The quantity BLDA must be equal to ALDA within ± 0.001 , otherwise the program will be terminated with an appropriate message. The TITB vector represents the quantities to be used for creating a composite title for the model. The quantities TITB(5) and TITB(6) represent the real and the imaginary part of the refractive index of the stratospheric aerosol

material, respectively. The normalized scattering phase function of a unit volume of the stratospheric aerosol [size distribution function stored in locations TITB(9), TITB(10) and TITB(11), and the refractive index ($m = n_1 - i n_2$) of its material stored in locations TITB(5) and TITB(6)] at the wavelength BLDA, is represented by a Legendre series with NMXST terms. The volume scattering and volume absorption coefficient per average particle of this aerosol distribution are given by BSCAST and BABSST, respectively. The coefficients of the above-mentioned Legendre series are represented by COFAS. The parameter LM representing the serial number of the very first coefficient punched on a COFAS card, is used to see if all COFAS cards are arranged in proper order. If not, the program is terminated with an appropriate message.

If there are any particles of the tropospheric aerosols, the program also calls for a fourth set of input consisting of the quantities BLDA, TITB(7), TITB(8), NMXTP, BSCATP, BABSTP, TITB(12), TITB(13), TITB(14), COFAT, and LM. The definition of these quantities can be obtained by replacing the word "stratospheric" in the preceding paragraph, with the word "tropospheric."

The third and fourth input datasets can be generated by using the program developed by the author under another NASA contract [Dave, 1972].

As mentioned earlier, the proposed ozone-estimation program for the NIMBUS G satellite calls for measurements of the back-scattered radiation at six different wavelengths, viz., 0.3125, 0.3175, 0.3312, 0.3398, 0.3600, and 0.3800 μm . Thus, for creation of the entire record no. NMOD

on the datafile no. 16, it is necessary to follow input sets 2, 3, and 4, described above with corresponding sets for the remaining five wavelengths. To avoid any confusion, it is advisable to arrange all wavelengths in their increasing order, and refer to the 0.3125 μm wavelength with ILDA = 1, and the 0.3800 μm wavelength with ILDA = 6.

It should be pointed out that for each of these six wavelengths, computations are carried out for a total of eleven different cases of illumination; ten unidirectional ones from above (i.e., ten different values of the solar zenith angle θ_0), and the eleventh case of the isotropic illumination from below. These ten values of θ_0 , viz., 0° , 45° , 60° , 70° , 75.6° , 79.6° , 82.5° , 84.7° , 86.7° , and 90° are given by a data statement in the subroutine LEGFUN (§4.3) called by SITBB. Furthermore, for each of these eleven cases of illumination, azimuth-independent component of the intensity of the scattered radiation emergent at the top is calculated for 18 different values of the nadir angle θ . The scanning mechanism of the TOMS instrument on the NIMBUS-G satellite (a circular orbit with a nominal altitude of 955 km above the mean sea-level) is planned to step through eighteen 3° steps from the nadir to horizon, i.e., $\theta' = 0^\circ$ (3°) 51° . A value of θ corresponding to a given value of θ' is also computed within the LEGFUN subroutine by using the formula

$$\sin \theta = (7326/6371) \sin \theta', \quad (1)$$

where the radius of the earth is taken to be equal to 6371 km.

2.4 Output from SITBB: For an atmospheric model containing both stratospheric and tropospheric aerosols, the printed output consists of the following seven sets for each of the six wavelengths. In addition, the record number NMOD in the datafile no. 16 is also created.

The first set of output is essentially a reproduction of the input atmospheric parameters GTH(I), PRTH(I), etc. The input values of the Legendre coefficients for the stratospheric and tropospheric aerosols of a given refractive index, and for the wavelength under investigation, are reproduced in the second and the third sets, respectively. The fourth set of the output neatly summarizes all optical information about the atmospheric model for the wavelength currently under investigation.

The fifth set of output can be understood only after some knowledge of the mechanics of the method of direct numerical solution of the spherical harmonics approximation to the radiative transfer equation. The Legendre series representing the scattering phase function of molecules consists of the first three terms only, while those for the stratospheric and tropospheric aerosols consist of NMXST and NMXTP terms, respectively. A provision is made to accommodate values of NMXTP or NMXST as high as 300. Experience has shown that nothing of practical value is gained by computing higher-order scattering contribution with all non-vanishing terms of the Legendre series [Dave, 1975]. Hence, for values of NMXST and/or NMXTP > 40, the Legendre series is terminated when a preselected and pretested criterion is satisfied. In other words, higher-order scattering contribution (i.e., except for the first

scattering of the direct beam illuminating the atmosphere from the outside) to the emergent radiation is represented by the P_L -th approximation where $(L+1) < \text{NMXST}$ and/or NMXTP . The first line of this fourth set gives the order of the P_L approximation used in the evaluation of the higher-order scattering contribution.

As mentioned in §2.3, the atmospheric model is divided into NBL YR number of basic layers. In order to maintain the accuracy in computation, all basic layers with optical thickness greater than 0.02 are divided into sublayers so that the optical thickness of no sublayer exceeds 0.02. A provision is made in the program to accommodate up to 300 sublayers. The program is terminated with an appropriate message if the number of sublayers required should exceed 300.

After dividing the basic layers into sublayers, positions of several sublevels are selected for performing stabilizing transformations on a matrix (F_j) representing the optical characteristics of the model. A provision is again made to accommodate cases requiring such a stabilizing transformation of the F_j matrix at up to 100 points. The program is terminated if a particular case requires more than 100 conditioning points. If not, the second part of the fourth set of output contains information about the level number and optical depth of all sublevels at which such stabilizing transformations are to be performed. Such a sublevel is called a conditioning point.

Further information about this stabilizing transformation will be provided in §3.4. It is sufficient to state here that this F_j matrix

is a rectangular matrix of the order $(L+1) \times (L+1)/2$, and that performance of a stabilizing transformation on it requires an inversion of its top-half. The following message is printed out after attempting to invert the top-half of F_j at a given conditioning point: THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER N ITERATIONS FOR CONDITIONING POINT NUMBER J. If the attempt is successful, the quantity N in this message carries a positive value and computations proceed further. If the attempt is unsuccessful, the quantity N has a zero, or a negative value. In this latter case, the program is terminated. The criteria used for selecting the total number of conditioning points for a given run are based on extensive numerical investigations previously carried out by the author and his colleague [e.g., Dave and Canosa, 1974]. However, if the program should terminate with a negative value for the quantity N, it can be re-run by increasing the number of conditioning points (§3.4).

The last part of the fifth set of the output is a message stating that the linear system of equations (§3.3 and 3.4) has been solved successfully for a given illumination of the atmosphere from the outside.

The sixth set of the printed output is related to the directly transmitted and diffusely transmitted, as well as diffusely reflected fluxes passing through various basic levels of the model. Values of the net fluxes are also printed out. These quantities are for π units of energy passing through a unit area normal to the direction of incidence if the incident radiation is unidirectional (i.e., solar radiation

at the top), and for π units of energy passing through a horizontal unit area at the bottom if the incident radiation is isotropically distributed. The value of the quantity SBAR representing the diffuse flux reflectivity of the model for the case of isotropic illumination from below, is also printed out at the bottom of this sixth set [see Eq. (2) below].

The azimuth-independent component of the intensity of the scattered radiation emerging at the top of the model is a function of the following six parameters: wavelength (λ), total ozone amount in the model (Ω), pressure at the base of the model (P), Lambert reflectivity of the ground (R), and the directional parameters θ_0 and θ . (It also depends upon various characteristics of aerosols present in the model, and also to some extent, on the vertical distribution of ozone.) Its value for a given value of R can be expressed as follows as the sum of two terms [see Eqs. (20), and (23), and also §3.5]:

$$I(\lambda, \Omega, P, R, \theta, \theta_0) = I(\lambda, \Omega, P, R=0, \theta, \theta_0) + \frac{T(\lambda, \Omega, P, \theta, \theta_0) R}{1 - R \bar{S}(\lambda, \Omega, P)} \quad (2)$$

No dependence on the azimuth angle appears because we are dealing only with the azimuth-independent component. The first term on the right hand side of Eq. (2) is the intensity of the emergent radiation in the absence of any ground reflection. The quantity $T(\lambda, \Omega, P, \theta, \theta_0)$ represents total (direct plus diffuse) transmission by the atmospheric model

in the direction θ when the atmosphere is illuminated from below by the isotropic radiation. The quantity $\bar{S}(\lambda, \Omega, P)$ was described in the earlier paragraph. Further information about these quantities can be found in §3.1.

The last set of the printed output is a table containing values of $I(\lambda, \Omega, P, R=0, \theta, \theta_0)$ and $T(\lambda, \Omega, P, \theta, \theta_0)$ for 10 different values of θ_0 , and 18 different values of θ given in §2.3. The value of the quantity $\bar{S}(\lambda, \Omega, P)$ is also repeated at the end of this output.

Summarized information about the model along with values of $I(\lambda, \Omega, P, R=0, \theta, \theta_0)$, $T(\lambda, \Omega, P, \theta, \theta_0)$, and $\bar{S}(\lambda, \Omega, P)$ for all six wavelengths, and various θ, θ_0 combinations wherever applicable, are stored as the record number NM0D in the file no. 16 for future use.

III. THEORY

3.1 Definitions: In this subsection, we will provide brief definitions of various quantities required in understanding the spherical harmonics approximation to the equation of radiative transfer for the azimuth-independent component of the scattered radiation in a plane-parallel atmosphere.

Parameter μ : The direction of propagation is denoted by the zenith angle ($\theta \equiv \cos^{-1}|\mu|$) which the direction makes with the local zenith. A negative (positive) sign before μ will imply the radiation traveling along the downward (upward) direction.

Normal optical thickness: For an atmospheric model with scattering by air molecules, absorption by ozone, and scattering as well as absorption by two different kinds of aerosols of interest to us, the optical depth τ of a level h km above the ground is given by

$$\tau = \tau^{(s,R)} + \tau^{(a)} + \tau^{(s,ST)} + \tau^{(a,ST)} + \tau^{(s,TP)} + \tau^{(a,TP)}. \quad (3)$$

The first component, $\tau^{(s,R)}$, of τ is given by

$$\tau^{(s,R)} = \int_h^\infty k^{(s,R)} \rho(h) dh, \quad (4)$$

where $k^{(s,R)}$ is the mass Rayleigh scattering coefficient of air at the wavelength λ under investigation, and $\rho(h)$ is the density of air at height h . To a very good first approximation, the value of the Rayleigh scattering optical thickness $\tau^{(s,R)}$ at any atmospheric level can be obtained from the value of $\tau_b^{(s,R)}$ (Rayleigh scattering optical thickness of the entire atmosphere), by making use of the following relationship:

$$\tau^{(s,R)} / \tau_b^{(s,R)} = p / p_b, \quad (5)$$

where p and p_b are the atmospheric pressures at the level under consideration and at the bottom of the atmosphere, respectively. The second component, $\tau^{(a)}$, of the normal optical thickness due to absorption by ozone is given by

$$\tau^{(a)} = \alpha \Omega(h), \quad (6)$$

where α is the pressure and temperature independent absorption coefficient of ozone at the wavelength λ , and $\Omega(h)$ is the amount of ozone in atm-cm above the level h . The third and fourth components, $\tau^{(s,ST)}$ and $\tau^{(a,ST)}$, of τ are due to scattering and absorption by the stratospheric aerosol, respectively. Similarly, the last two components of τ are due to the presence of the tropospheric aerosol in the model. The optical thickness, $\tau^{(x,y)}$, due to the y type of aerosol and x type of the process is obtained from the following relationship:

$$\tau^{(x,y)} = N^{(y)}(h) \bar{\beta}^{(x,y)} \quad (7)$$

where $N^{(y)}(h)$ is the total number of average particles of the y -kind of aerosol in a column of 1-cm² cross-section above the level h km above the ground, and $\bar{\beta}^{(x,y)}$ is the x kind of volume cross-section for the y -kind of aerosol. Values of $\bar{\beta}^{(x,y)}$ for a spherical polydispersion made from a material of known refractive index ($m = n_1 - i n_2$), and for a given wavelength can be computed by making use of the programs developed under another NASA contract by the author [Dave, 1972].

Albedo of single scattering: Also of interest are the albedos of single scattering of a unit volume due to molecules, and stratospheric as well as tropospheric aerosols. If $\Delta\tau$ is the incremental optical depth at the level τ , then these quantities are respectively given by

$$\text{and } \left. \begin{aligned} \omega_R(\tau) &= \Delta\tau^{(s,R)} / \Delta\tau, \\ \omega_{ST}(\tau) &= \Delta\tau^{(s,ST)} / \Delta\tau, \\ \omega_{TP}(\tau) &= \Delta\tau^{(s,TP)} / \Delta\tau \end{aligned} \right\} \quad (8)$$

The quantities $\Delta\tau(s,R)$, $\Delta\tau(s,ST)$, and $\Delta\tau(s,TP)$ are incremental optical depths at the level τ due to molecules, stratospheric aerosols, and tropospheric aerosols, respectively.

Normalized scattering phase function: This quantity represents, on a relative scale, the fraction of incident energy scattered by a unit volume at a level τ in the direction μ, ϕ when that volume is illuminated from the direction μ', ϕ' . (ϕ or ϕ' represents the azimuth angle of the direction of propagation referred to an arbitrarily chosen meridian plane.) This quantity, $P(\tau; \mu, \phi; \mu', \phi')$, can be represented by a Fourier series whose argument is $(\phi' - \phi)$. Accordingly,

$$P(\tau; \mu, \phi, \mu', \phi') = \sum_{n=0}^{\infty} P^{(n)}(\tau; \mu, \mu') \cos n(\phi' - \phi). \quad (9)$$

We will only consider the $P^{(0)}(\tau; \mu, \mu')$ coefficient of this series as our interest is restricted to the azimuth-independent component of the intensity of the scattered radiation. A value of $P^{(0)}(\tau; \mu, \mu')$ is given by

$$P^{(0)}(\tau; \mu, \mu') = \sum_{\ell=0}^{\infty} \Lambda_{\ell}(\tau) P_{\ell}(\mu) P_{\ell}(\mu'), \quad (10)$$

where $P_{\ell}(\mu)$ are the ordinary Legendre polynomials, and coefficients $\Lambda_{\ell}(\tau)$ are given by

$$\Lambda_{\ell}(\tau) = \omega_R(\tau) \Lambda_{\ell}^{(R)} + \omega_{ST}(\tau) \Lambda_{\ell}^{(ST)} + \omega_{TP}(\tau) \Lambda_{\ell}^{(TP)}. \quad (11)$$

Values of the normalized Legendre coefficients for Rayleigh scattering

are as follows: $\Lambda_0^{(R)} = 1$, $\Lambda_1^{(R)} = 0$, $\Lambda_2^{(R)} = 0.5$, and for $\ell > 2$, $\Lambda_\ell^{(R)} \equiv 0$. The normalized Legendre coefficients $\Lambda_\ell^{(ST)}$ and $\Lambda_\ell^{(TP)}$ representing the normalized scattering phase function of a unit volume of the stratospheric and tropospheric aerosols, respectively, are functions of the wavelength under investigation, refractive index of the aerosol material, and size distribution of aerosol particles. Their values can be obtained by making use of the programs used for generation of the quantity $\bar{\beta}^{(x,y)}$ described in the preceding paragraph. It should be added that the Legendre coefficients $\Lambda_\ell^{(R)}$, $\Lambda_\ell^{(ST)}$ and $\Lambda_\ell^{(TP)}$ are so normalized that integration of their respective scattering phase functions over a solid angle of 4π , yields a value of 4π .

Intensity: The intensity of a beam of monochromatic radiation of wavelength λ is defined as the amount of energy per unit wavelength interval at λ flowing per unit time in a cone of unit solid angle with its axis coinciding with the direction of propagation of energy. Let $I(\tau; \mu, \phi; -\mu_0, \phi_0)$ be the intensity of the scattered radiation emerging at a level τ , in the direction μ, ϕ . [The parameters $(-\mu_0, \phi_0)$ represents the direction of incidence of the incoming solar radiation with $\mu_0 = \cos \theta_0$.] This intensity is also a function of several other parameters such as magnitude of the energy incident upon the atmosphere from outside, optical characteristics of the atmospheric model, and reflectivity of the surface underlying the atmosphere. This quantity $I(\tau; \mu, \phi; -\mu_0, \phi_0)$ can also be expressed in a Fourier series of the form given by Eq. (9). However, we are only interested in the azimuth-

independent component of this series, viz., $I^{(0)}(\tau; \mu, -\mu_0)$ which we will, henceforth, refer to as $I(\tau; \mu, -\mu_0)$ for brevity.

For an atmospheric model resting on a perfectly absorbing surface and illuminated at the top by the direct solar radiation with the solar zenith angle θ_0 , the quantity $I(\tau=0; \mu, -\mu_0)$ corresponds to the first term on the right hand side of Eq. (2) provided λ , Ω , P , and other parameters of the model are understood to be the same for both.

We can also define the intensity $I(\tau=0; \mu, \text{iso})$ representing the scattered radiation emerging at the top of the same atmospheric model when it is illuminated by an isotropically distributed radiation of unit strength from below. The second term $T(\lambda, \Omega, P, \theta, \theta_0)$ appearing in the second term on the right hand side of Eq. (2) can be obtained after multiplying the quantity $[I(\tau=0; \mu, \text{iso}) + \exp(-\tau_b/\mu)]/\pi$ by the sum of the direct solar flux and diffuse sky flux emerging at the level τ_b for the appropriate value of θ_0 .

Intensity moments: The ℓ -th Legendre moment of the intensity is defined as follows:

$$f_\ell(\tau; x) = \int_{-1}^{+1} I(\tau; \mu, x) P_\ell(\mu) d\mu, \quad (12)$$

where $x = -\mu_0$ represents the case of unidirectional illumination from above, and $x = \text{iso}$ represents the case of isotropic illumination from below.

3.2 Spherical Harmonics Approximation: The method for deriving a spher-

$$\underline{C}(\tau) = \begin{bmatrix} \sigma_1(\tau) & & & & & \\ & \sigma_2(\tau) & & & & \\ & & \sigma_3(\tau) & & & \\ & & & \ddots & & \\ & & & & \ddots & \\ & & & & & \ddots \\ & & & & & & \sigma_{L-1}(\tau) \\ & & & & & & & \sigma_L(\tau) \end{bmatrix}, \quad (15)$$

with its element $\sigma_\ell(\tau)$ given by

$$\sigma_\ell(\tau) = \frac{\Lambda_\ell(\tau)}{2\ell + 1} - 1. \quad (16)$$

The column vectors $\underline{f}(\tau; \mathbf{x})$ and $\underline{s}(\tau; \mathbf{x})$ of length $(L+1)$ are given by

$$\underline{f}(\tau; \mathbf{x}) = \begin{bmatrix} f_0(\tau; \mathbf{x}) \\ f_1(\tau; \mathbf{x}) \\ f_2(\tau; \mathbf{x}) \\ \vdots \\ f_{L-1}(\tau; \mathbf{x}) \\ f_L(\tau; \mathbf{x}) \end{bmatrix}, \quad (17)$$

and

$$\underline{s}(\tau; x) = \begin{bmatrix} s_0(\tau; x) \\ s_1(\tau; x) \\ s_2(\tau; x) \\ \vdots \\ s_{L-1}(\tau; x) \\ s_L(\tau; x) \end{bmatrix}, \quad (18)$$

respectively.

The elements $f_\ell(\tau; x)$ of $\underline{f}(\tau; x)$ are defined by Eq. (12). Values of $s_\ell(\tau; x)$ for $x = -\mu_0$ and $x = \text{iso}$ are given by the following equations:

$$s_\ell(\tau; -\mu_0) = \frac{-\Lambda_\ell(\tau)}{2(2\ell+1)} F e^{-\tau/\mu_0} P_\ell(-\mu_0), \quad (19)$$

and

$$s_\ell(\tau; \text{iso}) = \frac{-I_g(-\mu_0) \Lambda_\ell(\tau)}{2\ell+1} \int_0^1 e^{-(\tau_b - \tau)/\mu_1} P_\ell(\mu_1) d\mu_1. \quad (20)$$

The expression for $s_\ell(\tau; -\mu_0)$ is for the case of a plane-parallel atmosphere illuminated by a monochromatic, unidirectional solar radiation of net flux πF per unit area normal to the direction of its propagation represented by $-\mu_0, \phi_0$. (The quantity F will be taken to be unity during computations.) For a pseudo-spherical atmosphere, the term $\exp(-\tau/\mu_0)$ appearing on the right hand side of Eq. (19) should be re-

placed by the term $\text{atten}_j(-\mu_0)$. This new term represents the attenuation suffered by the incoming solar radiation arriving at the j -th level where the optical depth is τ , and makes an angle θ_0 with the local zenith at that point. It is given by

$$\text{atten}_j(-\mu_0) = \sum_{i=1}^j \Delta s_{i,j}(-\mu_0) \Delta \tau_i, \quad (21)$$

where $\Delta s_{i,j}(-\mu_0)$ represents the magnification of a one km vertical path in the i -th layer while reaching the j -th level. It is given by

$$\begin{aligned} \Delta s_{i,j}(-\mu_0) &= [h_{i-1} - h_i]^{-1} \\ &\times \left\{ [(a+h_j)^2 \mu_0^2 + (h_{i-1} - h_j)(2a+h_{i-1}+h_j)]^{\frac{1}{2}} \right. \\ &\quad \left. - [(a+h_j)^2 \mu_0^2 + (h_i - h_j)(2a+h_i+h_j)]^{\frac{1}{2}} \right\}. \end{aligned} \quad (22)$$

Initial computations of $s_\ell(\tau; \text{iso})$ are carried out by taking a unit value for the quantity $I_g(-\mu_0)$ appearing on the right hand side of Eq. (20). Values of $s_\ell(\tau; \text{iso})$ so obtained would lead to computations of $I(\tau=0; \mu, \text{iso})$ (see §3.1) when the procedure discussed in §3.4 is followed. These values of $[I(\tau=0; \mu, \text{iso}) + \exp(-\tau_b/\mu)]$ can be then corrected to obtain the second term on the right hand side of Eq. (2) for each θ_0 , by making use of a value of $I_g(-\mu_0)$ given by the following equation:

$$I_g(-\mu_0) = \frac{R[F\mu_0 e^{-\tau_b/\mu_0} + 2|f_1(\tau_b; -\mu_0)|]}{1 - 2R|f_1(\tau_b; \text{iso})|}. \quad (23)$$

The quantity $2|f_1(\tau_b; \text{iso})|$ is the same as $\bar{S}(\lambda, \Omega, P)$ introduced in §2.4. The first and second terms inside the parenthesis in the numerator on the right hand side of Eq. (23) when multiplied by a factor of π , represent the direct solar flux and the diffuse sky radiation flux incident on the ground, respectively. Again, the factor $\exp(-\tau_b/\mu_0)$ appearing in Eq. (23) should be replaced by $\text{atten}_j(-\mu_0)$ for the value of the subscript j corresponding to the bottom of the atmosphere.

Finally, the boundary conditions of incidence of no scattered radiation from outside the atmosphere is given in terms of the Marshak's boundary condition matrix G [a square matrix of the order $(L+1)/2$] by the following two equations:

$$f_{\text{odd}}(\tau=0; x) = -G f_{\text{even}}(\tau=0; x), \quad (24)$$

and

$$f_{\text{odd}}(\tau=\tau_b; x) = G f_{\text{even}}(\tau=\tau_b; x), \quad (25)$$

where

$$f_{\text{odd}}(\tau; x) = \begin{bmatrix} f_1(\tau; x) \\ f_3(\tau; x) \\ \vdots \\ f_L(\tau; x) \end{bmatrix}, \quad (26)$$

and

$$\underline{f}_{\text{even}}(\tau; x) = \begin{bmatrix} f_0(\tau; x) \\ f_2(\tau; x) \\ \vdots \\ f_{L-1}(\tau; x) \end{bmatrix}. \quad (27)$$

Expressions for computing elements of the $\underline{G}$ matrix can be found elsewhere [e.g., Dave, 1974].

In concluding this subsection, we explicitly mention that Eq. (13) consists of $L+1$ inhomogeneous ordinary differential equations. The general solution, therefore, requires $(L+1)$ arbitrary constants of integration. Equation (24) provides $(L+1)/2$ conditions for determining one-half of these $(L+1)$ arbitrary constants of integration, while Eq. (25) provides $(L+1)/2$ additional conditions for determining the remaining one-half of these $(L+1)$ arbitrary constants of integration.

3.3 Form for the Direct Numerical Solution: Equation (13) along with the boundary conditions given by Eqs. (24) and (25) can be reduced to the following block algebraic system after dividing the atmospheric model into several layers of constant optical properties, and integrating Eq. (13) between two optical levels τ_{j-1} and τ_j ($j=1$ corresponding to the top of the atmosphere) with the trapezoidal rule of integration:

$$\underline{D}_{11} \underline{g}_1 + \underline{D}_{12} \underline{g}_2 = \underline{w}_1 ,$$

$$\underline{D}_{22} \underline{g}_2 + \underline{D}_{23} \underline{g}_3 = \underline{w}_2 ,$$

$$\underline{D}_{J-1,J-1} \underline{g}_{J-1} + \underline{D}_{J-1,J} \underline{g}_J = \underline{w}_{J-1} ,$$

$$\underline{g}_1^b = -\underline{G} \underline{g}_1^t \quad \text{and} \quad \underline{g}_J^b = \underline{G} \underline{g}_J^t . \quad (28)$$

The bottom-most level of the model is represented by the subscript J . The details for arriving at Eq. (28) starting with Eqs. (13), (24), and (25), can be found in a report by the author [Dave, 1974]. The $\underline{D}_{j-1,j-1}$ and $\underline{D}_{j-1,j}$ matrices [order $(L+1)$] are functions of the optical characteristics of the atmospheric models, while the $\underline{g}_j$ and $\underline{w}_j$ vectors are functions of τ_j and x where $x = -\mu_0$ or, iso. (For the sake of brevity, explicit referring to these parameters is not done in the following discussion.) Various quantities appearing in Eq. (28) are defined as follows:

$$\underline{g}_j = \begin{bmatrix} \underline{f}_{\text{even}}(\tau_j; x) \\ \underline{f}_{\text{odd}}(\tau_j; x) \end{bmatrix} . \quad (29)$$

$$\underline{w}_{j-1} = \frac{1}{2} \Delta\tau_{j-1} [\underline{s}(\tau_{j-1}; x) + \underline{s}(\tau_j; x)] , \quad (30)$$

with

$$\Delta\tau_j = \tau_j - \tau_{j-1} . \quad (31)$$

$$\underline{D}_{j-1,j-1} = \text{Column} \left[-\underline{A} + \frac{1}{2} \Delta\tau_{j-1} \underline{C}(\tau_{j-1} + \frac{1}{2} \Delta\tau_{j-1}) \right] , \quad (32)$$

and

$$\underline{D}_{j-1,j} = \text{Column}[\underline{A} + \frac{1}{2} \Delta \tau_{j-1} \underline{C}(\tau_{j-1} + \frac{1}{2} \Delta \tau_{j-1})], \quad (33)$$

where a column operator on a matrix denotes the rearrangement of its columns by parity. That is, the first half of the columns of the resulting matrix are the 1st, 3rd, 5th, $\dots$, L th columns of the matrix inside the parenthesis, and second half the 2nd, 4th, $\dots$, $(L+1)$ st columns.

Finally, the superscripts b and t on the $\underline{g}_j$ vector in the last equation in the system (28) represent the bottom-half and top-half of the corresponding vector, respectively.

In order to obtain a direct numerical solution of the block algebraic system represented by Eq. (28), it is necessary to introduce the following sequence of rectangular matrices of order $(L+1) \times (L+1)/2$:

$$\left. \begin{aligned} \underline{F}_1 &= \begin{bmatrix} \underline{I} \\ -\underline{G} \end{bmatrix}, \\ \underline{F}_2 &= \underline{\pi}_1 \underline{F}_1, \\ \underline{F}_3 &= \underline{\pi}_2 \underline{\pi}_1 \underline{F}_1 = \underline{\pi}_2 \underline{F}_2, \\ &\vdots \\ \underline{F}_J &= \underline{\pi}_{J-1} \underline{\pi}_{J-2} \dots \underline{\pi}_1 \underline{F}_1 = \underline{\pi}_{J-1} \underline{F}_{J-1} \end{aligned} \right\}, \quad (34)$$

where the square matrix $\underline{\pi}_j$ of the order $(L+1)$ is given by

$$\pi_j = -D_{j,j+1}^{-1} D_{j,j}, \quad (35)$$

and I is a unit matrix.

It is also necessary to introduce the following sequence of vectors $\underline{a}_j$ of $(L+1)$ components:

$$\left. \begin{aligned} \underline{a}_1 &= \underline{0}, \\ \underline{a}_2 &= D_{12}^{-1} \underline{w}_1 + \pi_1 \underline{a}_1, \\ \underline{a}_3 &= D_{23}^{-1} \underline{w}_2 + \pi_2 \underline{a}_2, \\ &\vdots \\ \underline{a}_J &= D_{J-1,J}^{-1} \underline{w}_{J-1} + \pi_{J-1} \underline{a}_{J-1} \end{aligned} \right\}. \quad (36)$$

Equation (28) can be then rewritten in the following concise form:

$$\underline{g}_j = \underline{F}_j \underline{g}_1^t + \underline{a}_j, \quad j = 1, 2, \dots, J. \quad (37)$$

After applying the lower-boundary conditions, the top and bottom half of $\underline{g}_J$ of Eq. (37) can be related as follows:

$$\left(\underline{F}_J^b - \underline{G} \underline{F}_J^t \right) \underline{g}_1^t = \underline{G} \underline{a}_J^t - \underline{a}_J^b. \quad (38)$$

Equation (38) now consists of $(L+1)/2$ unknowns, viz., the components of $\underline{g}_1^t$ at $\tau = 0$ (i.e., $\tau = \tau_1$), and are functions of $x (= -\mu_0$ or, iso). The matrix $\underline{F}_J^b - \underline{G} \underline{F}_J^t$ is dependent only upon the optical properties of the atmospheric model. The vector $\underline{G} \underline{a}_J^t - \underline{a}_J^b$ depends upon properties of the model, as well as on the parameter $x (= -\mu_0$ or, iso). Having de-

terminated $\underline{g}_1^t$, we can compute $\underline{g}_j$ by making use of Eq. (37), and hence the moments $\underline{f}(\tau_j; x)$; see Eq. (29).

3.4 Stabilizing Transformations: Our ability to evaluate the vector $\underline{g}_1^t$ by making use of Eq. (38) depends upon the success of inverting the matrix $\left(\underline{F}_J^b - \underline{G} \underline{F}_J^t \right)$. In many problems with $(L+1)$ of the order of 40 and higher and τ_b of the order of unity and greater, this inversion cannot be carried out successfully due to accumulation of round-off errors. Unfortunately, the problem of determining the effect of atmospheric dust on the estimated values of the total ozone from the measurements of the ultraviolet reflectivity of the earth-atmosphere system, falls into this latter category. For such cases, it is necessary to perform stabilizing transformations on the sequence $\underline{F}_j$ and $\underline{a}_j$. It should be remembered that the starting sequence $\underline{F}_1, \underline{a}_1$ is perfectly well-conditioned because its top halves are a unit matrix and a null vector, respectively [see the first equation in Eqs. (34) and (36)]. For our work, we have used the following criterion for selection of levels at which a stabilizing transformation will be performed on their corresponding $\underline{F}_j, \underline{a}_j$ sequence (the levels so selected are called conditioning points):

$$\text{Maximum optical distance between two conditioning points} = y = \frac{10}{L+1}.$$

$$\text{For } \tau_b \leq 4.0, \text{ and } (L+1) \leq 60, N_C = \frac{\tau_b}{y} + 4.$$

$$\text{For } \tau_b > 4.0, \text{ and } (L+1) > 60 \text{ but } \leq 80, N_C = \frac{\tau_b}{y} + 14.$$

$$\text{For } \tau_b > 4.0, \text{ and } (L+1) > 80, N_C = \frac{\tau_b}{y} + 30.$$

Thus, for $\tau_b = 5.0$, and $(L+1) = 100$, this criterion will select 80 of the sublevels as conditioning points. Even for the case of $\tau_b < 0.1$ and $(L+1) \leq 10$, this criterion will ask for 4 conditioning points. From Dave and Canosa [1974], we see that this latter case requires only two conditioning points, one at $j=1$, and the other at $j=J$. That is, Eq. (38) can be solved directly. Thus, the criterion used for determining the number of conditioning points here is somewhat stricter than the one used by us in our earlier work. This is for reducing the chances for a premature termination of the program.

The following discussion on the technique of the stabilizing transformation used is strictly a descriptive one, and is given primarily for understanding the mechanics of computations in the FORTRAN program SITBB: The reader interested in its mathematical aspects should refer to one of the several earlier publications on this subject [e.g., Canosa and Penafiel, 1973; Dave, 1974].

Let us serialize the levels selected as conditioning points as $C_1, C_2, \dots, C_n$. C_1 is the level corresponding to the top of the atmosphere ($j=1$), and C_n is the level corresponding to the bottom of the atmosphere ($j=J$). At C_1 , the sequence $\underline{F}_1, \underline{a}_1$ is very well-conditioned by definition. Starting with this $\underline{F}_1, \underline{a}_1$ sequence, we generate the sequences $\underline{F}_2, \underline{a}_2, \underline{F}_3, \underline{a}_3, \dots, \underline{F}_j, \underline{a}_j$, until we arrive at the sequence for the level corresponding to the conditioning point C_2 . Let us call this sequence old $\underline{F}_{C_2}$, old $\underline{a}_{C_2}$. We then compute the following transformation matrix T_{C_2} which is of the order $(L+1)/2 \times (L+1)/2$:

$$\underline{T}_{C_2} = \left[\text{old } \underline{F}_{C_2}^t \right]^{-1}. \quad (39)$$

The transformation of the old $\underline{F}_{C_2}$ is then given by old $\underline{F}_{C_2} \underline{T}_{C_2}$ which will be referred to as $\underline{U}_{C_2}$ matrix, or as a new $\underline{F}_{C_2}$ matrix. The top half of this new $\underline{F}_{C_2}$ matrix is a unit matrix while its bottom half is given by

$$\left[\text{new } \underline{F}_{C_2} \right]^b = \underline{U}_{C_2}^b = \left[\text{old } \underline{F}_{C_2}^b \right] \underline{T}_{C_2}. \quad (40)$$

The vector old $\underline{a}_{C_2}$ is also to be transformed so that new $\underline{a}_{C_2}$ is linearly independent of the columns of new $\underline{F}_{C_2}$. This is achieved as follows:

- (a) Store the top half of the old $\underline{a}_{C_2}$ as $\underline{t}_{C_2}$ for a future use, i.e.,

$$\underline{t}_{C_2} = \text{old } \underline{a}_{C_2}^t \quad (41)$$

- (b) Compute another vector $\underline{u}_{C_2}$ such that its top half is a null vector, and its bottom half is given by

$$\underline{u}_{C_2}^b = \text{old } \underline{a}_{C_2}^b - \underline{U}_{C_2}^b \text{ old } \underline{a}_{C_2}^t \quad (42)$$

- (c) This $\underline{u}_{C_2}$ vector is our new $\underline{a}_{C_2}$ vector.

Summarizing, after performing stabilizing transformations on the old sequence $\underline{F}_{C_2}, \underline{a}_{C_2}$ at the second conditioning point, we have arrived at a new sequence $\underline{F}_{C_2}, \underline{a}_{C_2}$ such that this new sequence is very well-conditioned like the first sequence $\underline{F}_{C_1}, \underline{a}_{C_1}$. During this process,

we have also generated $\underline{U}_{C_2}^b$ and $\underline{T}_{C_2}$ matrices which are of the order $(L+1)/2 \times (L+1)/2$, and $\underline{u}_{C_2}^b$ and $\underline{t}_{C_2}$ vectors which are of the length $(L+1)/2$. These two matrices are dependent upon the optical properties of the part of the atmospheric model contained between the first two conditioning points, while the vectors, in addition, are also dependent upon the parameter $x (= -\mu_0, \text{ or iso})$.

A repetition of the procedure outlined above between the conditioning points C_2 and C_3 will result in generation of $\underline{U}_{C_3}^b$, $\underline{T}_{C_3}$, $\underline{u}_{C_3}^b$, and $\underline{t}_{C_3}$ vectors. Eventually, after marching through all atmospheric levels, we will have N_C number of these vectors and matrices.

The sequence $\underline{U}_{C_n}^b$, $\underline{u}_{C_n}^b$ is then used to compute a vector $\underline{l}_{C_n}$ by solving the following system of linear equations:

$$\left(\underline{U}_{C_n}^b - \underline{G} \right) \underline{l}_{C_n} = -\underline{u}_{C_n}^b. \quad (43)$$

Since this $\underline{l}_{C_n}$ vector corresponds $\underline{g}_J^t$ [see Canosa and Penafiel, 1973], we have evaluated the entire vector $\underline{g}_J$ or the moments $\underline{f}(\tau_J; x)$ after making use of the lower boundary conditions.

Having obtained $\underline{l}_{C_n}$ corresponding to the last conditioning point or the lowest level in the model, values of $\underline{l}_{C_{k-1}}$ for the other conditioning points can be obtained by making use of the following equation:

$$\underline{l}_{C_{k-1}} = \underline{T}_{C_k} (\underline{l}_{C_k} - \underline{t}_{C_k}). \quad (44)$$

Again, these $\underline{l}_{C_k}$'s provide the top-half of $\underline{g}_j$ vectors at levels where the conditioning points C_k are located. The bottom half of

these $\underline{g}_{C_k}$ vectors are then obtained as follows:

$$\underline{g}_{C_k}^b = \underline{u}_{C_k}^b \underline{g}_{C_k} + \underline{u}_{C_k}^b. \quad (45)$$

Having obtained values of $\underline{g}_j$ vectors at all levels at which stabilizing transformations were performed, values of $\underline{g}_j$ at levels in between the two successive conditioning points can be obtained by making use of the following equation:

$$\underline{g}_j = \pi_{j-1} \underline{g}_{j-1} + \underline{D}_{j-1,j}^{-1} \underline{w}_{j-1}. \quad (46)$$

3.5 Computations of the Intensity: Having computed the Legendre moments of the azimuth-independent component of intensity [Eq. (12)] for all given directions of illumination of the atmospheric model from the outside, values of the quantity $I(\tau=0; \mu, x)$ can be computed with the following equation:

$$I(\tau=0; \mu, x) = \sum_{\ell=0}^L \frac{2\ell+1}{2} f_{\ell}(\tau=0) P_{\ell}(\mu). \quad (47)$$

If this expression can provide accurate and smooth I vs. μ curves, we do not need computations of $\underline{g}_j$ at all levels. It would be sufficient to have values of $\underline{g}_1$ only. Thus, the steps represented by Eqs. (45) and (46) would be unnecessary.

However, values of $I(\tau=0; \mu, x)$ so obtained are for the first $L+1$ terms of the Legendre series representing the scattering phase function of a unit volume. As mentioned in the third paragraph of §2.4, the Legendre series for some aerosol distributions may require as many

as 200 (or even 300 in some extreme case) terms, while the order of spherical harmonics approximation used varies between 40 and 100 depending upon the anisotropy of the phase function (§4.4). Even if the order of the spherical harmonics approximation was to be increased to account for all the terms in the input phase function, the curve $I(\tau=0; \mu, x)$ vs. μ would still exhibit an oscillatory character [e.g., Dave and Canosa, 1974]. Dave and Armstrong [1974] have applied two different methods for smoothing the $I(\tau; \mu, x)$ vs. μ curves obtained with a given order of the spherical harmonics approximation. One of the methods is the Cesáro summation method which provides smooth curves but the actual accuracy of the computed intensities is of somewhat poor quality. The other method, known as the integration-of-the-source-function method, provides results more accurate compared to those obtained with the Cesáro summation method.

For our work, we will adopt a modified version of this integration-of-the-source-function method [Dave, 1975]. Accordingly, the source function $J(\tau_j; \mu, -\mu_0)$ due to virtual emission at the center of the τ_j -th layer, and in the direction μ , is given by

$$\begin{aligned}
 J(\tau_j; \mu, -\mu_0) = & \frac{1}{4} F 0.5 [e^{-\tau_j/\mu_0} + e^{-\tau_{j+1}/\mu_0}] \\
 & \times \sum_{\ell=0}^{LMX} \Lambda_{\ell}(\tau_j) P_{\ell}(\mu) P_{\ell}(-\mu_0) + \frac{1}{2} \sum_{\ell=0}^L \Lambda_{\ell}(\tau_j) \\
 & \times 0.5 [f_{\ell}(\tau_j; -\mu_0) + f_{\ell}(\tau_{j+1}; -\mu_0)] P_{\ell}(\mu), \quad (48)
 \end{aligned}$$

and the source function due to the illumination condition $x = iso$ is given by

$$\begin{aligned}
 J(\tau_j; \mu, iso) = & \frac{1}{2} \sum_{\ell=0}^{LMX} \Lambda_{\ell}(\tau_j) P_{\ell}(\mu) \\
 & \times 0.5 \left[\int_0^1 e^{-(\tau_b - \tau_j)/\mu_1} P_{\ell}(\mu_1) d\mu_1 \right. \\
 & \quad \left. + \int_0^1 e^{-(\tau_b - \tau_{j+1})/\mu_1} P_{\ell}(\mu_1) d\mu_1 \right] \\
 & + \frac{1}{2} \sum_{\ell=0}^L \Lambda_{\ell}(\tau_j) 0.5 \left[f_{\ell}(\tau_j; iso) + f_{\ell}(\tau_{j+1}; iso) \right] \\
 & \times P_{\ell}(\mu) . \tag{49}
 \end{aligned}$$

The first term on the right hand side of Eqs. (48) and (49) represents a contribution due to the scattering of the direct solar radiation, and isotropic ground-reflected radiation, respectively. In other words, it represents the contribution due to the first (primary) scattering of the incoming direct radiation. This primary scattering contribution is computed after taking into account all terms of the Legendre series as the upper limit LMX assumes a value of 2 for a pure Rayleigh model, and is equal to greater of $NMXST-1$ and $NMXTP-1$ when the model contains stratospheric as well as tropospheric aerosols.

The second term on the right hand side of Eqs. (48) and (49) represents the contribution due to rescattering of the atmospheric radiation.

This higher-order contribution to the source function is computed using the P_L -th approximation.

Values of $I(\tau = 0; \mu, x)$ are then obtained by making use of the following series:

$$I(\tau = 0; \mu, x) = \frac{1}{\mu} \sum_{j=1} \overline{\exp(-\tau_j/\mu) J(\tau_j, \mu, x) \Delta\tau_j}, \quad (50)$$

where the bar implies the mean value of the terms under it.

IV. COMPUTATIONAL PROCEDURES

4.1 General: In §2, we mentioned that two computer programs (viz., SITAA and SITBB) are required for computing the azimuth-independent component of the intensity of the scattered radiation emerging from a nonhomogeneous, pseudo-spherical atmosphere. Computer requirements and the basic information for a successful running of these programs on an IBM 370 series computer were also given in that section. Some detailed information about the method of computations was given in §3. In the present section, we will give details about the programs themselves which are written in the FORTRAN IV language. This particular subsection is restricted to some features common to both programs, and to giving a general idea about the contents of the remaining three subsections of this §4.

The input datasets in both programs are read in by the statement READ (IR, ..., where the parameter IR is assigned a value of unity in the beginning of the program (SITAA 25 and SITBB 148). The

dataset intended as an input to a given program should therefore be made available on the disk assigned to the virtual machine with a file name of FILE, and a file type of FT01F001 before the program execution is called for.

The output intended in the printed form is written out by issuing a statement WRITE (IW, ..., where the parameter IW is assigned a value of 8 in the beginning (SITAA 26 and SITBB 149). In order to transfer this printer output to the printer disk-space of the host computer, it is necessary to issue the following file definition statement:

```
FI FT08F001 PRINTER (PERM RECFM UA BLKSIZE 132.
```

If not, the output will be stored on the disk attached to the virtual machine.

Subroutines from the FORTRAN library are accessed by issuing the statement GLOBAL TXTLIB FORTLIB before starting the execution of the program.

A subroutine TIMDAT is used to obtain information about the virtual and real CPU (Central Processing Unit) time, in seconds, required for a given production run. This subroutine has four arguments, viz., DATE, HOUR, ITV, and ITR. The arguments DATE and HOUR are in eight byte length (Real * 8). Readings of the virtual and real clocks in milliseconds are stored in the 4-byte integer locations ITV and ITR, respectively. The subroutine TIMDAT is called just before starting the main bulk of computations, and also just after all computations are

completed for a given subset of the job. The differences between these two clock-readings are converted in seconds, and this timing information along with other identifying information of interest, is typed out at the terminal by issuing the statement WRITE (6, ... This timing part of the program can be deleted without affecting the results of computations in any manner (statements numbered SITAA 22, 23, 40, 128 to 131, and SITBB 129, 130, 188, as well as 654 to 657).

Except for the subroutine TIMDAT discussed in the preceding paragraph, the program SITAA does not call for any subroutine unavailable in the standard FORTRAN library. On the other hand, the program SITBB does call for a number of such subroutines. Eight of these subroutines (viz., BCMAT, FLUX, LEGFUN, PITRIX, POLATE, SLPTH, SOLISY, and SOLVE) are discussed in §4.3. Remaining subroutines (viz., SUBSTA, SUBSTB, . . . , SUBSTM) consist of a group of statements pulled out of the original version of the SITBB program primarily for the purpose of decreasing the CPU time required for several test runs. The functions performed by this latter type of subroutines are discussed at appropriate places in §4.4. Reader may come across two different SUBSTx routines performing essentially the same task.

4.2 Program SITAA: The statements numbered SITAA 1 through SITAA 23 contain comment cards, dimension statements for the various variables appearing in the main body of the program, and the format statements for handling input and output. The statement no. SITAA 24 defines the format for the direct access output file number 15; it will consist of

101 records of 2004 bytes each. The third parameter inside the parenthesis, viz., the letter L, specifies that the preceding number is in bytes. The last parameter is a dummy parameter of little interest to us. This DEFINE FILE statement must be compatible with the file definition statement given in §2.1.

Values of the variables TAU, SUM, and BUM (see Table I) are initialized during execution of the statements SITAA 28 through SITAA 32, and the constants appearing in recursive computations of $P_\ell(\mu)$ starting with values of $P_0(\mu)$ and $P_1(\mu)$ are evaluated during execution of the statements numbered SITAA 33 through SITAA 38.

Table I. Some important variables appearing in the SITAA program and their mathematical equivalents.

Variable	Mathematical Equivalent
AMU	μ
BUM	single precision representation of the integral appearing in §2.2.
COKA to COKC	numerical constants in recursive computations of $P_\ell(\mu)$
DMU	$\Delta\mu$
FNEX	$\exp(-\tau/\mu)$
FNPL	$P_\ell(\mu)$
SUM	double precision representation of the integral appearing in §2.2.
TAU	τ
ZPL	zeroes of $P_\ell(\mu)$ for a given value of the subscript ℓ .

Positions of the zeroes of $P_\ell(\mu)$ for the value of the subscript ℓ under investigation are read in (SITAA 43 through SITAA 52) only if the value of the subscript ℓ exceeds unity. A check is also made to see that the cards containing values of the zeroes of $P_\ell(\mu)$ are in proper order (SITAA 47).

Statements SITAA 53 through SITAA 71 are used to divide the interval between two consecutive positions of the zeroes of $P_\ell(\mu)$ in an even number of subintervals of equal length. This is because contribution to the integral from the interval contained between two consecutive positions of the zeroes of $P_\ell(\mu)$ is to be evaluated at a later stage by using Simpson's rule of integration. Care is taken to see that each interval is subdivided as finely as possible provided the total number of subintervals in the entire range (0.0, -1.0) does not exceed 500. During the execution of these statements, the following quantities are also evaluated: μ_i at which the integrand $\exp(-\tau/\mu_i) P_\ell(\mu_i)$ will be evaluated, the subinterval $\Delta\mu_i = \mu_{i+1} - \mu_i$, and the quantity $\text{RAMU}(I)$ representing $\exp(-0.01/\mu_i)$.

Values of $P_\ell(\mu_i)$ for all values of μ_i are computed during execution of the statements numbered SITAA 72 through SITAA 93 by making use of the well-known, upward recursion formula. The function $\exp(-\tau_j/\mu_i)$ for values of τ_j given by $\tau_j = 0.00 (0.01) 5.00$ and $j = 1 (1) 501$ is computed in the part of the program contained between SITAA 94 and SITAA 104. This exponential function is set to zero if its value is found to be smaller than 1.0×10^{-60} for a given τ_j, μ_i combination; this is done for avoiding any undesirable underflow messages at a later stage.

Statements SITAA 105 through SITAA 125 are used to evaluate the contribution to the exponential integral in each of the intervals using Simpson's rule, and then for evaluation of the integral over the entire range. All these computations are carried out using double precision arithmetic procedures. However, only values of the exponential integral rounded to about first seven significant figures (SITAA 124), are stored for all 501 values of the parameter τ and a given value of the subscript ℓ as a record number $\ell + 1$ on the dataset 15 (SITAA 127).

The program is then returned to the statement no. SITAA 39 for performing computations for the next higher value of the subscript ℓ . If an end of file is encountered during the reading of zeroes of $P_{\ell}(u)$, the control is transferred from SITAA 45 to SITAA 134. The remaining part of the program is then used to generate a printed output of values of the exponential integral for 501 equally spaced values of the parameter τ and for all successive integer values of the subscript ℓ , starting with zero.

4.3 Subroutines called by SITBB: As mentioned in the last paragraph of §4.1, we will describe the following subroutines in this section: BCMAT, FLUX, LEGFUN, PITRIX, POLATE, SLPTH, SOLISY, and SOLVE.

Subroutine BCMAT: This subroutine is called by the statement no. SITBB 182 of the main program for returning computed values of the vectors AL, AR, and the matrix GMAT. The vectors AL and AR represent the arrays on the left and right hand side of the main diagonal of the matrix on the right hand side of Eq. (14), respectively. The matrix GMAT

represents elements of the boundary condition matrix $\underline{G}$ first appearing at the Eq. (24). Explicit expressions for computations of all elements of this $\underline{G}$ matrix can be found in §3.5 of a report by Dave [1974]. The calling program is written to accommodate up to P_{99} -th approximation of the Spherical Harmonics Approximation, and hence the orders of $\underline{A}$ and $\underline{G}$ matrices are 100 and 50, respectively. This subroutine is written to return values for these largest, called-for conditions. This subroutine is too small and too simple to require any further explanation.

Subroutine FLUX: This subroutine is called by the statement no. SITBB 570 and SITBB 587 for returning values of the direct solar flux $[F_s(\tau; x)]$, and upward as well as downward diffuse fluxes $[F_u(\tau; x)]$ and $[F_d(\tau; x)]$ at the level τ for all eleven cases of illumination of the atmospheric model under investigation. Mathematical equivalences of key variables appearing in this subroutine are given in Table II. The variable ISW carries information about the success or failure in computations of the $\underline{g}$ vector [see Eq. (29)] corresponding to the lowermost level in the atmospheric model by making use of the Eq. (43). In the case of failure for a given case of illumination, F_u and F_d are set to zero.

Computations of $F_d(\tau; x)$ and $F_u(\tau; x)$ (with $x = -\mu_0$ or iso) are carried out by making use of Eqs. (47) and (48), respectively, given in a report by Dave [1974]. For these computations, we require values of the moments $f_\ell(\tau; x)$ defined by Eq. (12). It should be pointed out that locations VECL1 contain values of the $\underline{g}$ vector at the level τ (symbol L in this subroutine) for all eleven cases of illumination,

Table II. Some important variables appearing in the subroutine
FLUX and their mathematical equivalent.

Variable	Mathematical Equivalent
AMUO	μ_0
ATEN	$-\exp(-\tau/\mu_0)$; see Eqs. (19 - 22)
FXD	$F_d(\tau; -\mu_0)$ or $F_d(\tau; \text{iso})$
FXN	Net flux, $F_n(\tau; -\mu_0)$ or $F_n(\tau; \text{iso})$
FXS	$F_s(\tau, -\mu_0)$ or $F_g(\tau; \text{iso})$
FXU	$F_u(\tau; -\mu_0)$ or $F_u(\tau; \text{iso})$
L	level number
NTR	Order of the Sp. H. Approx. + 1
VECL1	$\underline{g}$ vector at the level τ

and furthermore, the $\underline{g}$ vector is essentially an $\underline{f}$ vector rearranged as shown by Eq. (29). Hence, location VECL1(1, N) contains value of the moment $f_0(\tau)$ for the N-th case of illumination, while the location VECL1(NTR/2+1, N) contains the value of the moment $f_1(\tau)$ for the N-th case of illumination. The remaining even moments, i.e., $f_2(\tau; x)$, $f_4(\tau; x)$, $\dots$, $f_{L-1}(\tau; x)$, required for computations of the diffuse fluxes are found in the location VECL1(2, N), VECL1(3, N), $\dots$, VECL1(NTR/2, N), respectively. With this explanation, one should have no difficulty in following statements no. FLUX 18 through FLUX 27.

The algebraic summations of $f_\ell(\tau)$ carried out during the execution statements FLUX 18 through FLUX 27 provide values of $-F_d(\tau; x)/2\pi$ and

$F_u(\tau; x)/2\pi$. Therefore, these sums are multiplied by appropriate factors to obtain values of $F_d(\tau; x)$ and $F_u(\tau; x)$; statements no. FLUX 28 and FLUX 29.

Computations of $F_s(\tau; -\mu_0)$ given by the expression $\pi \mu_0 \exp(-\tau/\mu_0)$ are carried out during execution of the statements FLUX 31 through FLUX 33. Values of $F_g(\tau; \text{iso})$ for the case of isotropic illumination from below are provided by the calling program in locations FXS(L, 11).

Values of the net flux $F_n(\tau; x)$ for $x = -\mu_0$ and $x = \text{iso}$ are then computed by the statements FLUX 35 and FLUX 37, respectively, by making use of the following equations:

$$F_n(\tau; -\mu_0) = F_s(\tau; -\mu_0) + F_d(\tau; -\mu_0) - F_u(\tau; -\mu_0), \quad (51)$$

and

$$F_n(\tau; \text{iso}) = F_g(\tau; \text{iso}) + F_u(\tau; \text{iso}) - F_d(\tau; \text{iso}). \quad (52)$$

Subroutine LEGFUN: This subroutine is called by the statement no. SITBB 181 for returning values θ_0 , μ_0 , $P_\ell(-\mu_0)$, θ , μ , and $P_\ell(\mu)$. These six quantities are represented by the symbols THETO, AMUO, FNYN, THETA, AMU, and FNYP, respectively. Ten input values of θ_0 are initialized by the statement no. LEGFN 10 and LEGFN 11. Numerical constants needed in recursive evaluation of the Legendre polynomials $P_\ell(\mu)$ starting with the values of $P_0(\mu)$ and $P_1(\mu)$, are computed during the execution of statements LEGFN 14 through LEGFN 21. Values of μ_0 , and of $P_\ell(-\mu_0)$ for $\ell = 0(1)299$, are computed in the part of the program contained between the statements LEGFN 22 through LEGFN 37.

Equation (1) is used to compute values of values of θ and μ for the 18 different directions of observation for the NIMBUS-G configuration (LEGFN 40 through LEGFN 46). Remaining part of the subroutine deals with recursive evaluation of $P_{\ell}(\mu)$ for all 18 values of μ , and 300 values of the subscript ℓ .

Subroutine PITRIX: This subroutine is called by the statement no. SITBB 482 for obtaining values of all elements of the π_j and $D_{j,j+1}^{-1}$ matrices given by Eqs. (35) and (33), respectively. The fourth and sixth arguments, viz., PIMAT and DINV, specify respective matrix locations at which values of π_j and $D_{j,j+1}^{-1}$ for the j -th layer will be returned. The first and third arguments of this subroutine (viz., AL and AR) specify the nonvanishing elements of the bidiagonal matrix A (see subroutine BCMAT). Values of the diagonal elements of the matrix $\frac{1}{2} \Delta \tau_j C(\tau_j + \frac{1}{2} \Delta \tau_j)$ appearing in Eqs. (32) and (33) [also see Eqs. (15) and (16)] are given by the second argument of this subroutine. The last argument, viz., NMX specifies the order of the input and output matrices. The remaining arguments provide the temporary work area.

From Eqs. (32), (33), and (35), we find that the computations of the π_j matrix require values of $D_{j,j+1}^{-1}$ and $D_{j,j}$ matrices which, in turn, are tridiagonal matrices with their columns rearranged by parity. From the §5.4 of a report by Dave [1974], we find the following:

$$D_{j,j+1}^{-1} = \text{Row} \left[\underline{A} + \frac{1}{2} \Delta \tau_j C(\tau_j + \frac{1}{2} \Delta \tau_j) \right]^{-1}, \quad (53)$$

and

$$\begin{aligned}\pi_j &= - D_{j,j+1}^{-1} D_{j,j} \\ &= - \text{Row} \cdot \text{Column} \left[\underline{I} - 2 \left[\underline{A} + \frac{1}{2} \Delta \tau_j \underline{C}(\tau_j + \frac{1}{2} \Delta \tau_j) \right]^{-1} \underline{A} \right],\end{aligned}\quad (54)$$

where a Row operator on a matrix denotes the rearrangement of its rows by parity. This Row operator is similar to the Column operator which is described in the paragraph following Eq. (33) except that this new operator operates on rows, and not on columns of the matrix.

From the preceding discussion, it is clear that the task of computing elements of π_j and $D_{j,j+1}^{-1}$ matrices reduces to that of inverting the tridiagonal matrix inside the rectangular bracket in Eq. (53) or (54). Inversion of a matrix (general or tridiagonal) can be best carried out after obtaining its $\underline{L} \cdot \underline{U}$ decomposition, i.e., after breaking it up into a lower triangular matrix $\underline{L}$, and an upper triangular matrix $\underline{U}$. Using Gaussian elimination procedure, one can easily obtain an $\underline{L} \cdot \underline{U}$ decomposition of a tridiagonal matrix provided no pivoting is required [Ch. XIII in Forsythe and Moler, 1967]. However, we find that an $\underline{L} \cdot \underline{U}$ decomposition of the above-mentioned tridiagonal matrix does require some partial pivoting. The procedure described in Chapters IX and XI of the book on "Computer Solution of Linear Algebraic Systems" by Forsythe and Moler cited above, for $\underline{L} \cdot \underline{U}$ decomposition of a general square matrix was appropriately modified to take advantage of the tridiagonality of the matrix at hand. This decomposition is carried out by the part of this subroutine contained between the statements PITRX 30 and PITRX 110. This part of the subroutine can be followed by referring to the book of

Forsythe and Moler, and partially pivoting a small (8×8) matrix manually. On analysis of this part of the subroutine, a reader would find that some extra precautions are taken to err on the safe side. Naturally, this does result in a small increase in the computational load. The $\underline{L} \cdot \underline{U}$ decomposition is stored at the matrix location TEM.

Statements PITRX 111 through PITRX 158 are then used to obtain an explicit inverse of the tridiagonal matrix at hand by making use of its recently-arrived-at $\underline{L} \cdot \underline{U}$ decomposition as follows:

Consider linear systems of equations given by $\underline{A} \underline{x}_i = \underline{b}_i$ with $i = 1, 2, \dots, \text{NMX}$. The $\underline{b}_i$ -th vectors are so defined that all elements of the $\underline{b}_k$ -th vector have a zero value except for its k -th element which has a value of unity. Since $\underline{L} \cdot \underline{U}$ decomposition of $\underline{A}$ is available, we can evaluate $\underline{x}_i$ vector in two steps. [Note that $\underline{A}$ of this paragraph is not the $\underline{A}$ of Eq. (14).]

- (i) Forward substitution: $\underline{U} \underline{x}_i = \underline{L}^{-1} \underline{b}_i$ PITRX 124 through PITRX 141, and
- (ii) Backward substitution: $\underline{x}_i = \underline{U}^{-1} [\underline{L}^{-1} \underline{b}_i]$, PITRX 145 through PITRX 157.

The solution vector $\underline{x}_i$ so obtained represents the i -th column of $\underline{A}^{-1}$ matrix as $\underline{A} \underline{A}^{-1} = \underline{I}$.

A reader desiring further information on this subject is referred to Forsythe and Moler's book mentioned above. It may be noted that an inverse of $[\underline{A} + \frac{1}{2} \Delta \tau_j \underline{C}(\tau_j + \frac{1}{2} \Delta \tau_j)]$ is stored at the matrix location

PIMAT at the conclusion of the statement no. PITRX 158.

Statements PITRX 165 through PITRX 178 are then used to perform a Row operation on $\left[A + \frac{1}{2} \Delta \tau_j C(\tau_j + \frac{1}{2} \Delta \tau_j) \right]^{-1}$ to obtain $D_{j,j+1}^{-1}$; see Eq. (53).

Finally, statements PITRX 182 through 193 are used to obtain the matrix appearing inside the outer large parenthesis in Eq. (54); and statements PITRX 197 - PITRX 209 and PITRX 210 - PITRX 222 are used to perform a column and a row transfer, respectively, for obtaining π_j matrix in the matrix location TEM. The last part of this subroutine is used to transfer the π_j matrix from the matrix location TEM to the matrix location PIMAT.

Subroutine POLATE: This subroutine is called by the statements SITBB 445 and SITBB 452 of the main program for returning linearly interpolated value of a function YTAB at a value X when the function YTAB is tabulated at an interval of 0.01 in the parameter x starting with 0.0. The interpolated value is returned at the location of the third argument of this subroutine, viz., Y.

Subroutine SLPTH: This subroutine is called by the statement no. SITBB 183 for returning values of the quantity $\Delta s_{i,j}$ [Eq. (22)] for all 10 values of θ_0 , and for all 32 basic layers. The heights of bases of each of the 32 basic layers, and of the top of the atmosphere, are defined by the statements SLPTH 8 through SLPT 10. It should be noted that no attempt is made to compare these values with input values of

GTH (SITBB 157), or with the value of the radius of the earth in the subroutine LEGFUN. For another planet or for any other division of the atmosphere, proper care must be exercised.

Signs of the quantity μ_0 are changed (SLPTH 21) as values of μ_0 generated by the subroutine LEGFUN carry a negative sign before them. Again, this subroutine is too simple to require any detailed explanation.

Subroutine SOLISY: This subroutine is called by the statements SITBB 501 and SITBB 536 of the main program. It has 11 arguments. The first argument (viz., NCASE) can have a value of 1, or 2 only. For NCASE = 1, this subroutine returns an inverse of a general square matrix $\underline{A}$ (second argument) in the matrix location designated AINV (third argument). For NCASE = 2, a linear system of equations $\underline{A}\underline{x} = \underline{b}$ is solved [$\underline{b}$ vector in the vector location designated B (sixth argument), and $\underline{x}$ vector in the vector location designated X (fifth argument)]. The order of the $\underline{A}$ matrix is given by the eighth argument, viz., NMX.

The remaining arguments supply a temporary work area to the subroutine except the ninth argument, ITR. Information transmitted to the calling program by this ninth argument, will be described at a later stage.

For NCASE = 1 or 2, the first step is to obtain an $\underline{L} \cdot \underline{U}$ decomposition of the matrix $\underline{A}$ in the matrix location designated TEM (SOLIS 35 through SOLIS 82). The Gaussian elimination procedure with partial

pivoting (see discussion under subroutine PITRIX in the preceding paragraphs) is used for this purpose.

The next step is to solve the linear system of equations $\underline{A} \underline{x} = \underline{b}$ (NCASE = 2), or systems of linear equations $\underline{A} \underline{x}_i = \underline{b}_i$, $i = 1, 2, \dots$, NMX for obtaining the matrix $\underline{A}^{-1}$ (NCASE = 1). Again, reference is made to the discussion under the heading Subroutine PITRIX.

It should be pointed out that the matrix inverted in the subroutine PITRIX is a tridiagonal one. Hence, it is well-conditioned, and its inverse is assured against the propagation of round-off errors. On the other hand, the matrix to be inverted under this subroutine (SOLISY) is a general square matrix which may or may not be well-conditioned. Because of this, it is not sufficient for this subroutine to return numbers which may or may not truly represent the exact inverse of $\underline{A}$. This subroutine should also measure the condition of the matrix during computations and provide an appropriate message when the reliability of the results is in doubt. The procedure used for measuring the condition of the $\underline{A}$ matrix is described in Ch. XIII of the book by Forsythe and Moler [1967]. In brief, this procedure is as follows:

- (1) Obtain a first solution of the linear system of equations $\underline{A} \underline{x} = \underline{b}$ by following the procedure outlined under the heading Subroutine PITRIX. Call this first solution vector $\underline{x}^{(1)}$. This solution is obtained by calling the subroutine SOLVE at the stage SOLIS 94. It should be again pointed out that for NCASE = 2, the system $\underline{A} \underline{x} = \underline{b}$ is solved for only one value of the $\underline{b}$

vector while for NCASE = 1, it is solved for a set of vectors $\underline{b}_i$ with $i = 1, 2, \dots, \text{NMX}$ where the $\underline{b}_k$ -th vector has all its elements set to zero except its k -th element which has a value of unity (SOLIS 83 through SOLIS 93).

- (ii) Terminate the program with an appropriate message if $\underline{x}^{(1)}$ is a null vector (SOLIS 106 through SOLIS 113).
- (iii) Form the residual vector $\underline{r}^{(1)} = \underline{b}^{(1)} - \underline{b}$ (SOLIS 115 through SOLIS 122).
- (iv) Solve the linear system $\underline{A} \Delta \underline{x}^{(1)} = \underline{r}^{(1)}$ by calling the sub-routine SOLVE (SOLIS 123).
- (v) Compute $\underline{x}^{(1)} + \Delta \underline{x}^{(1)}$ and compare it with $\underline{x}^{(1)}$ vector. If the largest absolute values of these two vectors agree within 3 significant figures, attempt to improve on $\underline{x}^{(1)}$ by going through the steps which follow. Otherwise, return to the calling program with a negative value for the argument ITR (SOLIS 129 through SOLIS 133, and SOLIS 137 as well as SOLIS 138).
- (vi) Accept the solution $\underline{x}^{(1)}$ if the largest elements in $\underline{x}^{(1)}$ and $\underline{x}^{(1)} + \Delta \underline{x}^{(1)}$ agree within six significant figures (SOLIS 134). If not, go to the next step.
- (vii) Repeat steps (iii) to (vi) above by treating $\underline{x}^{(1)} + \Delta \underline{x}^{(1)}$ as $\underline{x}^{(2)}$, and then obtaining $\underline{r}^{(2)}$ and $\Delta \underline{x}^{(2)}$.

The iterative procedure outlined in step (vii) above is set to be repeated for 15 times (SOLIS 103) at the most. If after 15 iterations, the solution vector cannot be improved within the preset criteria, a return is made to the calling program with $ITR = 0$ (SOLIS 135, SOLIS 136, SOLIS 139, and SOLIS 140). The six-significant-figure convergence criterion is based on the single precision accuracy of the 370 series computers.

If the linear system of equations $\underline{A} \underline{x} = \underline{b}$ can be solved successfully (or if the matrix $\underline{A}$ can be inverted successfully for $NCASE=1$), an integer value between 1 and 15 is returned to the calling program via the argument ITR .

Subroutine SOLVE: This subroutine is called by statements SOLIS 94 and SOLIS 123 of the subroutine SOLISY. It receives $\underline{L} \cdot \underline{U}$ decomposition of a general square matrix $\underline{A}$ at the location designated TEM (first argument), and a vector $\underline{b}$ at the location designated B (third argument). The solution vector $\underline{x}$ (location designated X; second argument) is obtained by going through the forward substitution procedure ($\underline{U} \underline{x} = \underline{L}^{-1} \underline{b}$), and then the backward substitution procedure [$\underline{x} = \underline{U}^{-1}(\underline{L}^{-1} \underline{b})$].

4.4 Program SITBB: This is the main program used for computing the azimuth-independent component of the intensity of scattered radiation emerging at the top of a pseudo-spherical model of a terrestrial atmosphere. It consists of a total of 660 FORTRAN statements. Input to, and output from this program are discussed in §2.3 and 2.4, respective-

ly. Mathematical equivalence as appearing in the text (§3) and/or definition of various important variables appearing in this program are given in Table III.

After comment, dimension and format statements (SITBB 1 through 140) we arrive at the block SITBB 141 - SITBB 147 which deals with the FORTRAN equivalence of the file definition statements listed in §2.1. The datafiles no. 11 and 12 are for storing the U_{C_n} and T_{C_n} matrices (§3.4) generated at each of the conditioning points. A provision is made to deal with a maximum of 101 conditioning points for a given run (SITBB 385 - SITBB 388) and hence, each of these files has a capability of accommodating 101 records. The size of each of these records is 10,000 bytes based on (50, 50) REAL * 4 dimension of these matrices (SITBB 22). Datafiles no. 13 and 14 similarly accommodate vectors t_{C_n} and u_{C_n} for eleven directions of illumination. Their dimensions are (50, 11) each and hence a record length of 2,200 bytes.

The contents of datafile no. 15 are described in §2.2 and 4.2.

Datafile no. 16 is to store output of $I(\lambda, \Omega, P, R=0, \theta, \theta_0)$, $T(\lambda, \Omega, P, \theta, \theta_0)$, and $\bar{S}(\lambda, \Omega, P)$ for all six wavelengths of interest to the NIMBUS-G configuration, and for up to 200 different atmospheric models [Eq. (2) and discussion following it]. It therefore consists of 200 records. Each record consists of the single precision (REAL * 4) quantities TITB(14), EIC(18, 10, 6), TIC(18, 10, 6), and SSBERR(6); see SITBB 32, SITBB 33, and SITBB 647. Hence, the record length in bytes

Table III. Important variables appearing in the program SITBB
and their mathematical equivalence or definition.

Variable	Equivalence or Definition
A	Temporary work area.
AJVD	Exponential integral for the subscript ℓ ; §2.2.
AL	Vector on the left of the main diagonal in the matrix $\underline{A}$; Eq. (14).
ALDA	λ
AMOMT	$f_{\ell}(\tau; x)$ for a given τ ; Eq. (12).
AMU	μ ; §3.1.
AMUO	μ_0 ; §3.1.
AR	Vector on the right of the main diagonal in the matrix $\underline{A}$; Eq. (14).
ATEN	$-\exp(-\tau/\mu_0)$ or its equivalence in a spherical atmosphere; see discussion following Eq. (20).
AVECT	$\underline{a}_j$; Eq. (36).
B	Temporary work area.
BABSST	$\bar{\beta}(a, ST)$; Eq. (7).
BABSTP	$\bar{\beta}(a, TP)$; Eq. (7).
BLDA	λ
BMOMT	$f_{\ell}(\tau; x)$ for a given τ ; Eq. (12).
BREKA - BREKD	Equivalence for the core storage area of $\underline{\pi}_j$ and $\underline{D}_{j,j+1}^{-1}$ matrices.
BSCAST	$\bar{\beta}(s, ST)$; Eq. (7).
BSCATP	$\bar{\beta}(s, TP)$; Eq. (7).

Table III, continued

Variable	Equivalence or Definition
BTEN	$\exp(-\tau/\mu)$.
C	Temporary work area.
CAPLAM	$\Lambda_\ell^{(\tau)}$; Eq. (11).
CAPLX	$0.5 \sigma_\ell(\tau) \Delta\tau_j$; Eq. (16).
CAPLY	w_j ; Eq. (30).
CINV	F_j^t ; Eqs. (34) and (38).
CIMAT	Inverse of F_j^t .
COFAR	$\Lambda_\ell^{(R)}$; Eq. (11).
COFAS	$\Lambda_\ell^{(ST)}$; Eq. (11).
COFAT	$\Lambda_\ell^{(TP)}$; Eq. (11).
D	Temporary work area.
DATE	Date of the computer run.
DELS	$\Delta s_{1,j}(-\mu_0)$; Eq. (22).
DINV	$D_{j,j+1}^{-1}$; also used for a temporary storage, SITBB 523.
DISTAN	y ; §3.4.
DTAU	$\Delta\tau_j$.
DTAUH	$0.5 \Delta\tau_j$.
EIC	$I(0; \mu)$ for 18 values of μ , 10 values of θ_0 , and 6 values of λ .
EIN	$I(0; \mu)$ for 18 values of μ , 10 values of θ_0 , and also for isotropic illumination from below; §3.5
FMAT	F_j ; Eq. (34).
FNYN	$P_\ell(-\mu_0)$.
FNYP	$P_\ell(+\mu)$.

Table III, continued

Variable	Equivalence or definition
FXD	$F_d(\tau; x)$; §4.3, FLUX.
FXN	$F_n(\tau; x)$; Eqs. (51) and (52).
FXS	$F_s(\tau; -\mu_0)$ or $F_g(\tau; \text{iso})$.
FXU	$F_u(\tau; x)$; §4.3, FLUX.
GMAT	G ; Eq. (24).
GTH	Geometric thickness of a basic layer.
HOUR	Hour of the day read by the computer clock.
ICHCK	ICHCK _j = 11 means that the j-th sublayer is the top-most sublayer of a given basic layer; ICHCK _j = 0 means that it is not so.
ICPOS	Sublevel number of the conditioning point.
ILDA	Serial number of the wavelength; §2.3.
INEW	Sublevel number of a given conditioning point.
IP	Array used for carrying information on partial pivoting of a matrix.
IPITE	Basic layer number of a given sublayer.
IR	Read tape unit.
ISW	ISW _n = 0 implies a success in solving the system of linear equation for the n-th direction of illumination.
ITR	§4.3, SOLISY.
ITRB	Real CPU time in milliseconds at the beginning.
ITRE	Real CPU time in milliseconds at the end.
ITVB	Virtual CPU time in milliseconds at the beginning.
ITVE	Virtual CPU time in milliseconds at the end.
IW	Write tape unit.

Table III, continued

Variable	Equivalence or Definition
LIMU	Work area for PITRIX.
%XNLVL	Total number of sublevels.
%XNLYR	Total number of sublayers.
NBAS	Basic layer number.
NBAS1 - NBAS4	Record numbers for storing π_j and $D_{j,j+1}^{-1}$ on the unit no. 17.
NBYLR	Total number of basic layers; §2.3.
NMOD	Model number; §2.3.
SMXST	Upper limit of $\Lambda_{\ell}^{(ST)}$.
SMXTP	Upper limit of $\Lambda_{\ell}^{(TP)}$.
NTR	Order of the spherical harmonics approximation plus one.
NTRA	$NTR + 1$.
NTR2	$NTR / 2$.
NTR21	$NTR2 + 1$.
NUMCON	Total number of conditioning points.
NUMCO1	$NUMCON - 1$.
OMEGR	$\omega_R(\tau)$; Eq. (8).
OMEGST	$\omega_{ST}(\tau)$; Eq. (8).
OMEGTP	$\omega_{TP}(\tau)$; Eq. (8).
OZABS	α ; Eq. (6).
OZOTH	Ozone amount in a basic layer.
PRTH	Pressure thickness of a basic layer.
PIMAT	π_j ; Eq. (35).

Table III, concluded

Variable	Equivalence or Definition
SBAR	$\bar{S}(\lambda, \Omega, P)$; Eq. (2).
SSBBRR	SBAR for all 6 wavelengths for a given model.
STDUST	Stratospheric dust content of a basic layer.
TAU	τ ; Eq. (3).
TAUBSR	$\tau_b^{(s,R)}$; Eq. (4) or (5).
TAUTOT	τ_b
TEM	Temporary storage for a matrix.
TEMA - TEME	Temporary work area.
THETA	θ
THETO	θ_0
TIC	$T(\lambda, \Omega, P, \theta, \theta_0)$; Eq. (2); also §3.1, Intensity.
TIMR	Real CPU time in seconds.
TIMV	Virtual CPU time in seconds.
TITB	Title information.
TMAT	T_{C_n} ; Eq. (39).
TPDUST	Tropospheric dust content of a basic layer.
TVECT	t_{C_n} ; Eq. (41).
UMAT	$u_{C_n}^b$; Eq. (40).
UVECT	$u_{C_n}^b$; Eq. (42).
VECL1	ℓ_{C_n} ; Eq. (43).
VECL2	ℓ_{C_n} ; Eq. (43).
XBLNK	Variable to provide blank space in title.

is $4 \cdot [14 + (18 \cdot 10 \cdot 6) + (18 \cdot 10 \cdot 6) + 6]$, i.e., 8720. The parameters 18, 10, and 6 accommodate output for 18 values of θ , 10 values of θ_0 , and 6 values of λ , respectively. The quantity TITB carries information about the basic atmospheric model.

Datafile no. 17 is created for temporary storage of values of π_j and $D_{j,j+1}^{-1}$ matrices for each of 32 basic layers of the atmospheric model [Eqs. (35) and (33)]. These are single precision quantities of dimension 100×100 (SITBB 24). Thus, the required physical length of a record of either matrix for a given basic layer is 40,000 bytes. The maximum record length which the system can handle is 32K (1K = 1024 bytes) bytes. We have therefore broken up each full record in two physical records for writing and reading purposes. PIMAT matrix into BREKA and BREKB matrices, and DINV into BREKC and BREKD. Each of this BREKx record has a length of 20,000 bytes (SITBB 29 and SITBB 30). Equivalence between PIMAT, DINV, and BREKx are given by the statements no. SITBB 34 and SITBB 35.

The part of the program contained between statements SITBB 148 through SITBB 285 deals mainly with input and output which are discussed in §2.3 and 2.4, respectively. Quantities such as G , μ_0 , μ , $\Delta s_{i,j}$, etc., which are independent of wavelength are also generated by calling appropriate subroutines (SITBB 177 - SITBB 183).

The section of this program contained between the statements SITBB 286 through SITBB 360 is used for dividing all basic layers into sub-layers whenever necessary, and for computing various optical properties

of each of these sublayers. First, various optical thicknesses [viz., $\Delta\tau(s,R)$, $\Delta\tau(a)$, $\Delta\tau(s,ST)$, $\Delta\tau(a,ST)$, $\Delta\tau(s,TP)$, $\Delta\tau(a,TP)$, and $\Delta\tau$; see Eq. (3)] of each of the basic layers are computed during the execution of the statements no. SITBB 303 through SITBB 310. The next five statements are used to determine the number of sublayers into which a given basic layer will have to be subdivided for satisfying the criterion that total optical thickness of no sublayer will exceed 0.02. Statements SITBB 316 through SITBB 334 are then used to generate serial numbers of each of the sublayer, for computing their various albedoes [Eq. (8)] as well as optical thickness (DTAU), and for computing total optical depth (TAU) at their bases. The procedure is started with the top-most basic layer, and is terminated with an appropriate message if total number of sublayers required exceeds 300 (SITBB 322 - SITBB 325). The remaining statements in this section are used to initialize the vectors ICHCK and INEW (see Table III), and for computing attenuation suffered by the direct solar radiation as it arrives at bases of various sublayers from ten different directions (ATEN), as well as attenuation suffered by a ray while traveling through a sublayer from one of the 18 different directions (BTEN).

Statements numbered SITBB 366 through SITBB 380 are used to determine the order of the spherical harmonics approximation to be used for evaluating the multiple scattering contribution to the outgoing radiation. This is done by examining total number of terms in the Legendre series representing the normalized phase functions for scattering for

both types of aerosols. Even in the absence of any type of aerosol, the P_{39} -th approximation is used.

The next step (SITBB 381 - SITBB 403) is to determine the number of conditioning points, and their locations in terms of sublevel number (ICPOS) as well as corresponding optical depth (TAU).

The subroutine SUBSTA is then called upon for returning values of the quantities CAPLAM, CAPLX, and CAPLY defined in Table III.

Statements SITBB 405 through SITBB 432 deal with computations of the primary-scattering contribution to $I(0; \mu, -\mu_0)$. The first term on the right hand side of Eq. (48) is substituted in Eq. (50) for this purpose. This primary-scattering contribution is computed by taking into account all (greater of the input parameters NMXST and NMXTP) terms of the Legendre series representing scattering phase function of aerosols. The series appearing on the right hand side of Eq. (48) has been evaluated in two parts, viz., SITBB 418 - SITBB 420, and SITBB 421 - SITBB 426. This is because the quantity CAPLAM is available for the first, NTR number of terms, only.

The next step is computations of the term $0.5 \Delta\tau_j [s_\ell(\tau_j, \text{iso}) + s_\ell(\tau_{j+1}; \text{iso})]$ assuming $I_g(-\mu_0)$ to be equal to unity [see Eqs. (20) and (30)], and the primary-scattering contribution to the diffuse radiation emerging at the top when the model is illuminated by isotropic radiation from below [the first term on the right hand side of Eq. (49) substituted in Eq. (50)]. Computations of both of these terms require

values of the exponential integral defined in §2.2, and stored in data-file no. 15. After reading in tabulated values of the integral for a given value of the subscript k (SITBB 443), subroutine POLATE is called upon to return the interpolated value of the integral at a given value of τ . The first of the two terms listed in the beginning of this paragraph is stored in locations designated CAPLY(I, L, 11), while the second one is stored in locations designated EIN(J, 11). Completion of computations in this particular section (SITBB 433 through SITBB 462) also provide values of the directly transmitted upward flux due to isotropic illumination from below $\left\{ 2\pi \int_0^1 \exp[-(\tau_b - \tau)/\mu] \mu d\mu \right\}$ in locations designated FXS(L, 11).

The part of the program contained between statements no. SITBB 463 through SITBB 468 is used for initializing values of $\underline{a}_1$ vectors for all eleven directions of illumination [Eq. (36)], and of the $\underline{F}_1$ matrix [Eq. (34)] by calling the subroutine SUBSTB.

A very good portion of the computational load is contained in the next block, viz., SITBB 469 - SITBB 514. It essentially consists of a DO LOOP 400 whose purpose is to compute $\underline{\pi}_j$ [Eq. (35)] and $\underline{D}_{j,j+1}^{-1}$ [Eq. (33)] matrices for all sublayers of the atmospheric model under study (SITBB 477 - SITBB 494), and to perform the stabilizing transformations (§3.4) for those sublevels corresponding to one of the conditioning points (SITBB 499 - SITBB 513).

First the matrices $\underline{D}_{j,j+1}^{-1}$ and $\underline{\pi}_j$ for the j -th sublayer are evaluated by calling the subroutine PITRIX, only if this sublayer cor-

responds to the topmost sublayer of a basic layer (SITBB 477 - SITBB 482). If these matrices are evaluated, then their values are also stored on the datafile no. 17 (fifth paragraph in §4.4) by executing the next eight statements. Subroutine SUBSTC (SITBB 494) is then called to compute $\underline{F}_j$ matrix [Eq. (34)], and $\underline{a}_j$ vectors [Eq. (36)].

Second, for a sublevel corresponding to one of the conditioning points (SITBB 499), a stabilizing transformation is performed as follows:

- (i) Call the subroutine SUBSTD (SITBB 500) for transferring the top-half of the $\underline{F}_j$ matrix into a matrix location designated CINV.
- (ii) Call the subroutine SOLISY (SITBB 501) for obtaining an explicit inverse of the matrix CINV in another matrix location designated CIMAT.
- (iii) After printing information about the result of attempts to invert CINV, terminate the program in the case of a failure (see discussion of the argument ITR in the subroutine SOLISY).
- (iv) Call the subroutine SUBSTE (SITBB 505) to generate $\underline{U}_{C_n}$ and $\underline{T}_{C_n}$ matrices (§3.4), and store their values on the datafiles no. 11 and 12, respectively.
- (v) Call the subroutine SUBSTF (SITBB 509) to generate new $\underline{F}_j$ matrix, i.e., the reconditioned one.
- (vi) Call the subroutine SUBSTG (SITBB 510) to generate $\underline{t}_{C_n}$ and $\underline{u}_{C_n}$ vectors for all eleven directions of illumination, and store their values on datafiles no. 13 and 14, respectively.

Execution of the statements contained between SITBB 515 and SITBB 550 results in evaluation of the vector $\underline{l}_{C_n}$ corresponding to the bottom-most conditioning point (lower-most level of the atmospheric model) by using Eq. (43). This vector $\underline{l}_{C_n}$ is evaluated for each of the eleven directions of illumination, and the parameter ISW is set to a non-zero value in the case of a failure in solving the linear system of equations [Eq. (43)] for a given direction. The subroutine SUBSTH is used for transferring $\underline{U}_{C_n}^b$ to a location designated DINV, and the subroutine SUBSTI is used for generating the bottom-half of $\underline{g}_J$ vectors [Eq. (28)]. The quantity $\overline{S}(\lambda, \Omega, P)$ appearing in Eq. (2) is computed at the stage SITBB 551; also see Eq. (23).

The second number-crunching portion of the program is contained between the statements SITBB 556 through SITBB 605. Its first purpose is to evaluate $\underline{g}_j$ vectors at all conditioning-point levels of the model and for all eleven directions of illumination by making use of Eqs. (44) and (45). Its second purpose is to compute upward and downward diffuse fluxes (see subroutine FLUX), and the multiple-scattering contribution to the outgoing diffuse radiation [second term on the right hand side of Eqs. (48) and (49) substituted in Eq. (50)]. The direct transmission of the isotropic illumination from below is added to the outgoing diffuse radiation during execution of the statements no. SITBB 603 through SITBB 605.

The first purpose is served by the statements SITBB 557 through SITBB 567. The $\underline{l}_{C_k}$ vectors appearing on the right hand side of Eq.

(44) are available at the locations designated VECL2. After reading in values of $\underline{U}_{C_{k-1}}^b$ matrix and $\underline{u}_{C_{k-1}}^b$ as well as $\underline{t}_{C_k}$ vectors from the disk (SITBB 558 - SITBB 562), an entry is made in the subroutine SUBSTJ. Statements no. SUBTJ 9 through SUBTJ 18 are used for computing and storing values of the $\underline{l}_{C_{k-1}}$ vectors at locations designated VECL1, and AVECT. At this stage, the AVECT locations contain the top-half of $\underline{g}_j$ vectors at the level under scrutiny. The bottom-half of $\underline{g}_j$ vectors is computed by making use of statements no. SUBTJ 20 through SUBTJ 26 if the conditioning point does not correspond to the top-most level of the model, and by making use of statements no. SUBTJ 28 through SUBTJ 35 if the conditioning point does correspond to the topmost level of the model. This is because, for this latter case, $\underline{U}_{C_1}^b = -\underline{G}$ by definition. The $\underline{T}_{C_{k-1}}$ matrix is then read in for being ready for the next time around. At this stage, we have values of $\underline{g}_j$ vectors at atmospheric sublevels where the conditioning points C_{k-1} and C_k are located.

The second purpose is served during execution of the statements no. SITBB 568 through SITBB 597. Subroutine FLUX is called at the stage SITBB 570 for computing values of various fluxes at the sublevel corresponding to the C_{k-1} -st conditioning point. Then an entry is made in the subroutine SUBSTK for storing values of $\underline{g}_{C_{k-1}}$ vectors in the location designated AMOMT. The DO LOOP 800 (SITBB 573 - SITBB 590) is for evaluating $\underline{g}_j$ vectors [Eq. (46)] for all sublevels located between the conditioning points C_{k-1} and C_k (subroutine SUBSTL, SITBB 586).*

After obtaining $\underline{g}_j$ vectors for a given sublevel intermediate between

*Footnote is on page 68.

the conditioning points C_{k-1} and C_k , fluxes at that sublevel are computed during execution of the statement no. SITBB 587. After a call to the subroutine SUBSTK(SITBB 588), we have values of $\underline{g}_j$ vectors for two consecutive sublevels in locations designated AMOMT and BMOMT. We can therefore compute the multiple-scattering contribution to the outgoing radiation due to the scattering mass between these two sublevels, by calling the subroutine SUBSTM.

The last two sections of the program (SITBB 606 - SITBB 635, and SITBB 636 - SITBB 657) are used for generating the flux and intensity outputs described in §2.4. After this, the control is unconditionally

(Footnote from pg. 67)

*For evaluation of $\underline{g}_j$ vectors between two consecutive conditioning points, we require values of π_{j-1} and $D_{j-1,j}^{-1}$ matrices for all intermediate sublayers. However, if two consecutive sublayers are part of the same basic layer, their optical properties, and hence their π_{j-1} and $D_{j-1,j}^{-1}$ matrices are exactly the same. (Because of this, values of these matrices stored on the disk are for the topmost sublayers of all basic layers, only.) Thus, values of these matrices are to be read in for the first value (LMIN) of the index L of the DO LOOP 800, or alternately, if the current sublayer has different optical properties from the preceding one. This objective is accomplished through the part of the program contained between statements no. SITBB 575 through SITBB 585.

transferred to the statement no. SITBB 187 for starting computations for the next wavelength, but for the same atmospheric model.

V. REFERENCES

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VI. LISTING OF THE FORTRAN STATEMENTS

6.1 Program SITAA: (See page 72.)

C		SITAA 1
C	PROGRAM FOR COMPUTING THE INTEGRAL	SITAA 2
C	EXP(-TAU/MU) * P SUB L OF MU * DMU OVER THE RANGE 0.0 TO 1.0	SITAA 3
C	AFTER DIVIDING THE RANGE AT ZERO-POSITIONS OF P SUB L,	SITAA 4
C	AND THEN INTEGRATING OVER EACH INTERVAL USING SIMPSON'S RULE..	SITAA 5
C		SITAA 6
	REAL * 8 TAU(501),ZPL(52),AMU(501),DMU(500),FNPL(501),SUM(501),	SITAA 7
	1 TEMA,TEMB,TEMC,TEME,TEMF,CONA,DATE,HOUR,FNEX(501),	SITAA 8
	2 COKA(100),COKB(100),COKC(100),RAMU(501)	SITAA 9
	REAL * 4 BUM(501)	SITAA 10
	INTEGER * 4 ILIM(52)	SITAA 11
15	FORMAT (I5)	SITAA 12
20	FORMAT (5F10.7,16X,I4)	SITAA 13
30	FORMAT (I1//T20,'INTEGRAL EXP(-TAU/MU) * P SUB',I5,T56,	SITAA 14
	1 'OF MU * DMU FOR TAU EQUAL TO'/)	SITAA 15
40	FORMAT (/T4,'TAU',T15,'0.00',T27,'0.01',T39,'0.02',T51,'0.03',	SITAA 16
	1 T63,'0.04',T75,'0.05',T87,'0.06',T99,'0.07',T111,'0.08',T123,	SITAA 17
	2 '0.09'/)	SITAA 18
50	FORMAT (OPF7.3,1P10D12.4)	SITAA 19
55	FORMAT (OPF7.3,1P10D12.4)	SITAA 20
70	FORMAT (/T20,'PROGRAM TERMINATED AS L AND LC ARE = ',2I5//)	SITAA 21
80	FORMAT (/T3,'COMPLETED L = ',I5,T25,'VIRTUAL & REAL TIME IN SECS.'	SITAA 22
	1 ,2F9.2//)	SITAA 23
	DEFINE FILE 15 (101,2004,L,IPT)	SITAA 24
	IR = 1	SITAA 25
	IW = 8	SITAA 26
	READ (IR,15) L	SITAA 27
	DO 95 N = 1,501	SITAA 28
	TAU(N) = (N-1) * 1.0D-02	SITAA 29
	SUM(N) = 0.000	SITAA 30
	BUM(N) = 0.0	SITAA 31
95	CONTINUE	SITAA 32
	DO 98 J = 1,100	SITAA 33
	COKA(J) = 2*J - 1	SITAA 34
	COKB(J) = J - 1	SITAA 35
	COKC(J) = 1.0D0/J	SITAA 36
98	CONTINUE	SITAA 37
	CONA = 1.0D0/3.0D0	SITAA 38
100	CONTINUE	SITAA 39
	CALL TIMDAT (DATE,HOUR,ITVB,ITRB)	SITAA 40
	NZPL = (L/2) + 1	SITAA 41
	ZPL(1) = 0.0D0	SITAA 42
	IF (NZPL .EQ. 1) GO TO 120	SITAA 43
	DO 110 I = 2,NZPL,5	SITAA 44
	READ (IR,20,END=1000) ZPL(I),ZPL(I+1),ZPL(I+2),ZPL(I+3),	SITAA 45
	1 ZPL(I+4),LC	SITAA 46
	IF (LC .EQ. L) GO TO 110	SITAA 47
	WRITE (IW,70) L,LC	SITAA 48
	GO TO 1000	SITAA 49
110	CONTINUE	SITAA 50
120	CONTINUE	SITAA 51
	ZPL(NZPL+1) = 1.0D0	SITAA 52
	NSUB = 500/NZPL	SITAA 53
	NS = (NSUB/2) * 2	SITAA 54
	IF (NS .NE. NSUB) NSUB = NSUB - 1	SITAA 55

AMU(1) = 0.000	SITAA 56
I1 = 1	SITAA 57
ILIM(1) = 1	SITAA 58
TEME = 1.000/NSUB	SITAA 59
DO 160 K = 1,NZPL	SITAA 60
TEMA = (ZPL(K+1) - ZPL(K)) * TEME	SITAA 61
I2 = I1 + NSUB - 1	SITAA 62
ILIM(K+1) = I2 + 1	SITAA 63
DO 150 I = I1,I2	SITAA 64
DMU(I) = TEMA	SITAA 65
AMU(I+1) = AMU(I) + TEMA	SITAA 66
RAMU(I+1) = DEXP(-1.00-02/AMU(I+1))	SITAA 67
150 CONTINUE	SITAA 68
I1 = I2 + 1	SITAA 69
160 CONTINUE	SITAA 70
IMAX = I1	SITAA 71
IF (L .GT. 0) GO TO 170	SITAA 72
DO 165 I = 1,IMAX	SITAA 73
FNPL(I) = 1.000	SITAA 74
165 CONTINUE	SITAA 75
GO TO 200	SITAA 76
170 IF (L .GT. 1) GO TO 180	SITAA 77
DO 175 I = 1,IMAX	SITAA 78
FNPL(I) = AMU(I)	SITAA 79
175 CONTINUE	SITAA 80
GO TO 200	SITAA 81
180 CONTINUE	SITAA 82
DO 198 I = 1,IMAX	SITAA 83
TEMA = 1.000	SITAA 84
TEMB = AMU(I)	SITAA 85
DO 195 J = 2,L	SITAA 86
TEMC = (COKA(J) * AMU(I) * TEMB - COKB(J) * TEMA) * COKC(J)	SITAA 87
TEMA = TEMB	SITAA 88
TEMB = TEMC	SITAA 89
195 CONTINUE	SITAA 90
FNPL(I) = TEMC	SITAA 91
198 CONTINUE	SITAA 92
200 CONTINUE	SITAA 93
DO 210 I = 1,IMAX	SITAA 94
FNEX(I) = 1.000	SITAA 95
210 CONTINUE	SITAA 96
DO 400 N = 1,501	SITAA 97
IF (N .EQ. 1) GO TO 240	SITAA 98
FNEX(1) = 0.000	SITAA 99
DO 230 I = 2,IMAX	SITAA100
FNEX(I) = FNEX(I) * RAMU(I)	SITAA101
IF (FNEX(I) .LT. 1.00-60) FNEX(I) = 0.000	SITAA102
230 CONTINUE	SITAA103
240 CONTINUE	SITAA104
SUM(N) = 0.000	SITAA105
DO 300 J = 1,NZPL	SITAA106
I1 = ILIM(J)	SITAA107
I2 = ILIM(J+1)	SITAA108
TEMB = DMU(I1)*CONA	SITAA109
TEMA = FNEX(I1) * FNPL(I1) + FNEX(I2) * FNPL(I2)	SITAA110

I1 = I1 + 1	SITAA111
TEME = 0.000	SITAA112
DO 260 I = I1,I2,2	SITAA113
TEME = TEME + FNEX(I) * FNPL(I)	SITAA114
260 CONTINUE	SITAA115
I1 = I1 + 1	SITAA116
I2 = I2 - 1	SITAA117
TEMF = 0.000	SITAA118
DO 280 I = I1,I2,2	SITAA119
TEMF = TEMF + FNEX(I) * FNPL(I)	SITAA120
280 CONTINUE	SITAA121
SUM(N) = SUM(N) + TEMB * (TEMA + 4.000 * TEME + 2.000 * TEMF)	SITAA122
300 CONTINUE	SITAA123
BUM(N) = SUM(N)	SITAA124
400 CONTINUE	SITAA125
LK = L + 1	SITAA126
WRITE (15,LK) BUM	SITAA127
CALL TIMDAT (DATE, HOUR, ITVE, ITRE)	SITAA128
TIMV = (ITVE - ITVB) * 0.001	SITAA129
TIMR = (ITRE - ITPB) * 0.001	SITAA130
WRITE (6,80) L, TIMV, TIMR	SITAA131
L = L + 1	SITAA132
GO TO 100	SITAA133
1000 CONTINUE	SITAA134
LMX = L	SITAA135
DO 600 L = 1, LMX	SITAA136
READ (15,L) BUM	SITAA137
LI = L - 1	SITAA138
WRITE (IW,30) LI	SITAA139
WRITE (IW,40)	SITAA140
DO 500 I = 1, 500, 10	SITAA141
WRITE (IW,50) TAU(I), (BUM(I+J-1), J=1,10)	SITAA142
500 CONTINUE	SITAA143
WRITE (IW,55) TAU(501), BUM(501)	SITAA144
600 CONTINUE	SITAA145
RETURN	SITAA146
END	SITAA147

6.2 Subroutines called by SITBB: (See page 76.)

C	SUBROUTINE BCMAT(GMAT,AL,AR)	BCMAT	1
C		BCMAT	2
C	PROGRAM FOR COMPUTING ALL ELEMENTS OF THE 50 BY 50 BOUNDARY	BCMAT	3
C	CONDITION MATRIX,G,,,, AND ELEMENTS OF THE BIDIAGONAL MATRIX A..	BCMAT	4
C		BCMAT	5
	REAL * 4 GMAT(50,50),AL(100),AR(100)	BCMAT	6
	TEMA = -0.5	BCMAT	7
	DO 110 J = 1,50	BCMAT	8
	L = J - 1	BCMAT	9
	GMAT(1,J) = TEMA	BCMAT	10
	DO 100 I = 2,50	BCMAT	11
	II = I - 1	BCMAT	12
	TEMB = (-2*L + 2*II - 1) * (L + II) * (2*II + 1)	BCMAT	13
	TEMC = 2 * II * (2*L - 2*II - 1) * (L + II + 1)	BCMAT	14
	GMAT(I,J) = (TEMB * GMAT(II,J))/TEMC	BCMAT	15
100	CONTINUE	BCMAT	16
	TEMB = (3 - 2*J) * (1 + 4*J)	BCMAT	17
	TEMC = (2*J + 2) * (4*J - 3)	BCMAT	18
	TEMA = (TEMA * TEMB)/TEMC	BCMAT	19
110	CONTINUE	BCMAT	20
	DO 120 I = 1,100	BCMAT	21
	TEMA = 1.0/(2*I - 1)	BCMAT	22
	AL(I) = TEMA * (I - 1)	BCMAT	23
	AR(I) = TEMA * I	BCMAT	24
120	CONTINUE	BCMAT	25
	RETURN	BCMAT	26
	END	BCMAT	27
	SUBROUTINE FLUX (AMUD,ATEN,VECL1,FXS,FXU,FXD,FXN,NTR,L,ISW)	FLUX	1
C		FLUX	2
C	SUBROUTINE FOR COMPUTING UPWARD AND DOWNWARD DIFFUSE	FLUX	3
C	FLUXES AT A GIVEN LEVEL FROM VALUES OF THE MOMENTS....	FLUX	4
C		FLUX	5
	REAL * 4 VECL1(100,11),AMUD(10),ATEN(301,10),FXS(301,11),	FLUX	6
	1 FXD(301,11),FXU(301,11),FXN(301,11)	FLUX	7
	INTEGER * 4 ISW(11)	FLUX	8
	DATA CONA /-6.283185/, CONB /-3.141593/	FLUX	9
	NTR2 = NTR/2	FLUX	10
	I1 = NTR2 + 1	FLUX	11
	DO 150 N = 1,11	FLUX	12
	IF (ISW(N) .EQ. 0) GO TO 120	FLUX	13
	FXU(L,N) = 0.0	FLUX	14
	FXD(L,N) = 0.0	FLUX	15
	GO TO 150	FLUX	16
120	CONTINUE	FLUX	17
	TEMA = -0.25 * VECL1(1,N) + 0.5 * VECL1(I1,N)	FLUX	18
	TEMB = 0.25 * VECL1(1,N) + 0.5 * VECL1(I1,N)	FLUX	19
	TEMC = 0.5	FLUX	20
	DO 130 J = 2,NTR2	FLUX	21
	J1 = (J-1) * 2	FLUX	22
	TEMC = ((3 - J1) * TEMC) / (J1 + 2)	FLUX	23
	TEMD = (J1 + 0.5) * TEMC * VECL1(J,N)	FLUX	24
	TEMA = TEMA - TEMD	FLUX	25
	TEMB = TEMB + TEMD	FLUX	26
130	CONTINUE	FLUX	27
	FXD(L,N) = CONA * TEMA	FLUX	28

	FXU(L,N) = 6.283185 * TEMB	FLUX 29
150	CONTINUE	FLUX 30
	DO 160 N = 1,10	FLUX 31
	FXS(L,N) = CONB * AMUO(N) * ATEN(L,N)	FLUX 32
160	CONTINUE	FLUX 33
	DO 170 N = 1,10	FLUX 34
	FXN(L,N) = FXS(L,N) + FXD(L,N) - FXU(L,N)	FLUX 35
170	CONTINUE	FLUX 36
	FXN(L,11) = FXS(L,11) + FXU(L,11) - FXD(L,11)	FLUX 37
	RETURN	FLUX 38
	END	FLUX 39
	SUBROUTINE LEGFUN (THETO,AMUO,FNYN,THETA,AMU,FNYP)	LEGFN 1
C		LEGFN 2
C	PROGRAM FOR COMPUTING LEGENDRE POLYNOMIALS FOR 28 (10 NEGATIVE,	LEGFN 3
C	AND 18 POSITIVE) DIFFERENT VALUES OF THEIR ARGUMENTS, MU...	LEGFN 4
C		LEGFN 5
	REAL * 4 THETO(10),AMUO(10),FNYN(300,10),THETA(18),AMU(18),	LEGFN 6
	1 FNYP(300,18)	LEGFN 7
	REAL * 8 DHETO(10),TEMA,TEMB,TEMC,TEMD,TEMX,TEME,COKA(300),	LEGFN 8
	1 COKB(300),COKC(300)	LEGFN 9
	DATA DHETO /0.000,45.000,60.000,70.000,75.600,79.600,82.500,	LEGFN 10
	1 84.700,86.700,90.000/	LEGFN 11
	TEMD = 3.1415926535897932/180.000	LEGFN 12
	TEME = 1.0/TEMD	LEGFN 13
	COKA(1) = -1.000	LEGFN 14
	COKB(1) = -1.000	LEGFN 15
	COKC(1) = 0.000	LEGFN 16
	DO 120 K = 2,300	LEGFN 17
	COKA(K) = 2*K - 3	LEGFN 18
	COKB(K) = K - 2	LEGFN 19
	COKC(K) = 1.000/(K-1)	LEGFN 20
120	CONTINUE	LEGFN 21
	DO 150 I = 1,10	LEGFN 22
	THETO(I) = DHETO(I)	LEGFN 23
	TEMA = 1.000	LEGFN 24
	TEMB = -DCOS(TEMD * DHETO(I))	LEGFN 25
	IF (DHETO(I) .EQ. 90.000) TEMB = 0.000	LEGFN 26
	AMUO(I) = TEMB	LEGFN 27
	FNYN(1,I) = TEMA	LEGFN 28
	FNYN(2,I) = TEMB	LEGFN 29
	TEMX = TEMB	LEGFN 30
	DO 130 K = 3,300	LEGFN 31
	TEMC = (COKA(K) * TEMX * TEMB - COKB(K) * TEMA)*COKC(K)	LEGFN 32
	TEMA = TEMB	LEGFN 33
	TEMB = TEMC	LEGFN 34
	FNYN(K,I) = TEMC	LEGFN 35
130	CONTINUE	LEGFN 36
150	CONTINUE	LEGFN 37
	DO 200 I = 1,18	LEGFN 38
	TEMA = 1.000	LEGFN 39
	TEMB = (7326.000/6371.000) * DSIN (TEMD * 3.000 * (I-1))	LEGFN 40
C		LEGFN 41
C	7326 = 6371 + 955 = RAD. OF EARTH + HEIGHT OF THE SATELLITE..	LEGFN 42
C		LEGFN 43
	TEMB = DSQRT(1.000 - TEMB * TEMB)	LEGFN 44

AMU(I) = TEMB	LEGFN 45
THETA(I) = TEME * DARCOS(TEMB)	LEGFN 46
FNYP(1,I) = TEMA	LEGFN 47
FNYP(2,I) = TEMB	LEGFN 48
TEMX = TEMB	LEGFN 49
DO 180 K = 3,300	LEGFN 50
TEMC = (COKA(K) * TEMX * TEMB - COKB(K) * TEMA) * COKC(K)	LEGFN 51
TFMA = TEMB	LEGFN 52
TEMB = TEMC	LEGFN 53
FNYP(K,I) = TEMC	LEGFN 54
180 CONTINUE	LEGFN 55
200 CONTINUE	LEGFN 56
RETURN	LEGFN 57
END	LEGFN 58
SUBROUTINE PITRIX (AL,AM,AR,PIMAT,TEM,DINV,X,B,IP,LIMU,NMX)	PITRX 1
C	PITRX 2
C SUBROUTINE FOR OBTAINING VALUES OF THE ELEMENTS OF THE PI MATRIX	PITRX 3
C STARTING WITH ELEMENTS AL AND AR OF THE BIDIAGONAL MATRIX A,	PITRX 4
C AND ELEMENTS AM OF THE DIAGONAL MATRIX C..	PITRX 5
C N.B. : THE SCALAR FACTOR 0.5 * DELTA TAU IS TO BE INCLUDED	PITRX 6
C IN AM BEFORE CALLING THIS SUBROUTINE...	PITRX 7
C	PITRX 8
C THIS PROGRAM ALSO RETURNS VALUES OF THE ELEMENTS OF THE	PITRX 9
C INVERSE OF THE MATRIX D SUB I,I+1.....	PITRX 10
C	PITRX 11
REAL * 4 AL(100),AM(100),AR(100),PIMAT(100,100),TEM(100,100),	PITRX 12
1 B(100),X(100)	PITRX 13
REAL * 4 DINV(100,100)	PITRX 14
INTEGER * 4 IP(100),LIMU(100)	PITRX 15
10 FORMAT (/T10,'UPPER LIMIT OF THE DO LOOP IS LOWER THAN ITS LOWER LIMIT. PROGRAM TERMINATED. I AND LIMU(I) ARE =',2I5//)	PITRX 16
20 FORMAT (/T10,'ALL ELEMENTS IN ROW NUMBER',I5,T45,'ARE ZEROS. PROGRAM TERMINATED.')	PITRX 17
30 FORMAT (/T10,'ZERO PIVOT FOR COLUMN NUMBER',I5,T47,'. PROGRAM TERMINATED.')	PITRX 18
C	PITRX 19
C DECOMPOSE A MATRIX (GAUSSIAN ELIMINATION WITH PIVOTING)	PITRX 20
C IN L * U FORM. CHAPTERS 9 & 11 OF COMPUTER SOLUTION OF LINEAR	PITRX 21
C ALGEBRAIC SYSTEMS BY G. FORSYTHE AND C.B. MOLER,	PITRX 22
C PRENTICE - HALL, 1967..	PITRX 23
C	PITRX 24
IW = 6	PITRX 25
NMX1 = NMX - 1	PITRX 26
DO 110 J = 1,NMX	PITRX 27
DO 105 I = 1,NMX	PITRX 28
TEM(I,J) = 0.0	PITRX 29
105 CONTINUE	PITRX 30
110 CONTINUE	PITRX 31
DO 115 I = 1,NMX	PITRX 32
IP(I) = I	PITRX 33
TEM(I,I) = AM(I)	PITRX 34
115 CONTINUE	PITRX 35
DO 120 I = 2,NMX	PITRX 36
I1 = I - 1	PITRX 37
TEM(I,I1) = AL(I)	PITRX 38
	PITRX 39
	PITRX 40
	PITRX 41

120 CONTINUE	PITRX 42
DO 125 I = 1,NMX1	PITRX 43
I1 = I + 1	PITRX 44
TEM(I,I1) = AR(I)	PITRX 45
125 CONTINUE	PITRX 46
X(1) = AMAX1(ABS(TEM(1,1)),ABS(TEM(1,2)))	PITRX 47
X(NMX) = AMAX1(ABS(TEM(NMX,NMX1)),ABS(TEM(NMX,NMX)))	PITRX 48
DO 130 I = 2,NMX1	PITRX 49
I1 = I - 1	PITRX 50
I2 = I + 1	PITRX 51
X(I) = AMAX1(ABS(TEM(I,I1)),ABS(TEM(I,I2)))	PITRX 52
X(I) = AMAX1(X(I),ABS(TEM(I,I2)))	PITRX 53
130 CONTINUE	PITRX 54
DO 140 I = 1,NMX	PITRX 55
IF (X(I) .NE. 0.0) GO TO 135	PITRX 56
WRITE (IW,20) I	PITRX 57
CALL EXIT	PITRX 58
135 X(I) = 1.0/X(I)	PITRX 59
140 CONTINUE	PITRX 60
DO 180 K = 1,NMX1	PITRX 61
TEMA = 0.0	PITRX 62
K1 = K + 1	PITRX 63
DO 150 I = K,K1	PITRX 64
IS = IP(I)	PITRX 65
TEMB = TEM(IS,K) * X(IS)	PITRX 66
TEMB = ABS(TEMB)	PITRX 67
IF (TEMB .LE. TEMA) GO TO 150	PITRX 68
TEMA = TEMB	PITRX 69
IDX = I	PITRX 70
150 CONTINUE	PITRX 71
IF (TEMA .NE. 0.0) GO TO 155	PITRX 72
WRITE (IW,30) K	PITRX 73
CALL EXIT	PITRX 74
155 CONTINUE	PITRX 75
IF (IDX .EQ. K) GO TO 160	PITRX 76
J = IP(K)	PITRX 77
IP(K) = IP(IDX)	PITRX 78
IP(IDX) = J	PITRX 79
160 CONTINUE	PITRX 80
KP = IP(K)	PITRX 81
TEMA = 1.0/TEM(KP,K)	PITRX 82
K2 = K + 2	PITRX 83
IF (K2 .GT. NMX) K2 = NMX	PITRX 84
DO 175 I = K1,K2	PITRX 85
IS = IP(I)	PITRX 86
TEM(IS,K) = TEM(IS,K) * TEMA	PITRX 87
K3 = K + 3	PITRX 88
IF (K3 .GT. NMX) K3 = NMX	PITRX 89
DO 170 J = K1,K3	PITRX 90
TEM(IS,J) = TEM(IS,J) - TEM(IS,K) * TEM(KP,J)	PITRX 91
170 CONTINUE	PITRX 92
175 CONTINUE	PITRX 93
180 CONTINUE	PITRX 94
IS = IP(NMX)	PITRX 95
IF (TEM(IS,NMX) .NE. 0.0) GO TO 190	PITRX 96

WRITE (IW,30) NMX	PITRX 97
CALL EXIT	PITRX 98
190 CONTINUE	PITRX 99
DO 210 I = 1,NMX	PITRX100
IF (IP(I) .GE. 1) GO TO 205	PITRX101
LIMU(I) = IP(I) - 1	PITRX102
GO TO 208	PITRX103
205 LIMU(I) = I - 1	PITRX104
208 CONTINUE	PITRX105
IF (LIMU(I) .LE. 0) LIMU(I) = 1	PITRX106
210 CONTINUE	PITRX107
DO 220 I = 1,NMX	PITRX108
B(I) = 0.0	PITRX109
220 CONTINUE	PITRX110
DO 400 ISOL = 1,NMX	PITRX111
IF (ISOL .NE. 1) B(ISOL-1) = 0.0	PITRX112
B(ISOL) = 1.0	PITRX113
C	PITRX114
C SOLVE THE LINEAR SYSTEM OF EQUATIONS (A * X = B) BY USING	PITRX115
C THE L * U DECOMPOSITION OF THE A MATRIX...	PITRX116
C	PITRX117
C COMPUTE U * X = (INVERSE OF L) * B = X TEMPORARY..	PITRX118
C NOTE THAT THE L MATRIX IS A BIDIAGONAL ONE WITH ALL ELEMENTS	PITRX119
C ALONG ITS MAIN DIAGONAL EQUAL TO UNITY...	PITRX120
C	PITRX121
C COMPUTE U * X = (INVERSE OF L) * B = X TEMPORARY..	PITRX122
C	PITRX123
X(I) = B(IP(I))	PITRX124
DO 260 I = 2,NMX	PITRX125
IS = IP(I)	PITRX126
I1 = LIMU(I)	PITRX127
I2 = I - 1	PITRX128
X(I) = B(IS)	PITRX129
IF (I2 - I1) 225,230,250	PITRX130
225 WRITE (IW,10) I,LIMU(I)	PITRX131
CALL EXIT	PITRX132
230 X(I) = X(I) - TEM(IS,I1) * X(I1)	PITRX133
GO TO 260	PITRX134
250 CONTINUE	PITRX135
DO 255 J = I1,I2	PITRX136
X(I) = X(I) - TEM(IS,J) * X(J)	PITRX137
255 CONTINUE	PITRX138
260 CONTINUE	PITRX139
IS = IP(NMX)	PITRX140
X(NMX) = X(NMX)/TEM(IS,NMX)	PITRX141
C	PITRX142
C COMPUTE X = (INVERSE OF U) * X TEMPORARY...	PITRX143
C	PITRX144
II = NMX - 1	PITRX145
IS = IP(II)	PITRX146
X(II) = (X(II) - TEM(IS,NMX)*X(NMX))/TEM(IS,II)	PITRX147
DO 280 I = 3,NMX	PITRX148
II = NMX + 1 - I	PITRX149
IS = IP(II)	PITRX150
I1 = II + 1	PITRX151

	I2 = I1 + 1	PITRX152
	X(I1) = (X(I1) - TEM(IS,I1)*X(I1) - TEM(IS,I2)*X(I2))/TEM(IS,I1)	PITRX153
280	CONTINUE	PITRX154
	DO 300 J = 1,NMX	PITRX155
	PIMAT(J,ISOL) = X(J)	PITRX156
300	CONTINUE	PITRX157
400	CONTINUE	PITRX158
C		PITRX159
C	PIMAT NOW CONTAINS INVERSE OF THE MATRIX S SUB I,I+1.....	PITRX160
C		PITRX161
C	RE-ARRANGE ROWS OF PIMAT TO GENERATE INVERSE OF THE MATRIX	PITRX162
C	D SUB I,I+1...	PITRX163
C		PITRX164
	NMX2 = NMX/2	PITRX165
	DO 440 I = 1,NMX2	PITRX166
	I2 = 2*I - 1	PITRX167
	DO 420 J = 1,NMX	PITRX168
	DINV(I,J) = PIMAT(I2,J)	PITRX169
420	CONTINUE	PITRX170
440	CONTINUE	PITRX171
	DO 480 I = 1,NMX2	PITRX172
	I1 = 2 * I	PITRX173
	I2 = NMX2 + I	PITRX174
	DO 460 J = 1,NMX	PITRX175
	DINV(I2,J) = PIMAT(I1,J)	PITRX176
460	CONTINUE	PITRX177
480	CONTINUE	PITRX178
C		PITRX179
C	COMPUTE THE MATRIX (-I + 2 * INVERSE OF S SUB I,I+1 * A).....	PITRX180
C		PITRX181
	DO 540 J = 1,NMX	PITRX182
	TEM(J,1) = 2.0 * PIMAT(J,2) * AL(2)	PITRX183
	DO 520 K = 2,NMX1	PITRX184
	K1 = K - 1	PITRX185
	K2 = K + 1	PITRX186
	TEM(J,K) = 2.0 * (PIMAT(J,K1) * AR(K1) + PIMAT(J,K2) * AL(K2))	PITRX187
520	CONTINUE	PITRX188
	TEM(J,NMX) = 2.0 * PIMAT(J,NMX1) * AR(NMX1)	PITRX189
540	CONTINUE	PITRX190
	DO 550 I = 1,NMX	PITRX191
	TEM(I,I) = -1.0 + TEM(I,I)	PITRX192
550	CONTINUE	PITRX193
C		PITRX194
C	RE-ARRANGE BY ROWS AND THEN BY COLUMNS TO GENERATE PI MATRIX....	PITRX195
C		PITRX196
	DO 560 J = 1,NMX2	PITRX197
	J1 = J * 2 - 1	PITRX198
	DO 555 I = 1,NMX	PITRX199
	PIMAT(I,J1) = TEM(I,J)	PITRX200
555	CONTINUE	PITRX201
560	CONTINUE	PITRX202
	DO 570 J = 1,NMX2	PITRX203
	J1 = NMX2 + J	PITRX204
	J2 = J * 2	PITRX205
	DO 565 I = 1,NMX	PITRX206

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PIMAT(I,J1) = TEM(I,J2)
565 CONTINUE
570 CONTINUE
DO 580 I = 1,NMX2
  I1 = I * 2 - 1
DO 575 J = 1,NMX
  TEM(I,J) = PIMAT(I1,J)
575 CONTINUE
580 CONTINUE
DO 590 I = 1,NMX2
  I1 = NMX2 + I
  I2 = I * 2
DO 585 J = 1,NMX
  TEM(I1,J) = PIMAT(I2,J)
585 CONTINUE
590 CONTINUE
DO 600 I = 1,NMX
DO 595 J = 1,NMX
  PIMAT(I,J) = TEM(I,J)
595 CONTINUE
600 CONTINUE
RETURN
END
SUBROUTINE POLATE (YTAB,X,Y)

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C
C   SUBROUTINE FOR OBTAINING A LINEARLY INTERPOLATED
C   VALUE (Y) OF A FUNCTION AT A POINT X, WHEN ITS TABULATED
C   VALUES (YTAB) ARE AVAILABLE AT 0.01 INTERVAL IN X STARTING
C   WITH X = 0.00....
C

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REAL * 4 YTAB(1)
N = 100.0 * X + 1
N1 = N + 1
XN = 0.01 * (N-1)
Y = YTAB(N) + (100.0 * (X - XN) * (YTAB(N1) - YTAB(N)))
RETURN
END
SUBROUTINE SLPTH (AMUO,DELS)

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C
C   COMPUTATIONS OF THE LENGTH OF ONE KM VERTICAL PATHS IN A
C   SPHERICAL ATMOSPHERE ALONG VARIOUS DIRECTIONS, AND
C   AT VARIOUS POINTS IN THE ATMOSPHERE....
C

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REAL * 4 DELS(32,10,32),H(33),AMUO(10),AMUOSQ(10),RDH(33)
DATA H /70.0,60.0,50.0,45.0,40.0,35.0,30.0,25.0,24.0,23.0,22.0,
1 21.0,20.0,19.0,18.0,17.0,16.0,15.0,14.0,13.0,12.0,11.0,10.0,
2 9.0,8.0,7.0,6.0,5.0,4.0,3.0,2.0,1.0,0.0/
DATA RAD /6371.0/
DO 130 L = 1,32
  PDH(L) = 1.0/(H(L) - H(L+1))
DO 120 J = 1,10
DO 110 K = 1,32
  DELS(K,J,L) = 0.0
110 CONTINUE
120 CONTINUE

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PITRX207
PITRX208
PITRX209
PITRX210
PITRX211
PITRX212
PITRX213
PITRX214
PITRX215
PITRX216
PITRX217
PITRX218
PITRX219
PITRX220
PITRX221
PITRX222
PITRX223
PITRX224
PITRX225
PITRX226
PITRX227
PITRX228
PITRX229
POLAT 1
POLAT 2
POLAT 3
POLAT 4
POLAT 5
POLAT 6
POLAT 7
POLAT 8
POLAT 9
POLAT 10
POLAT 11
POLAT 12
POLAT 13
POLAT 14
SLPTH 1
SLPTH 2
SLPTH 3
SLPTH 4
SLPTH 5
SLPTH 6
SLPTH 7
SLPTH 8
SLPTH 9
SLPTH 10
SLPTH 11
SLPTH 12
SLPTH 13
SLPTH 14
SLPTH 15
SLPTH 16
SLPTH 17
SLPTH 18

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130	CONTINUE	SLPTH 19
	DO 140 J = 1,10	SLPTH 20
	AMUO(J) = -AMUO(J)	SLPTH 21
	AMUOSQ(J) = AMUO(J) * AMUO(J)	SLPTH 22
140	CONTINUE	SLPTH 23
	RAD2 = 2.0 * RAD	SLPTH 24
	DO 200 KK = 1,32	SLPTH 25
	K = KK + 1	SLPTH 26
	DO 190 J = 1,10	SLPTH 27
	TEMX = (RAD + H(K)) * (RAD + H(K)) * AMUOSQ(J)	SLPTH 28
	TEMY = (RAD + H(K)) * AMUO(J)	SLPTH 29
	TEMA = TEMX + (H(1) - H(K)) * (RAD2 + H(K) + H(1))	SLPTH 30
	TEMA = SQRT(TEMA) - TEMY	SLPTH 31
	DO 180 L = 2,K	SLPTH 32
	L1 = L - 1	SLPTH 33
	TEMB = TEMX + (H(L) - H(K)) * (RAD2 + H(K) + H(L))	SLPTH 34
	TEMB = SQRT(TEMB) - TEMY	SLPTH 35
	DELS(L1,J,KK) = TEMA - TEMB	SLPTH 36
	TEMA = TEMB	SLPTH 37
190	CONTINUE	SLPTH 38
190	CONTINUE	SLPTH 39
200	CONTINUE	SLPTH 40
	DO 203 K = 1,32	SLPTH 41
	DO 202 J = 1,10	SLPTH 42
	DO 201 L = 1,K	SLPTH 43
	DELS(L,J,K) = DELS(L,J,K) * RDH(L)	SLPTH 44
201	CONTINUE	SLPTH 45
202	CONTINUE	SLPTH 46
203	CONTINUE	SLPTH 47
	RETURN	SLPTH 48
	END	SLPTH 49
	SUBROUTINE SOLISY (NCASE,A,AINV,TEM,X,B,IP,NMX,ITR,RESID,DELX)	SOLIS 1
C		SOLIS 2
C	NCASE = 1 : OBTAIN AN INVERSE OF MATRIX A IN LOCATION	SOLIS 3
C	REPRESENTED BY AINV...	SOLIS 4
C		SOLIS 5
C	NCASE = 2 : SOLVE THE LINEAR SYSTEM OF EQUATIONS A * X = B WHERE	SOLIS 6
C	A IS AN NMX BY NMX SQUARE MATRIX AND, X AND B	SOLIS 7
C	ARE VECTORS WITH NMX ELEMENTS.	SOLIS 8
C		SOLIS 9
C	ITR (+) : NUMBER OF ITERATIONS REQUIRED TO OBTAIN THE DESIRED	SOLIS 10
C	CONVERGENCE OF THE SOLUTION...	SOLIS 11
C	ITR (-) : ABSOLUTE VALUE OF ITR GIVES THE NUMBER OF DIGITS	SOLIS 12
C	TO WHICH THE FIRST TWO SETS OF X AGREE. NEGATIVE VALUES	SOLIS 13
C	OF ITR ARE RETURNED ONLY WHEN THE INPUT MATRIX	SOLIS 14
C	IS TOO ILL-CONDITIONED TO ATTEMPT ANY CONVERGENCE..	SOLIS 15
C	ITR = 0 : ITERATIONS DID NOT CONVERGE....	SOLIS 16
C		SOLIS 17
	REAL * 4 A(100,100),AINV(100,100),TEM(100,100),B(100),X(100),	SOLIS 18
	RESID(100),DELX(100)	SOLIS 19
	INTEGER * 4 IP(100)	SOLIS 20
	REAL * 8 AUL,BUL	SOLIS 21
20	FORMAT (/T10,'ALL ELEMENTS IN ROW NUMBER',I5,T45,'ARE ZEROS. PROGR	SOLIS 22
	1AM TERMINATED.'/)	SOLIS 23
30	FORMAT (/T10,'ZERO PIVOT FOR COLUMN NUMBER',I5,T47,'. PROGRAM TERMS	SOLIS 24

	11NATED.'//)	SOLIS 25
	40 FORMAT (/T10,'A SOLUTION OF A*X=B SYSTEM GIVES A ZERO VALUE FOR ALL	SOLIS 26
	11 COMPONENTS OF VECTOR X. PROGRAM TERMINATED.'//)	SOLIS 27
C		SOLIS 28
C	DECOMPOSE A MATRIX (GAUSSIAN ELIMINATION WITH PIVOTING)	SOLIS 29
C	IN L * U FORM. CHAPTERS 9 & 11 OF COMPUTER SOLUTION OF LINEAR	SOLIS 30
C	ALGEBRAIC SYSTEMS BY G. FORSYTHE AND C.B. MOLER,	SOLIS 31
C	PRENTICE - HALL, 1967..	SOLIS 32
C		SOLIS 33
	IW = 6	SOLIS 34
	DO 130 I = 1,NMX	SOLIS 35
	X(I) = 0.0	SOLIS 36
	IP(I) = I	SOLIS 37
	DO 120 J = 1,NMX	SOLIS 38
	TEM(I,J) = A(I,J)	SOLIS 39
	X(I) = AMAX1(X(I),ABS(TEM(I,J)))	SOLIS 40
120	CONTINUE	SOLIS 41
	IF (X(I) .NE. 0.0) GO TO 125	SOLIS 42
	WRITE (IW,20) I	SOLIS 43
	CALL EXIT	SOLIS 44
125	X(I) = 1.0/X(I)	SOLIS 45
130	CONTINUE	SOLIS 46
	NMX1 = NMX - 1	SOLIS 47
	DO 180 K = 1,NMX1	SOLIS 48
	TEMA = 0.0	SOLIS 49
	DO 150 I = K,NMX	SOLIS 50
	IS = IP(I)	SOLIS 51
	TEMB = TEM(IS,K) * X(IS)	SOLIS 52
	TEMB = ABS(TEMB)	SOLIS 53
	IF (TEMB .LE. TEMA) GO TO 150	SOLIS 54
	TEMA = TEMB	SOLIS 55
	IDX = I	SOLIS 56
150	CONTINUE	SOLIS 57
	IF (TEMA .NE. 0.0) GO TO 155	SOLIS 58
	WRITE (IW,30) K	SOLIS 59
	CALL EXIT	SOLIS 60
155	CONTINUE	SOLIS 61
	IF (IDX .EQ. K) GO TO 160	SOLIS 62
	J = IP(K)	SOLIS 63
	IP(K) = IP(IDX)	SOLIS 64
	IP(IDX) = J	SOLIS 65
160	CONTINUE	SOLIS 66
	KP = IP(K)	SOLIS 67
	TEMA = 1.0/TEM(KP,K)	SOLIS 68
	KP1 = K + 1	SOLIS 69
	DO 175 I = KP1,NMX	SOLIS 70
	IS = IP(I)	SOLIS 71
	TEM(IS,K) = TEM(IS,K) * TEMA	SOLIS 72
	DO 170 J = KP1,NMX	SOLIS 73
	TEM(IS,J) = TEM(IS,J) - TEM(IS,K) * TEM(KP,J)	SOLIS 74
170	CONTINUE	SOLIS 75
175	CONTINUE	SOLIS 76
180	CONTINUE	SOLIS 77
	IS = IP(NMX)	SOLIS 78
	IF (TEM(IS,NMX) .NE. 0.0) GO TO 190	SOLIS 79

WRITE (IW,30) NMX	SOLIS 80
CALL EXIT	SOLIS 81
190 CONTINUE	SOLIS 82
IF (NCASE .EQ. 1) GO TO 200	SOLIS 83
ISOL = NMX	SOLIS 84
GO TO 240	SOLIS 85
200 CONTINUE	SOLIS 86
DO 220 I = 1,NMX	SOLIS 87
B(I) = 0.0	SOLIS 88
220 CONTINUE	SOLIS 89
DO 1000 ISOL = 1,NMX	SOLIS 90
IF (ISOL .NE. 1) B(ISOL-1) = 0.0	SOLIS 91
B(ISOL) = 1.0	SOLIS 92
240 CONTINUE	SOLIS 93
CALL SOLVE (TEM,X,B,IP,NMX)	SOLIS 94
C	SOLIS 95
C IMPROVE THE SOLUTION X BY FOLLOWING THE PROCEDURE OUTLINED	SOLIS 96
C IN CHAPTER 13 OF FORSYTHE AND MOLER..	SOLIS 97
C	SOLIS 98
C THE QUANTITIES MAXITR, IDIG, AND TEMC ARE MACHINE DEPENDENT.	SOLIS 99
C THEIR VALUES AS GIVEN BELOW ARE FOR SINGLE PRECISION WORK ON	SOLIS100
C SYSTEMS 360 AND 370...	SOLIS101
C	SOLIS102
MAXITR = 15	SOLIS103
IDIG = 7	SOLIS104
TEMC = 1.0E-06	SOLIS105
TEMA = 0.0	SOLIS106
DO 250 I = 1,NMX	SOLIS107
TEMA = AMAX1(TEMA,ABS(X(I)))	SOLIS108
250 CONTINUE	SOLIS109
IF (TEMA .NE. 0.0) GO TO 260	SOLIS110
WRITE (IW,40)	SOLIS111
CALL EXIT	SOLIS112
260 CONTINUE	SOLIS113
DO 400 ITR =1,MAXITR	SOLIS114
DO 300 I = 1,NMX	SOLIS115
AUL = B(I)	SOLIS116
DO 290 J = 1,NMX	SOLIS117
BUL = X(J)	SOLIS118
AUL = AUL - A(I,J) * BUL	SOLIS119
290 CONTINUE	SOLIS120
RESID(I) = AUL	SOLIS121
300 CONTINUE	SOLIS122
CALL SOLVE (TEM,DELX,RESID,IP,NMX)	SOLIS123
TEMB = 0.0	SOLIS124
DO 320 I = 1,NMX	SOLIS125
TEMB = AMAX1(TEMB,ABS(DELX(I)))	SOLIS126
X(I) = X(I) + DELX(I)	SOLIS127
320 CONTINUE	SOLIS128
IF (ITR .NE. 1) GO TO 370	SOLIS129
II = -ALOG10(ABS(TEMB/TEMA))	SOLIS130
IDIG = MIN0(II,IDIG)	SOLIS131
IF (IDIG .LE. 3) GO TO 410	SOLIS132
370 CONTINUE	SOLIS133
IF (TEMB .LE. TEMA*TEMC) GO TO 450	SOLIS134

400	CONTINUE	SOLIS135
	GO TO 420	SOLIS136
410	ITR = -IDIG	SOLIS137
	RETURN	SOLIS138
420	ITR = 0	SOLIS139
	RETURN	SOLIS140
450	CONTINUE	SOLIS141
	IF (.NCASE .EQ. 2) RETURN	SOLIS142
	DO 480 J = 1,NMX	SOLIS143
	AINV(J,ISOL) = X(J)	SOLIS144
480	CONTINUE	SOLIS145
	IF (ISOL .EQ. 1) JVD = ITR	SOLIS146
	IF (ISOL .GT. 1) JVD = MAX0(JVD,ITR)	SOLIS147
1000	CONTINUE	SOLIS148
	ITR = JVD	SOLIS149
	RETURN	SOLIS150
	END	SOLIS151
	SUBROUTINE SOLVE (TEM,X,B,IP,NMX)	SOLVE 1
C		SOLVE 2
C	THIS SUBROUTINE IS CALLED BY THE SUBROUTINE SOLISY. L * U	SOLVE 3
C	MATRIX IS IN THE LOCATION TEM..	SOLVE 4.
C		SOLVE 5
C	SOLVE THE LINEAR SYSTEM OF EQUATIONS (A * X = B) BY USING	SOLVE 6
C	THE L * U DECOMPOSITION OF A MATRIX OBTAINED EARLIER..	SOLVE 7
C		SOLVE 8
C	COMPUTE U * X = (INVERSE OF L) * B = X TEMPORARY..	SOLVE 9
C		SOLVE 10
	REAL * 4 TEM(100,100),X(100),B(100)	SOLVE 11
	INTEGER * 4 IP(100)	SOLVE 12
	X(1) = B(IP(1))	SOLVE 13
	DO 260 I = 2,NMX	SOLVE 14
	IS = IP(I)	SOLVE 15
	IM = I - 1	SOLVE 16
	X(I) = B(IS)	SOLVE 17
	DO 250 J = 1,IM	SOLVE 18
	X(I) = X(I) - TEM(IS,J) * X(J)	SOLVE 19
250	CONTINUE	SOLVE 20
260	CONTINUE	SOLVE 21
	IS = IP(NMX)	SOLVE 22
	X(NMX) = X(NMX)/TEM(IS,NMX)	SOLVE 23
C		SOLVE 24
C	COMPUTE X = (INVERSE OF U) * X TEMPORARY..	SOLVE 25
C		SOLVE 26
	DO 280 I = 2,NMX	SOLVE 27
	II = NMX + 1 - I	SOLVE 28
	IS = IP(II)	SOLVE 29
	IP1 = II + 1	SOLVE 30
	DO 270 J = IP1,NMX	SOLVE 31
	X(II) = X(II) - TEM(IS,J) * X(J)	SOLVE 32
270	CONTINUE	SOLVE 33
	X(II) = X(II)/TEM(IS,II)	SOLVE 34
280	CONTINUE	SOLVE 35
	RETURN	SOLVE 36
	END	SOLVE 37
	SUBROUTINE SUBSTA (OMEGR,COFAR,OMEGST,COFAS,OMEGTP,COFAT,	SUBTA 1

C	1 MXNLYR,NTR,DTAUH,ATEN,FNYN,CAPLAM,CAPLX,CAPLY)	SUBTA 2
C	SUBROUTINE FOR COMPUTING CAPITAL LAMDA SUB K OF TAU SUB L	SUBTA 3
C	AND OTHER RELATED QUANTITIES.....	SUBTA 4
C		SUBTA 5
	REAL * 4 OMEGR(300),COFAR(3),OMEGST(300),COFAS(300),	SUBTA 6
	1 OMEGTP(300),COFAT(300),DTAUH(300),ATEN(301,10),FNYN(300,10),	SUBTA 7
	2 CAPLAM(100,300),CAPLX(100,300),CAPLY(100,300,11)	SUBTA 8
	DO 150 L = 1,MXNLYR	SUBTA 9
	DO 110 I = 1,3	SUBTA 10
	CAPLAM(I,L) = OMEGR(L) * COFAR(I) + OMEGST(L) * COFAS(I) +	SUBTA 11
	1 OMEGTP(L) * COFAT(I)	SUBTA 12
110	CONTINUE	SUBTA 13
	DO 130 I = 4,NTR	SUBTA 14
	CAPLAM(I,L) = OMEGST(L) * COFAS(I) + OMEGTP(L) * COFAT(I)	SUBTA 15
130	CONTINUE	SUBTA 16
150	CONTINUE	SUBTA 17
	DO 200 I = 1,NTR	SUBTA 18
	TEMA = 1.0/(2*I - 1)	SUBTA 19
	TEMB = 0.5 * TEM A	SUBTA 20
	DO 190 L = 1,MXNLYR	SUBTA 21
	L1 = L + 1	SUBTA 22
	CAPLX(I,L) = CAPLAM(I,L) * TEM A * DTAUH(L) - DTAUH(L)	SUBTA 23
	DO 170 N = 1,10	SUBTA 24
	CAPLY(I,L,N) = DTAUH(L) * (ATEN(L,N) + ATEN(L1,N)) *	SUBTA 25
	1 CAPLAM(I,L) * FNYN(I,N) * TEM B	SUBTA 26
170	CONTINUE	SUBTA 27
190	CONTINUE	SUBTA 28
200	CONTINUE	SUBTA 29
	RETURN	SUBTA 30
	END	SUBTA 31
	SUBROUTINE SUBSTB (AVECT,FMAT,GMAT,NTR,NTR2)	SUBTA 32
C		SUBTB 1
C	SUBROUTINE FOR INITIALIZING F SUB 1 MATRIX, AND A VECTORS...	SUBTB 2
C		SUBTB 3
	REAL * 4 AVECT(100,11),FMAT(100,50),GMAT(50,50)	SUBTB 4
	DO 150 J = 1,11	SUBTB 5
	DO 130 I = 1,NTR	SUBTB 6
	AVECT(I,J) = 0.0	SUBTB 7
130	CONTINUE	SUBTB 8
150	CONTINUE	SUBTB 9
	DO 200 J = 1,NTR2	SUBTB 10
	DO 170 I = 1,NTR2	SUBTB 11
	FMAT(I,J) = 0.0	SUBTB 12
	FMAT(NTR2+I,J) = -GMAT(I,J)	SUBTB 13
170	CONTINUE	SUBTB 14
200	CONTINUE	SUBTB 15
	DO 250 I = 1,NTR2	SUBTB 16
	FMAT(I,I) = 1.0	SUBTB 17
250	CONTINUE	SUBTB 18
	RETURN	SUBTB 19
	END	SUBTB 20
	SUBROUTINE SUBSTC (A,PIMAT,FMAT,DINV,CAPLY,AVECT,NTR,NTR2,L)	SUBTB 21
C		SUBTC 1
C	SUBROUTINE FOR COMPUTING F SUB J MATRIXES, AND A SUB J VECTORS.	SUBTC 2
C		SUBTC 3

C	REAL * 4 A(300),PIMAT(100,100),FMAT(100,50),DINV(100,100),	SUBTC 4
	1 CAPLY(100,300,11),AVECT(100,11)	SUBTC 5
	DO 200 J = 1,NTR2	SUBTC 6
	DO 150 I = 1,NTR	SUBTC 7
	A(I) = 0.0	SUBTC 8
	DO 120 K = 1,NTR	SUBTC 9
	A(I) = A(I) + PIMAT(I,K) * FMAT(K,J)	SUBTC 10
120	CONTINUE	SUBTC 11
150	CONTINUE	SUBTC 12
	DO 180 I = 1,NTR	SUBTC 13
	FMAT(I,J) = A(I)	SUBTC 14
180	CONTINUE	SUBTC 15
200	CONTINUE	SUBTC 16
	DO 400 N = 1,11	SUBTC 17
	DO 360 I = 1,NTR	SUBTC 18
	A(I) = 0.0	SUBTC 19
	DO 350 J = 1,NTR	SUBTC 20
	A(I) = A(I) + DINV(I,J) * CAPLY(J,L,N) +	SUBTC 21
	1 PIMAT(I,J) * AVECT(J,N)	SUBTC 22
350	CONTINUE	SUBTC 23
360	CONTINUE	SUBTC 24
	DO 370 I = 1,NTR	SUBTC 25
	AVECT(I,N) = A(I)	SUBTC 26
370	CONTINUE	SUBTC 27
400	CONTINUE	SUBTC 28
	RETURN	SUBTC 29
	END	SUBTC 30
	SUBROUTINE SUBSTD (CINV,FMAT,NTR2)	SUBTC 31
	REAL * 4 CINV(100,100),FMAT(100,50)	SUBTD 1
	DO 200 J = 1,NTR2	SUBTD 2
	DO 150 I = 1,NTR2	SUBTD 3
	CINV(I,J) = FMAT(I,J)	SUBTD 4
150	CONTINUE	SUBTD 5
200	CONTINUE	SUBTD 6
	RETURN	SUBTD 7
	END	SUBTD 8
	SUBROUTINE SUBSTE (TMAT,CIMAT,FMAT,UMAT,NTR2)	SUBTD 9
C		SUBTE 1
C	SUBROUTINE FOR COMPUTING THE U AND T MATRIXES....	SUBTE 2
C		SUBTE 3
	REAL * 4 TMAT(50,50),CIMAT(100,100),FMAT(100,50),UMAT(50,50)	SUBTE 4
	DO 200 I = 1,NTR2	SUBTE 5
	I1 = NTR2 + I	SUBTE 6
	DO 150 J = 1,NTR2	SUBTE 7
	TMAT(I,J) = CIMAT(I,J)	SUBTE 8
	TEMA = 0.0	SUBTE 9
	DO 130 K = 1,NTR2	SUBTE 10
	TEMA = TEMA + FMAT(I1,K) * CIMAT(K,J)	SUBTE 11
130	CONTINUE	SUBTE 12
	UMAT(I,J) = TEMA	SUBTE 13
150	CONTINUE	SUBTE 14
200	CONTINUE	SUBTE 15
	RETURN	SUBTE 16
	END	SUBTE 17
		SUBTE 18

C	SUBROUTINE SUBSTF (FMAT,UMAT,NTR2)	SUBTF 1
C	SUBROUTINE FOR INITIALIZING F SUB J MATRIX AFTER PERFORMING	SUBTF 2
C	A STABILIZING TRANSFORMATION.....	SUBTF 3
C		SUBTF 4
	REAL * 4 FMAT(100,50),UMAT(50,50)	SUBTF 5
	DO 200 J = 1,NTR2	SUBTF 6
	DO 150 I = 1,NTR2	SUBTF 7
	FMAT(I,J) = 0.0	SUBTF 8
	FMAT(NTR2+I,J) = UMAT(I,J)	SUBTF 9
150	CONTINUE	SUBTF 10
200	CONTINUE	SUBTF 11
	DO 250 I = 1,NTR2	SUBTF 12
	FMAT(I,I) = 1.0	SUBTF 13
250	CONTINUE	SUBTF 14
	RETURN	SUBTF 15
	END	SUBTF 16
	SUBROUTINE SUBSTG (TVECT,AVECT,UMAT,UVECT,NTR,NTR2,NTR21)	SUBTF 17
C		SUBTG 1
C	SUBROUTINE FOR SETTING UP U AND T VECTORS AFTER	SUBTG 2
C	PERFORMING A STABILIZING TRANSFORMATION....	SUBTG 3
C		SUBTG 4
	REAL * 4 TVECT(50,11),AVECT(100,11),UMAT(50,50),UVECT(50,11)	SUBTG 5
	DO 300 N = 1,11	SUBTG 6
	DO 150 I = 1,NTR2	SUBTG 7
	TVECT(I,N) = AVECT(I,N)	SUBTG 8
	TEMA = -AVECT(NTR2+I,N)	SUBTG 9
	DO 130 J = 1,NTR2	SUBTG 10
	TEMA = TEMA + UMAT(I,J) * AVECT(J,N)	SUBTG 11
130	CONTINUE	SUBTG 12
	UVECT(I,N) = TEMA	SUBTG 13
150	CONTINUE	SUBTG 14
	DO 230 I = 1,NTR2	SUBTG 15
	AVECT(I,N) = 0.0	SUBTG 16
230	CONTINUE	SUBTG 17
	DO 250 I = NTR21,NTR	SUBTG 18
	AVECT(I,N) = -UVECT(I-NTR2,N)	SUBTG 19
250	CONTINUE	SUBTG 20
300	CONTINUE	SUBTG 21
	RETURN	SUBTG 22
	END	SUBTG 23
	SUBROUTINE SUBSTH (DINV,UMAT,GMAT,NTR2)	SUBTG 24
	REAL * 4 DINV(100,100),UMAT(50,50),GMAT(50,50)	SUBTH 1
	DO 200 J = 1,NTR2	SUBTH 2
	DO 150 I = 1,NTR2	SUBTH 3
	DINV(I,J) = UMAT(I,J) - GMAT(I,J)	SUBTH 4
150	CONTINUE	SUBTH 5
200	CONTINUE	SUBTH 6
	RETURN	SUBTH 7
	END	SUBTH 8
	SUBROUTINE SUBSTI (N,VECL2,GMAT,NTR2)	SUBTH 9
	REAL * 4 VECL2(100,11),GMAT(50,50)	SUBTI 1
	DO 200 I = 1,NTR2	SUBTI 2
	TEMA = 0.0	SUBTI 3
	DO 150 J = 1,NTR2	SUBTI 4
		SUBTI 5

	TEMA = TEMA + GMAT(I,J) * VECL2(J,N)	SUBTI 6
150	CONTINUE	SUBTI 7
	VECL2(NTR2+I,N) = TEMA	SUBTI 8
200	CONTINUE	SUBTI 9
	RETURN	SUBTI 10
	END	SUBTI 11
	SUBROUTINE SUBSTJ (ISW,K1,NTR2,VECL1,VECL2,TVECT,AVECT,UVECT,	SUBTJ 1
	1 TMAT,UMAT,GMAT)	SUBTJ 2
C		SUBTJ 3
C	SUBROUTINE FOR COMPUTING L SUB K VECTORS...	SUBTJ 4
C		SUBTJ 5
	REAL * 4 VECL1(100,11),VECL2(100,11),TVECT(50,11),AVECT(100,11),	SUBTJ 6
	1 UVECT(50,11),TMAT(50,50),UMAT(50,50),GMAT(50,50)	SUBTJ 7
	INTEGER * 4 ISW(11)	SUBTJ 8
	DO 700 N = 1,11	SUBTJ 9
	IF (ISW(N) .NE. 0) GO TO 700	SUBTJ 10
	DO 630 I = 1,NTR2	SUBTJ 11
	TEMA = 0.0	SUBTJ 12
	DO 620 J = 1,NTR2	SUBTJ 13
	TEMA = TEMA + TMAT(I,J) * (VECL2(J,N) - TVECT(J,N))	SUBTJ 14
620	CONTINUE	SUBTJ 15
	VECL1(I,N) = TEMA	SUBTJ 16
	AVECT(I,N) = TEMA	SUBTJ 17
630	CONTINUE	SUBTJ 18
	IF (K1 .EQ. 0) GO TO 665	SUBTJ 19
	DO 650 I = 1,NTR2	SUBTJ 20
	TEMA = -UVECT(I,N)	SUBTJ 21
	DO 640 J = 1,NTR2	SUBTJ 22
	TEMA = TEMA + UMAT(I,J) * VECL1(J,N)	SUBTJ 23
640	CONTINUE	SUBTJ 24
	AVECT(NTR2+I,N) = TEMA	SUBTJ 25
650	CONTINUE	SUBTJ 26
	GO TO 700	SUBTJ 27
665	CONTINUE	SUBTJ 28
	DO 680 I = 1,NTR2	SUBTJ 29
	TEMA = 0.0	SUBTJ 30
	DO 670 J = 1,NTR2	SUBTJ 31
	TEMA = TEMA - GMAT(I,J) * VECL1(J,N)	SUBTJ 32
670	CONTINUE	SUBTJ 33
	AVECT(NTR2+I,N) = TEMA	SUBTJ 34
690	CONTINUE	SUBTJ 35
700	CONTINUE	SUBTJ 36
	RETURN	SUBTJ 37
	END	SUBTJ 38
	SUBROUTINE SUBSTK (AMOMT,AVECT,NTR,NTR2)	SUBTK 1
C		SUBTK 2
C	SUBROUTINE FOR RE-ARRANGING LEGENDRE MOMENTS OF THE	SUBTK 3
C	INTENSITY COMPONENT.....	SUBTK 4
C		SUBTK 5
	REAL * 4 AMOMT(100,11),AVECT(100,11)	SUBTK 6
	DO 200 N = 1,11	SUBTK 7
	DO 140 I = 1,NTR2	SUBTK 8
	AMOMT(2*I-1,N) = AVECT(I,N)	SUBTK 9
140	CONTINUE	SUBTK 10
	NTR21 = NTR2 + 1	SUBTK 11

	DO 180 I = NTR21,NTR	SUBTK 12
	AMOMT(2*I-NTR,N) = AVECT(I,N)	SUBTK 13
130	CONTINUE	SUBTK 14
230	CONTINUE	SUBTK 15
	RETURN	SUBTK 16
	END	SUBTK 17
	SUBROUTINE SUBSTL (B,DINV,CAPLY,PIMAT,AVECT,NTR,L1)	SUBTL 1
	REAL * 4 B(300),DINV(100,100),CAPLY(100,300,11),PIMAT(100,100),	SUBTL 2
	1 AVECT(100,11)	SUBTL 3
	DO 780 N = 1,11	SUBTL 4
	DO 770 I = 1,NTR	SUBTL 5
	B(I) = 0.0	SUBTL 6
	DO 760 J = 1,NTR	SUBTL 7
	B(I) = B(I) + DINV(I,J) * CAPLY(J,L1,N) + PIMAT(I,J) * AVECT(J,N)	SUBTL 8
760	CONTINUE	SUBTL 9
770	CONTINUE	SUBTL 10
	DO 775 I = 1,NTR	SUBTL 11
	AVECT(I,N) = B(I)	SUBTL 12
775	CONTINUE	SUBTL 13
780	CONTINUE	SUBTL 14
	RETURN	SUBTL 15
	END	SUBTL 16
	SUBROUTINE SUBSTM(CAPLAM,BTEN,AMOMT,BMOMT,FNYP,DTAUH,EIN,NTR,L,L1)	SUBTM 1
C		SUBTM 2
C	SUBROUTINE FOR COMPUTING MULTIPLE-SCATTERING CONTRIBUTION	SUBTM 3
C	TO THE SCATTERED RADIATION.....	SUBTM 4
C		SUBTM 5
	REAL * 4 CAPLAM(100,300),BTEN(301,18),AMOMT(100,11),BMOMT(100,11),	SUBTM 6
	1 FNYP(300,18),DTAUH(300),EIN(18,11)	SUBTM 7
	TEMB = 0.5 * DTAUH(L1)	SUBTM 8
	DO 798 N = 1,11	SUBTM 9
	DO 792 J = 1,18	SUBTM 10
	TEMA = 0.0	SUBTM 11
	DO 785 I = 1,NTR	SUBTM 12
	TEMA = TEMA + CAPLAM(I,L1) * (BTEN(L1,J) * AMOMT(I,N) +	SUBTM 13
	1 BTEN(L,J) * BMOMT(I,N)) * FNYP(I,J) * TEMB	SUBTM 14
785	CONTINUE	SUBTM 15
	EIN(J,N) = EIN(J,N) + TEMA	SUBTM 16
792	CONTINUE	SUBTM 17
	DO 795 I = 1,NTR	SUBTM 18
	AMOMT(I,N) = BMOMT(I,N)	SUBTM 19
795	CONTINUE	SUBTM 20
798	CONTINUE	SUBTM 21
	RETURN	SUBTM 22
	END	SUBTM 23

6.3 Program SITBB: (See page 93.)

C		SITBB 1
C	PROGRAM FOR COMPUTING THE 0-TH FOURIER COMPONENT OF THE	SITBB 2
C	INTENSITY OF THE SCATTERED RADIATION EMERGING AT THE TOP	SITBB 3
C	OF A NONHOMOGENEOUS ATMOSPHERIC MODEL WITH ARBITRARY VERTICAL	SITBB 4
C	DISTRIBUTIONS OF OZONE AND STRATOSPHERIC AS WELL AS TROPOSPHERIC	SITBB 5
C	AEROSOLS, AND RESTING ON A LAMBERT GROUND.....	SITBB 6
C		SITBB 7
C	THIS PARTICULAR PROGRAM IS BASED ON THE USE OF THE SPHERICAL	SITBB 8
C	HARMONICS METHOD IN CONJUNCTION WITH PERFORMING OF THE	SITBB 9
C	STABILIZING TRANSFORMATIONS AT ANYWHERE FROM TWO TO	SITBB 10
C	ONE HUNDRED AND ONE CONDITIONING POINTS....	SITBB 11
C		SITBB 12
C	IN THIS PROGRAM, WE FOLLOW CHANDRASEKHAR'S CONVENTION ,I.E.,	SITBB 13
C	DOWNWARD DIRECTION IS REPRESENTED BY -MU.....	SITBB 14
C		SITBB 15
	DATA XBLNK /' /	SITBB 16
	REAL * 4 GTH(32),PKTH(32),OZOTH(32),STDUST(32),TPDUST(32)	SITBB 17
	REAL * 8 DATE,HOUR	SITBB 18
	REAL * 4 THETO(10),AMUN(10),A(300),B(300),C(300),D(300),TAU(301),	SITBB 19
	1 TITB(14),COFAS(300),COFAT(300),DTAU(300),THETA(18),AMU(18)	SITBB 20
	REAL * 4 AL(100),AR(100),GMAT(50,50),ATEN(301,10),DELS(32,10,32)	SITBB 21
	REAL * 4 UMAT(50,50),TMAT(50,50),TVECT(50,11),UVECT(50,11)	SITBB 22
	REAL * 4 FMAT(100,50),AVECT(100,11),BTEN(301,18)	SITBB 23
	REAL * 4 PIMAT(100,100),TEM(100,100),DINV(100,100)	SITBB 24
	REAL * 4 CINV(100,100),CIMAT(100,100)	SITBB 25
	REAL * 4 VECL1(100,11),VECL2(100,11)	SITBB 26
	REAL * 4 FNYP(300,18),FNYN(300,10),EIN(18,11),COFAR(3)	SITBB 27
	REAL * 4 OMEGR(300),OMEGST(300),OMEGTP(300),DTAUH(300),AJVD(501),	SITBB 28
	1 CAPLX(100,300),BREKA(100,50),BREKB(100,50)	SITBB 29
	REAL * 4 BREKC(100,50),BREKD(100,50),FXS(301,11),FXD(301,11),	SITBB 30
	1 FXU(301,11),FXN(301,11),CAPLY(100,300,11)	SITBB 31
	REAL * 4 AMOMT(100,11),BMOMT(100,11),EIC(18,10,6),TIC(18,10,6),	SITBB 32
	1 SSRPR(6),CAPLAM(100,300)	SITBB 33
	EQUIVALENCE (BREKA(1,1),PIMAT(1,1)),(BREKB(1,1),PIMAT(1,51))	SITBB 34
	EQUIVALENCE (BREKC(1,1),DINV(1,1)),(BREKD(1,1),DINV(1,51))	SITBB 35
	DATA COFAR /1.0,0.0,0.5/	SITBB 36
	INTEGER * 4 IP(100),LIMU(100),ISW(11),ICPOS(101),ICCHK(300)	SITBB 37
	INTEGER * 4 INEW(33),IPITE(300)	SITBB 38
	4 FORMAT (//T10,'PROGRAM TERMINATED AS THE INPUT MODEL CONTAINS	SITBB 39
	1 MORE THAN 32 BASIC LAYERS. NBLR = ',I5//T10,'OR NMOD IS NOT SET.	SITBB 40
	2 NMOD = ',I5//)	SITBB 41
	5 FORMAT (//T10,'PROGRAM TERMINATED AS THE NUMBER OF CONDITIONING POI	SITBB 42
	INTS IS OUTSIDE THE RANGE OF THE DIMENSION STATEMENTS.'//T20,	SITBB 43
	2 ' INPUT PARAMETER NUMCON = ',I5/)	SITBB 44
	6 FORMAT (//T10,'PROGRAM TERMINATED AS THE AEROSOL MODEL REQUIRES	SITBB 45
	1 MORE THAN 300 LEGENDRE COEFFICIENTS. NMX = ',I5//)	SITBB 46
	10 FORMAT (1H1)	SITBB 47
	12 FORMAT (2I10)	SITBB 48
	15 FORMAT (I5,OP2F10.2,OPF10.5,1P2E11.2)	SITBB 49
	17 FORMAT (2F10.5)	SITBB 50
	19 FORMAT (I5,3F10.4)	SITBB 51
	21 FORMAT (OP3F10.5,I5,1P2E15.5,3A4)	SITBB 52
	23 FORMAT (1P5E13.5,I5)	SITBB 53
	24 FORMAT (//T10,'PROGRAM TERMINATED AS WAVELENGTHS ON THE MAIN CARD,	SITBB 54
	1 AND ON THE COEFF CARDS ARE UNEQUAL.'//T10,'ALDA AND BLDA = ',	SITBB 55

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2 2F10.5//)
25 FORMAT (//T10,'PROGRAM TERMINATED AS THE LEGENDRE COEFFICIENT CARDSITBB 57
15 ARE NOT IN ORDER FOR THE STRATOSPHERIC AEROSOL CASE. LL AND LM ASITBB 58
2RF RESPECTIVELY = ',215//)
26 FORMAT (//T10,'PROGRAM TERMINATED AS THE LEGENDRE COEFFICIENT CARDSITBB 60
15 ARE NOT IN ORDER FOR THE TROPOSPHERIC AEROSOL CASE. LL AND LM SITBB 61
2 ARE RESPECTIVELY = ',215//)
28 FORMAT (1H1/T6,'LAYER',T22,'GEOMETRIC',T43,'PRESSURE',T66,'OZONE',SITBB 63
1 T78,'STRATOSPHERIC',T99,'TROPOSPHERIC'/T5,'NUMBER', SITBB 64
2 T22,'THICKNESS',T42,'THICKNESS',T65,'AMOUNT',T79,'DUST CONTENT', SITBB 65
3 T99,'DUST CONTENT'//)
30 FORMAT (110,OP2F20.2,OPF20.5,1P2E20.2)
32 FORMAT (////T30,'ATMOSPHERIC MODEL NUMBER : ',15//T10,
1 'SURFACE PRESSURE (MB) : ',F10.2,T55,'TOTAL OZONE AMOUNT (ATM-CM)SITBB 69
2 : ',F10.3////T40,'DUST DATA'//T9,'TYPE OF', SITBB 70
3 T24,'SIZE DISTRIBUTION',T48,'PART OF REFRACTIVE INDEX', SITBB 71
4 T86,'TOTAL'/T8,'AEROSOLS',T30,'FUNCTION',T52,'REAL', SITBB 72
5 T62,'IMAGINARY',T85,'AMOUNT'//)
34 FORMAT (1/T4,'TROPOSPHERIC',9X,3A4,4X,OP2F15.3,1P1E20.2)
36 FORMAT (1/T4,'STRATOSPHERIC',8X,3A4,4X,OP2F15.3,1P1E20.2)
38 FORMAT (1H1/T10,'LEGENDRE COEFFICIENTS REPRESENTING PHASE FUNCTIONSITBB 76
1 FOR THE STRATOSPHERIC AEROSOL AT WAVELENGTH OF',F10.5//T4,'L', SITBB 77
2 T13,'L',T25,'L+1',T37,'L+2',T49,'L+3',T61,'L+4',T73,'L+5', SITBB 78
3 T85,'L+6',T97,'L+7',T109,'L+8',T121,'L+9'//)
40 FORMAT (15,1P10E12.4)
42 FORMAT (1H1/T10,'LEGENDRE COEFFICIENTS REPRESENTING PHASE FUNCTIONSITBB 81
1 FOR THE TROPOSPHERIC AEROSOL AT WAVELENGTH OF',F10.5//T4,'L', SITBB 82
2 T13,'L',T25,'L+1',T37,'L+2',T49,'L+3',T61,'L+4',T73,'L+5', SITBB 83
3 T85,'L+6',T97,'L+7',T109,'L+8',T121,'L+9'//)
44 FORMAT (1H1/T20,'VARIOUS NORMAL OPTICAL THICKNESSES OF THE ENTIRE SITBB 85
1 ATMOSPHERIC MODEL : ',15//T20,'FOR THE INCIDENT RADIATION OF SITBB 86
2 WAVELENGTH : ',F10.5//)
3 T30,'RAYLEIGH SCATTERING : ',F10.5// SITBB 88
4 T30,'OZONE ABSORPTION : ',F10.5// SITBB 89
5 T30,'STRATOSPHERIC AEROSOL SCATTERING : ',F10.5// SITBB 90
6 T30,'STRATOSPHERIC AEROSOL ABSORPTION : ',F10.5// SITBB 91
7 T30,'TROPOSPHERIC AEROSOL SCATTERING : ',F10.5// SITBB 92
8 T30,'TROPOSPHERIC AEROSOL ABSORPTION : ',F10.5// SITBB 93
9 T30,'TOTAL : ',F10.5) SITBB 94
45 FORMAT (//T10,'PROGRAM TERMINATED AS TOTAL NORMAL OPTICAL THICKNESSITBB 95
15 OF THE MODEL IS GREATER THAN 5.0. IT IS = ',F10.5//) SITBB 96
47 FORMAT (//T10,'PROGRAM TERMINATED AS THE MODEL HAS TO BE DIVIDED SITBB 97
1 INTO MORE THAN 300 LAYERS.'//) SITBB 98
49 FORMAT (//T10,'THIS SET OF COMPUTATIONS IS DONE WITH',110,T65, SITBB 99
1 'NUMBER OF TERMS.'//) SITBB100
51 FORMAT (//T10,'CONDITIONING POINT',15,T40,'IS AT THE OPTICAL DEPTH'SITBB101
1 ,F10.5,T80,' GIVEN BY THE LEVEL NUMBER',15) SITBB102
53 FORMAT (//T10,'THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER', SITBB103
1 15,T70,'ITERATIONS FOR THE CONDITIONING POINT NUMBER',15) SITBB104
55 FORMAT (//T10,'LINEAR SYSTEM SOLVED FOR THETA SUB ZERO = ',F10.2, SITBB105
1 T70,'AFTER',15,T85,'NUMBER OF ITERATIONS.') SITBB106
57 FORMAT (//T10,'LINEAR SYSTEM SOLVED FOR THE ISOTROPIC CASE', SITBB107
1 T70,'AFTER',15,T85,'NUMBER OF ITERATIONS.') SITBB108
61 FORMAT (////T15,'MODEL : ',15,T40,'WAVELENGTH : ',F10.4, SITBB109
1 T85,'THETA SUB ZERO : ',F10.2//) SITBB110

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63	FORMAT (///T15,'MODEL : ',I5,T40,'WAVELENGTH : ',F10.4,	SIT8B111
1	T85,'ISOTROPIC GROUND ILLUMINATION FROM BELOW.'//)	SIT8B112
65	FORMAT (/T2,'LAY.',T13,'DIRECT',T27,'DIFFUSE',T41,'DIFFUSE',	SIT8B113
1	T56,'NET',T68,'LAY.',T77,'DIRECT',T90,'DIFFUSE',T104,'DIFFUSE',	SIT8B114
2	T119,'NET'/T2,'NUM.',T13,'FLUX',T27,'DOWNWARD',T41,'UPWARD',	SIT8B115
3	T56,'FLUX',T68,'NUM.',T77,'FLUX',T90,'DOWNWARD',T104,'UPWARD',	SIT8B116
4	T119,'FLUX'//)	SIT8B117
67	FORMAT (I5,1P4E14.4,4X,I5,1P4E14.4)	SIT8B118
69	FORMAT (I5,1P4E14.4)	SIT8B119
71	FORMAT (///T10,'SBAR = ',F10.5)	SIT8B120
73	FORMAT (1H1/T25,'MODEL NUMBER : ',I5,T75,'WAVELENGTH : ',	SIT8B121
1	F10.4//)	SIT8B122
75	FORMAT (T16,'0-TH FOURIER COMPONENT OF INTENSITY OF THE RADIATION	SIT8B123
1	EMERGENT AT THE TOP (R = 0.0) FOR THETA SUB ZERO = '/T2,	SIT8B124
2	'THETA',T10,'AMU',10F11.2//)	SIT8B125
77	FORMAT (OPF5.1,OPF7.3,1P10E11.3)	SIT8B126
79	FORMAT (///T22,'CONTRIBUTION (MULTIPLIED BY (1-R*SBAR)/R) DUE TO	SIT8B127
1	ISOTROPIC ILLUMINATION FROM BELOW.'//)	SIT8B128
95	FORMAT (/T5,' MODEL : ',I5,T30,'WAVELENGTH : ',F10.4,	SIT8B129
1	//T5,'VIRTUAL AND REAL TIME IN SECS. = ',2F10.2//)	SIT8B130
C		SIT8B131
C	FILE 11 : U MATRIX...	SIT8B132
C	FILE 12 : T MATRIX...	SIT8B133
C	FILE 13 : T VECTOR...	SIT8B134
C	FILE 14 : U VECTOR...	SIT8B135
C	FILE 15 : INTEGRALS REQUIRED FOR THE GROUND REFLECTION PART...	SIT8B136
C	FILE 16 : OUTPUT OF I SUB ZERO AT THE TOP FOR 18 MUS AND 6 LAMDA	SIT8B137
C	AND OTHER RELATED INFORMATION FOR A LFUTURE USE...	SIT8B138
C	FILE 17 : PI AND DINV MATRIXES FOR ALL BASIC LAYERS...	SIT8B139
C		SIT8B140
	DEFINE FILE 11 (101,10000,L,IPA)	SIT8B141
	DEFINE FILE 12 (101,10000,L,IPB)	SIT8B142
	DEFINE FILE 13 (101,2200,L,IPC)	SIT8B143
	DEFINE FILE 14 (101,2200,L,IPD)	SIT8B144
	DEFINE FILE 15 (101,2004,L,IPE)	SIT8B145
	DEFINE FILE 16 (200,8720,L,IPF)	SIT8B146
	DEFINE FILE 17 (128,20000,L,IPG)	SIT8B147
	IR = 1	SIT8B148
	IW = 8	SIT8B149
C		SIT8B150
C	READ IN AND PRINT OUT ATMOSPHERIC PARAMETERS...	SIT8B151
C		SIT8B152
	READ (IR,12) NMCD,NBLVR	SIT8B153
	IF (NBLVR .LE. 32 .AND. NMCD .GT. 0) GO TO 101	SIT8B154
	WRITE (IW,4) NBLVR,NMCD	SIT8B155
	GO TO 1000	SIT8B156
101	READ (IR,15) (II,GTH(I),PRTH(I),OZOTH(I),STOUST(I),TPDOUST(I),I=1,	SIT8B157
1	NBLVR)	SIT8B158
	READ (IR,17) TEMA,TEMB	SIT8B159
	DO 102 I = 1,NBLVR	SIT8B160
	STOUST(I) = TEMA * STOUST(I)	SIT8B161
	TPDOUST(I) = TEMA * TPDUST(I)	SIT8B162
102	CONTINUE	SIT8B163
	TITB(1) = 0.0	SIT8B164
	TITB(2) = 0.0	SIT8B165

TITB(3) = 0.0	SITB8166
TITB(4) = 0.0	SITB8167
DO 104 I = 1,NBLYR	SITB8168
TITB(1) = TITB(1) + PRTH(I)	SITB8169
TITB(2) = TITB(2) + OZOTH(I)	SITB8170
TITB(3) = TITB(3) + STDUST(I)	SITB8171
TITB(4) = TITB(4) + TPDUST(I)	SITB8172
104 CONTINUE	SITB8173
WRITE (IW,28)	SITB8174
WRITE (IW,30) (I,GTH(I),PRTH(I),OZOTH(I),STDUST(I),TPDUST(I),	SITB8175
1 I = 1,NBLYR)	SITB8176
	SITB8177
COMPUTE MODEL - INDEPENDENT QUANTITIES BY CALLING	SITB8178
VARIOUS SUBROUTINES.....	SITB8179
	SITB8180
CALL LEGFUN (THETO,AMUG,FNYP,THETA,AMU,FNYP)	SITB8181
CALL BCMAT (GMAT,AL,AR)	SITB8182
CALL SLPTH (AMUC,DELS)	SITB8183
	SITB8184
READ IN AND PRINT OUT OPTICAL PARAMETERS FOR THE INPUT LAMDA...	SITB8185
	SITB8186
108 CONTINUE	SITB8187
CALL TIMDAT (DATE,HOUR,ITVB,ITRB)	SITB8188
READ (IR,19,END=1000) ILDA,ALDA,TAUBSR,OZABS	SITB8189
IF (TITB(3) .GT. 0.0) GO TO 110	SITB8190
TITB(5) = 1.0	SITB8191
TITB(6) = 0.0	SITB8192
TITB(9) = XBLNK	SITB8193
TITB(10) = XBLNK	SITB8194
TITB(11) = XBLNK	SITB8195
NMXST = 0	SITB8196
BSCAST = 0.0	SITB8197
BABSST = 0.0	SITB8198
DO 109 I = 1,300	SITB8199
COFAS(I) = 0.0	SITB8200
109 CONTINUE	SITB8201
GO TO 118	SITB8202
110 CONTINUE	SITB8203
READ (IR,21) BLDA,TITB(5),TITB(6),NMXST,BSCAST,BABSST,TITB(9),	SITB8204
1 TITB(10),TITB(11)	SITB8205
IF (NMXST .LE. 300) GO TO 111	SITB8206
WRITE (IW,6) NMXST	SITB8207
GO TO 1000	SITB8208
111 IF (ABS(ALDA - BLDA) .LE. 0.001) GO TO 112	SITB8209
WRITE (IW,24) ALDA,BLDA	SITB8210
GO TO 1000	SITB8211
112 LL = 1	SITB8212
DO 115 L = 1,NMXST,5	SITB8213
READ (IR,23) COFAS(L),COFAS(L+1),COFAS(L+2),COFAS(L+3),	SITB8214
1 COFAS(L+4),LM	SITB8215
IF (LL .EQ. LM) GO TO 113	SITB8216
WRITE (IW,25) LL,LM	SITB8217
GO TO 1000	SITB8218
113 LL = LL + 5	SITB8219
115 CONTINUE	SITB8220

118	IF (TITB(4) .GT. 0.0) GO TO 120	SIT88221
	TITB(7) = 1.0	SIT88222
	TITB(9) = 0.0	SIT88223
	TITB(12) = XBLNK	SIT88224
	TITB(13) = XBLNK	SIT88225
	TITB(14) = XBLNK	SIT88226
	NMXTP = 0	SIT88227
	BSCATP = 0.0	SIT88228
	BABSTP = 0.0	SIT88229
	DO 119 I = 1,300	SIT88230
	COFAT(I) = 0.0	SIT88231
119	CONTINUE	SIT88232
	GO TO 130	SIT88233
120	CONTINUE	SIT88234
	READ (IR,21) BLDA,TITB(7),TITB(8),NMXTP,BSCATP,BABSTP,TITB(12),	SIT88235
	1 TITB(13),TITB(14)	SIT88236
	IF (NMXTP .LE. 300) GO TO 121	SIT88237
	WRITE (IW,6) NMXTP	SIT88238
	GO TO 1000	SIT88239
121	IF (ABS(ALDA - BLDA) .LE. 0.001) GO TO 122	SIT88240
	WRITE (IW,24) ALDA,BLDA	SIT88241
	GO TO 1000	SIT88242
122	LL = 1	SIT88243
	DO 130 L = 1,NMXTP,5	SIT88244
	READ (IR,23) COFAT(L),COFAT(L+1),COFAT(L+2),COFAT(L+3),	SIT88245
	1 COFAT(L+4),LM	SIT88246
	IF (LL .EQ. LM) GO TO 125	SIT88247
	WRITE (IW,26) LL,LM	SIT88248
	GO TO 1000	SIT88249
125	LL = LL + 5	SIT88250
130	CONTINUE	SIT88251
	IF (TITB(3) .LE. 0.0) GO TO 135	SIT88252
	WRITE (IW,38) ALDA	SIT88253
	DO 132 L = 1,NMXST,10	SIT88254
	L1 = L - 1	SIT88255
	WRITE (IW,40) L1,COFAS(L),COFAS(L+1),COFAS(L+2),COFAS(L+3),	SIT88256
	1 COFAS(L+4),COFAS(L+5),COFAS(L+6),COFAS(L+7),COFAS(L+8),COFAS(L+9)	SIT88257
132	CONTINUE	SIT88258
135	IF (TITB(4) .LE. 0.0) GO TO 140	SIT88259
	WRITE (IW,42) ALDA	SIT88260
	DO 138 L = 1,NMXTP,10	SIT88261
	L1 = L - 1	SIT88262
	WRITE (IW,40) L1,COFAT(L),COFAT(L+1),COFAT(L+2),COFAT(L+3),	SIT88263
	1 COFAT(L+4),COFAT(L+5) JFAT(L+6),COFAT(L+7),COFAT(L+8),COFAT(L+9)	SIT88264
138	CONTINUE	SIT88265
140	CONTINUE	SIT88266
C		SIT88267
C	PRINT OUT VARIOUS NORMAL OPTICAL THICKNESSES OF THE	SIT88268
C	ENTIRE ATMOSPHERIC MODEL...	SIT88269
C		SIT88270
	TAUBSR = (TITB(1)/1000.0) * TAUBSR	SIT88271
	TEMA = TITB(2) * OZABS	SIT88272
	TEMB = TITB(3) * BSCAST	SIT88273
	TEMC = TITB(3) * BABSST	SIT88274
	TEMD = TITB(4) * BSCATP	SIT88275

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TEME = TITB(4) * BABSTP
TAUTOT = TAUBSR + TEMA + TEMB + TEMC + TEMD + TEME
WRITE ( IW,44) NMUD,ALDA,TAUBSR,TEMA,TEMB,TEMC,TEMD,TEME,TAUTOT
WRITE (IW,32) NMUD,TITB(1),TITB(2)
WRITE (IW,36) TITB(9),TITB(10),TITB(11),TITB(5),TITB(6),TITB(3)
WRITE (IW,34) TITB(12),TITB(13),TITB(14),TITB(7),TITB(8),TITB(4)
IF ( TAUTOT .LE. 5.0 ) GO TO 142
WRITE (IW,45) TAUTOT
GO TO 1000

```

142 CONTINUE

DIVIDE BASIC LAYERS WITH DELTA TAU GREATER THAN 0.02 INTO
SUB-LAYERS SO THAT DELTA TAU OF NO RESULTANT LAYER EXCEEDS
0.02,.....

AND THEN,.....

COMPUTE ATTENUATION FACTORS FOR THE INCOMING DIRECT SOLAR
RADIATION FOR ALL TEN DIFFERENT DIRECTIONS,
AND AT ALL LAYERS.....

```

TAU(1) = 0.0
INew(1) = 1
DO 144 J = 1,10
  ATEN(1,J) = -1.0
  A(J) = 0.0
CONTINUE
C(1) = TAUBSR/TITB(1)
L1 = 1
DO 160 L = 1,NBLYR
  C(2) = PRTH(L) * C(1)
  C(3) = OZOTH(L) * OZABS
  C(4) = STDUST(L) * BSCAST
  C(5) = STDUST(L) * BABSST
  C(6) = TPDUST(L) * BSCATP
  C(7) = TPDUST(L) * BABSTP
  B(L) = C(2) + C(3) + C(4) + C(5) + C(6) + C(7)
  IF ( B(L) .GT. 0.02 ) GO TO 146
  N = 1
  GO TO 148

```

GO TO 148

146 N = B(L)/0.02 + 1

148 TEMA = 1.0/N

C(2) = TEMA * C(2)

C(4) = TEMA * C(4)

C(6) = TEMA * C(6)

C(8) = TEMA * B(L)

L2 = L1 + N - 1

C(9) = 1.0/C(8)

IF (L2 .LE. 300) GO TO 149

WRITE (IW,47)

GO TO 1000

149 CONTINUE

DO 150 LJ = L1,L2

ICHCK(LJ) = 0

OMEGR(LJ) = C(2) * C(9)

OMEGST(LJ) = C(4) * C(9)

OMEGTP(LJ) = C(6) * C(9)

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DTAU(LJ) = C(8)	SIT88331
DTAUH(LJ) = 0.5 * DTAU(LJ)	SIT88332
TAU(LJ+1) = TAU(LJ) + DTAU(LJ)	SIT88333
150 CONTINUE	SIT88334
ICHCK(L1) = 11	SIT88335
DO 158 J = 1,10	SIT88336
TEMB = 0.0	SIT88337
DO 152 K = 1,L	SIT88338
TEMB = TEMB + B(K) * DELS(K,J,L)	SIT88339
152 CONTINUE	SIT88340
DO 156 LJ = L1,L2	SIT88341
LJ1 = LJ + 1	SIT88342
TEMC = A(J) + TEMA * (TEMB - A(J)) * (LJ1 - L1)	SIT88343
IF (TEMC .GT. 100.0) GO TO 154	SIT88344
ATEN(LJ1,J) = -EXP(-TEMC)	SIT88345
GO TO 156	SIT88346
154 ATEN(LJ1,J) = 0.0	SIT88347
156 CONTINUE	SIT88348
A(J) = TEMB	SIT88349
158 CONTINUE	SIT88350
L1 = L1 + N	SIT88351
INEW(L+1) = L1	SIT88352
160 CONTINUE	SIT88353
MXNLYR = L2	SIT88354
MXNLVL = MXNLYR + 1	SIT88355
DO 162 L = 1,MXNLVL	SIT88356
DO 161 J = 1,18	SIT88357
BTEN(L,J) = EXP(-TAU(L)/AMU(J))	SIT88358
161 CONTINUE	SIT88359
162 CONTINUE	SIT88360
C	SIT88361
C DETERMINE NTR, THE UPPER LIMIT OF THE LEGENDRE SERIES FOR THE	SIT88362
C MULTIPLE SCATTERING CALCULATIONS,,,,, AND THEN,,,,	SIT88363
C DETERMINE POSITIONS OF THE VARIOUS CONDITIONING POINTS...	SIT88364
C	SIT88365
IF (NMXST .GT. 0 .OR. NMXTP .GT. 0) GO TO 165	SIT88366
NTR = 40	SIT88367
GO TO 175	SIT88368
165 NTR = 60	SIT88369
IF (NMXTP .GT. 0) GO TO 168	SIT88370
GO TO 175	SIT88371
168 IF (NMXTP .GT. 180) GO TO 171	SIT88372
GO TO 175	SIT88373
171 IF (NMXTP .GT. 240) GO TO 173	SIT88374
NTR = 80	SIT88375
GO TO 175	SIT88376
173 NTR = 100	SIT88377
175 NTR2 = NTR/2	SIT88378
WRITE (IW,10)	SIT88379
WRITE (IW,49) NTR	SIT88380
DISTAN = 10.0/NTR	SIT88381
NUMCCN = TAU(MXNLVL)/DISTAN + 4.0001	SIT88382
IF (TAU(MXNLVL) .GT. 4.0 .AND. NTR .GT. 60) NUMCON = NUMCON + 10	SIT88383
IF (TAU(MXNLVL) .GT. 4.0 .AND. NTR .GT. 80) NUMCON = NUMCON + 16	SIT88384
IF (NUMCON .LE. 100) GO TO 180	SIT88385

WRITE (IW,5) NUMCON	SIT88386
GO TO 1000	SIT88387
180 NUMCO1 = NUMCON - 1	SIT88388
ICPOS(1) = 1	SIT88389
TEMA = TAU(MXNLVL)/NUMCO1	SIT88390
TEMB = TEMA	SIT88391
J = 2	SIT88392
DO 185 I = 1, MXNLVL	SIT88393
IF (TAU(I) .LE. TEMB) GO TO 185	SIT88394
ICPOS(J) = I	SIT88395
J = J + 1	SIT88396
TEMB = TEMB + TEMA	SIT88397
185 CONTINUE	SIT88398
ICPOS(NUMCON) = MXNLVL	SIT88399
DO 186 I = 1, NUMCON	SIT88400
II = ICPOS(I)	SIT88401
WRITE (IW,51) I,TAU(II),II	SIT88402
186 CONTINUE	SIT88403
CALL SUBSTA (OMEGR,COFAR,OMEGST,COFAS,OMEGTP,COFAT,MXNLVR,NTR,	SIT88404
1 DTAUH,ATEN,FNYP,CAPLAM,CAPLX,CAPLY)	SIT88405
C	SIT88406
C COMPUTE PRIMARY-SCATTERED CONTRIBUTION TO THE EMERGENT RADIATION	SIT88407
C FOR ALL CASES OF THE UNIDIRECTIONAL ILLUMINATION FROM ABOVE...	SIT88408
C	SIT88409
LIMIT = MAXO(NMXST,NMXTPI)	SIT88410
DO 199 N = 1,10	SIT88411
DO 198 J = 1,18	SIT88412
TEMB = 0.0	SIT88413
DO 197 L = 1, MXNLVR	SIT88414
L1 = L + 1	SIT88415
TEMC = -0.5 * (ATEN(L,N) * BTEN(L,J) + ATEN(L1,N) * BTEN(L1,J))	SIT88416
TEMA = 0.0	SIT88417
DO 190 I = 1, NTR	SIT88418
TEMA = TEMA + CAPLAM(I,L) * FNYP(I,J) * FNYN(I,N)	SIT88419
190 CONTINUE	SIT88420
NTRA = NTR + 1	SIT88421
IF (LIMIT .LE. NTR) GO TO 192	SIT88422
DO 191 I = NTRA,LIMIT	SIT88423
TEMA = TEMA + (COFAS(I) * OMEGST(L) + COFAT(I) * OMEGTP(L)) *	SIT88424
1 FNYP(I,J) * FNYN(I,N)	SIT88425
191 CONTINUE	SIT88426
192 CONTINUE	SIT88427
TEMB = TEMB + 0.25 * TEMC * TEMA * DTAU(L)	SIT88428
197 CONTINUE	SIT88429
EIN(J,N) = TEMB	SIT88430
198 CONTINUE	SIT88431
199 CONTINUE	SIT88432
C	SIT88433
C COMPUTE SOURCE TERMS DUE TO ISOTROPIC ILLUMINATION FROM BELOW....	SIT88434
C AND ALSO,,,,,	SIT88435
C PRIMARY-SCATTERED CONTRIBUTION TO THE EMERGENT RADIATION.....	SIT88436
C	SIT88437
DO 201 J = 1,18	SIT88438
EIN(J,11) = 0.0	SIT88439
201 CONTINUE	SIT88440

TEMA = TAU(MXNLVL) - TAU(1)	SITB8441
DO 220 I = 1,NTR	SITB8442
READ (15,1) AJVD	SITB8443
TEME = -0.5/(2*I-1)	SITB8444
CALL POLATE (AJVD,TEMA,TEMB)	SITB8445
IF (I.NE. 2) GO TO 203	SITB8446
FXS(I,11) = 6.283185 * TEMB	SITB8447
203 CONTINUE	SITB8448
DO 210 L = 1,MXNLVR	SITB8449
LI = L + 1	SITB8450
TEMC = TAU(MXNLVL) - TAU(LI)	SITB8451
CALL POLATE (AJVD,TEMC,TEMD)	SITB8452
CAPLY(I,L,11) = CAPLAM(I,L) * TEME * DTAU(L) * (TEMB + TEMD)	SITB8453
DO 205 J = 1,18	SITB8454
EIN(J,11) = EIN(J,11) + 0.25 * (BTEN(L,J) * TEMB + BTEN(LI,J) * 1 TEMD) * DTAU(L) * CAPLAM(I,L) * FNYP(I,J)	SITB8455
205 CONTINUE	SITB8456
IF (I.NE. 2) GO TO 208	SITB8457
FXS(LI,11) = 6.283185 * TEMD	SITB8458
208 TEMB = TEMD	SITB8459
210 CONTINUE	SITB8460
220 CONTINUE	SITB8461
C	SITB8462
C SET ELEMENTS OF THE A VECTOR TO ZERO FOR ALL VALUES OF THETA	SITB8463
C SUB ZERO, AND ALSO FOR THE CASE OF ISOTROPIC ILLUMINATION,	SITB8464
C AND THEN FORM THE MATRIX F SUB 1...	SITB8465
C	SITB8466
C CALL SUBSTB (AVECT,FMAT,GMAT,NTR,NTR2)	SITB8467
C	SITB8468
C GENERARE F SUB J MATRIX AND A SUB J VECTORS FOR ALL	SITB8469
C LAYERS AND FOR ALL POSITIONS OF THE SUN, AS WELL AS THE	SITB8470
C CASE OF ILLUMINATION FROM BELOW....	SITB8471
C	SITB8472
KKK = 2	SITB8473
NBAS = 0	SITB8474
DO 400 L = 1,MXNLVR	SITB8475
IF (L.EQ. 1) GO TO 295	SITB8476
IF (ICHCK(L).EQ. 0) GO TO 325	SITB8477
295 CONTINUE	SITB8478
NBAS = NBAS + 1	SITB8479
IPITE(L) = NBAS	SITB8480
CALL PITRIX (AL,CAPLX(1,L),AR,PIMAT,TEM,DINV,B,C,IP,LIMU,NTR)	SITB8481
NBS1 = 4*NBAS - 3	SITB8482
NBS2 = NBS1 + 1	SITB8483
NBS3 = NBS2 + 1	SITB8484
NBS4 = NBS3 + 1	SITB8485
WRITE (17,NBS1) BREKA	SITB8486
WRITE (17,NBS2) BREKB	SITB8487
WRITE (17,NBS3) BREKC	SITB8488
WRITE (17,NBS4) BREKD	SITB8489
GO TO 327	SITB8490
325 IPITE(L) = NBAS	SITB8491
327 CONTINUE	SITB8492
C CALL SUBSTC (A,PIMAT,FMAT,DINV,CAPLY,AVECT,NTR,NTR2,L)	SITB8493
C	SITB8494
	SITB8495

C	COMPUTE U AND T MATRICES, AS WELL AS U AND T VECTORS	SIT88496
C	IF THE LEVEL CORRESPONDS TO ONE OF THE CONDITIONING POINTS...	SIT88497
C		SIT88498
	IF ((L+1) .NE. ICPOS(KKK)) GO TO 400	SIT88499
	CALL SUBSTD (CINV,FMAT,NTR2)	SIT88500
	CALL SOLISY(1,CINV,CIMAT,TEM,B,A,IP,NTR2,ITR,C,D)	SIT88501
	WRITE (IW,53) ITR,KKK	SIT88502
	IF (ITR .LE. 0) GO TO 1000	SIT88503
	KKM = KKK - 1	SIT88504
	CALL SUBSTE (TMAT,CIMAT,FMAT,UMAT,NTP2)	SIT88505
	WRITE (11*KKM) UMAT	SIT88506
	WRITE (12*KKM) TMAT	SIT88507
	NTR21 = NTR2 + 1	SIT88508
	CALL SUBSTF (FMAT,UMAT,NTR2)	SIT88509
	CALL SUBSTG (TVECT,AVECT,UMAT,UVECT,NTR,NTR2,NTR21)	SIT88510
	WRITE (13*KKM) TVECT	SIT88511
	WRITE (14*KKM) UVECT	SIT88512
	KKK = KKK + 1	SIT88513
	400 CONTINUE	SIT88514
C		SIT88515
C	SOLVE THE LINEAR SYSTEM TO OBTAIN VALUES OF THE ELEMENTS	SIT88516
C	OF THE L SUB K VECTOR CORRESPONDING TO THE CONDITIONING	SIT88517
C	POINT FOR THE LOWER BOUNDARY OF THE ATMOSPHERE....	SIT88518
C		SIT88519
	K = NUMC01	SIT88520
	CALL SUBSTH (DINV,UMAT,GMAT,NTR2)	SIT88521
C		SIT88522
C	DINV NOW CONTAINS BOTTOM HALF OF RECTANGULAR MATRIX	SIT88523
C	U SUB 2 MINUS G MATRIX.....	SIT88524
C		SIT88525
	READ (14*K) UVECT	SIT88526
	DO 600 N = 1,11	SIT88527
	ISW(N) = 0	SIT88528
	DO 560 I = 1,NTR2	SIT88529
	A(I) = UVECT(I,N)	SIT88530
	560 CONTINUE	SIT88531
C		SIT88532
C	A NOW CONTAINS BOTTOM HALF OF THE U SUB 2 VECTOR	SIT88533
C	BUT WITH OPPOSITE SIGN....	SIT88534
C		SIT88535
	CALL SOLISY (2,DINV,PIMAT,TEM,B,A,IP,NTR2,ITR,C,D)	SIT88536
	IF (N .EQ. 11) GO TO 562	SIT88537
	WRITE (IW,55) THETO(N),ITR	SIT88538
	GO TO 563	SIT88539
562	CONTINUE	SIT88540
	WRITE (IW,57) ITR	SIT88541
563	CONTINUE	SIT88542
	IF (ITR .GT. 0) GO TO 565	SIT88543
	ISW(N) = 11	SIT88544
565	CONTINUE	SIT88545
	DO 570 I = 1,NTR2	SIT88546
	VECL2(I,N) = B(I)	SIT88547
570	CONTINUE	SIT88548
	CALL SUBSTI (N,VECL2,GMAT,NTR2)	SIT88549
600	CONTINUE	SIT88550

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C      SUBAR = -2.0 * VECL2(NTR2+1,11)
C      COMPUTE FLUXES AT ALL LEVELS AFTER COMPUTING L SUB (K-1),
C      L SUB (K-2),-----, L SUB 1 VECTORS....
C
      K = NUMCO1
615 K1 = K - 1
      READ (13,K) TVECT
      IF ( K1 .EQ. 0 ) GO TO 617
      READ (11,K1) UMAT
      READ (14,K1) UVECT
617 CONTINUE
      CALL SUBSTJ (ISW,K1,NTR2,VECL1,VECL2,TVECT,AVECT,UVECT,
      1 TMAT,UMAT,GMAT)
      IF ( K1 .EQ. 0 ) GO TO 710
      READ (12,K1) TMAT
710 CONTINUE
      LMIN = ICPOS(K)
      LMAX = ICPOS(K+1)
      CALL FLUX (AMUD,ATEN,AVECT,FXS,FXU,FXD,FXN,NTR,LMIN,ISW)
      CALL SUBSTK (AMOMT,AVI(1),NTR,NTR2)
      LMIN = LMIN + 1
      DO 900 L = LMIN,LMAX
      L1 = L - 1
      IF ( L .EQ. LMIN ) GO TO 725
      IF ( ICHCK(L1) .EQ. 0 ) GO TO 730
725 NBS1 = 4 * IPITE(L1) - 1
      NBS2 = NBS1 + 1
      NBS3 = NBS2 + 1
      NBS4 = NBS3 + 1
      READ (17,NBS1) BREKA
      READ (17,NBS2) BREKB
      READ (17,NBS3) BREKC
      READ (17,NBS4) BREKD
730 CONTINUE
      CALL SUBSTL (B,DINV,CAPLY,PIMAT,AVECT,NTR,L1)
      CALL FLUX (AMUD,ATEN,AVECT,FXS,FXU,FXD,FXN,NTR,L,ISW)
      CALL SUBSTK (BMOMT,AVI(1),NTR,NTR2)
      CALL SUBSTM (CAPLAM,BI(1),AMCMT,BMOMT,FNYP,DTAUH,EIN,NTR,L,L1)
800 CONTINUE
      K = K - 1
      DO 905 N = 1,11
      DO 900 I = 1,NTR
      VECL2(I,N) = VECL1(I,N)
900 CONTINUE
905 CONTINUE
      IF ( K .GT. 0 ) GO TO 615
      DO 915 N = 1,11
      DO 910 J = 1,18
      EIN(J,N) = EIN(J,N)/AMH(J)
910 CONTINUE
915 CONTINUE
      DO 918 J = 1,18
      EIN(J,11) = EIN(J,11) + BTEN(MXNLVL,J)
918 CONTINUE

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C
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PRINT OUT FLUXES.....

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WRITE (IW,10)
DO 950 N = 1,11
  IF ( N .EQ. 11 ) GO TO 920
  WRITE (IW,61) NMOD,ALDA,THETO(N)
  GO TO 925
920 WRITE ( IW,63) NMOD,ALDA
925 WRITE ( IW,65)
  NN = NBLR/2
  NN = 2 * NN
  IF ( NN .EQ. NBLR ) GO TO 927
  LMAX = NBLR
  GO TO 928
927 LMAX = NBLR - 1
928 DO 930 L = 1,LMAX,2
  L1 = L + 1
  L2 = INEW(L)
  L3 = INEW(L1)
  WRITE (IW,67) L,FXS(L2,N),FXD(L2,N),FXU(L2,N),FXN(L2,N),
  1 L1,FXS(L3,N),FXD(L3,N),FXU(L3,N),FXN(L3,N)
930 CONTINUE
  IF ( NN .NE. NBLR ) GO TO 940
  L1 = NBLR + 1
  L2 = INEW(L1)
  WRITE (IW,69) L1,FXS(L2,N),FXD(L2,N),FXU(L2,N),FXN(L2,N)
940 CONTINUE
950 CONTINUE
  WRITE (IW,71) SBAR

```

C
C
C

PRINT OUT INTENSITY OF THE EMERGENT RADIATION.....

```

DO 970 N = 1,10
  TEMA = (FXS(MXNLVL,N) + FXD(MXNLVL,N))/3.141593
  DO 960 J = 1,18
    EIC(J,N,ILDA) = EIN(J,N)
    TIC(J,N,ILDA) = TEMA * EIN(J,11)
960 CONTINUE
970 CONTINUE
  SSBRR(ILDA) = SBAR
  WRITE (16,NMOD) TITB,EIC,TIC,SSBRR
  WRITE (IW,73) NMOD,ALDA
  WRITE (IW,75) (THETO(N),N=1,10)
  WRITE (IW,77) (THETA(J),AMU(J),(EIC(J,N,ILDA),N=1,10),J=1,18)
  WRITE (IW,79)
  WRITE (IW,77) (THETA(J),AMU(J),(TIC(J,N,ILDA),N=1,10),J=1,18)
  WRITE (IW,71) SSBRR(ILDA)
  CALL TIMDAT (DATE,HOURL,ITVE,ITRE)
  TIMV = (ITVE - ITVB) * 0.001
  TIMR = (ITRE - ITRB) * 0.001
  WRITE (6,95) NMOD,ALDA,TIMV,TIMR
  GO TO 108
1000 RETURN
END

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VII. INPUT FOR A TEST RUN

7.1 Input for SITAA: (See page 106.)

000						
0.5773503	0.0	0.0	0.0	0.0	ZERGES OF P SUB	2
0.7745967	0.0	0.0	0.0	0.0	ZEROES OF P SUB	3
0.3399810	0.8611363	0.0	0.0	0.0	ZERGES OF P SUB	4
0.5384693	0.9061798	0.0	0.0	0.0	ZERGES OF P SUB	5
0.2386192	0.6612094	0.9324695	0.0	0.0	ZEROES OF P SUB	6
0.4058452	0.7415312	0.9491079	0.0	0.0	ZEROES OF P SUB	7
0.1834346	0.5255324	0.7966665	0.9602899	0.0	ZEROES OF P SUB	8
0.3242534	0.6133714	0.8360311	0.9681602	0.0	ZEROES OF P SUB	9
0.1488743	0.4333954	0.6794096	0.8650634	0.9739065	ZEROES OF P SUB	10
0.2695432	0.5190961	0.7301520	0.8870626	0.9782287	ZERGES OF P SUB	11
0.1252334	0.3678315	0.5873180	0.7699027	0.9041173	ZEROES OF P SUB	12
0.9815606	0.0	0.0	0.0	0.0	ZEROES OF P SUB	12
0.2304583	0.4484928	0.6423493	0.8015781	0.9175984	ZEROES OF P SUB	13
0.9841831	0.0	0.0	0.0	0.0	ZEROES OF P SUB	13
0.1080549	0.3191124	0.5152486	0.6872929	0.8272013	ZEROES OF P SUB	14
0.9284349	0.9862838	0.0	0.0	0.0	ZEROES OF P SUB	14
0.2011941	0.3941513	0.5709722	0.7244177	0.8482066	ZEROES OF P SUB	15
0.9372734	0.9879925	0.0	0.0	0.0	ZEROES OF P SUB	15
0.0950125	0.2816036	0.4580169	0.6178762	0.7554044	ZEROES OF P SUB	16
0.8656312	0.9445750	0.9894009	0.0	0.0	ZEROES OF P SUB	16
0.1784842	0.3512318	0.5126905	0.6576712	0.7815140	ZEROES OF P SUB	17
0.8802392	0.9506755	0.9905755	0.0	0.0	ZEROES OF P SUB	17
0.0847750	0.2518862	0.4117512	0.5597708	0.6916870	ZERGES OF P SUB	18
0.8037050	0.8926025	0.9558239	0.9915652	0.0	ZEROES OF P SUB	18
0.1603586	0.3165641	0.4645707	0.6005453	0.7209662	ZERGES OF P SUB	19
0.8227147	0.9031559	0.9602082	0.9924068	0.0	ZEROES OF P SUB	19
0.0765265	0.2277859	0.3737061	0.5108670	0.6360537	ZEROES OF P SUB	20
0.7463319	0.3391170	0.9122344	0.9639719	0.9931286	ZEROES OF P SUB	20
0.1455619	0.2880213	0.4243421	0.5516188	0.6671388	ZEROES OF P SUB	21
0.7684400	0.8533634	0.9200993	0.9672268	0.9937522	ZEROES OF P SUB	21
0.0697393	0.2078604	0.3419358	0.4693558	0.5876404	ZEROES OF P SUB	22
0.6944873	0.7878168	0.8658126	0.9269568	0.9700605	ZERGES OF P SUB	22
0.9942946	0.0	0.0	0.0	0.0	ZERGES OF P SUB	22
0.1332568	0.2641357	0.3903010	0.5095015	0.6196099	ZEROES OF P SUB	23
0.7186614	0.8048884	0.8767524	0.9329711	0.9725425	ZEROES OF P SUB	23
0.9947693	0.0	0.0	0.0	0.0	ZEROES OF P SUB	23
0.0640569	0.1911189	0.3150427	0.4337935	0.5454215	ZEROES OF P SUB	24
0.6480937	0.7401242	0.8200020	0.8864155	0.9382746	ZEROES OF P SUB	24
0.9747286	0.9951872	0.0	0.0	0.0	ZEROES OF P SUB	24
0.1228647	0.2438669	0.3611723	0.4730027	0.5776629	ZEROES OF P SUB	25
0.6735664	0.7592593	0.8334426	0.8949920	0.9429746	ZEROES OF P SUB	25
0.9766639	0.9955570	0.0	0.0	0.0	ZEROES OF P SUB	25
0.0592301	0.1768588	0.2920048	0.4030518	0.5084407	ZEROES OF P SUB	26
0.6066923	0.6964273	0.7763859	0.8454459	0.9026379	ZEROES OF P SUB	26
0.9471591	0.9783854	0.9958857	0.0	0.0	ZERGES OF P SUB	26
0.1139726	0.2264594	0.3359939	0.4411483	0.5405516	ZEROES OF P SUB	27
0.6329080	0.7170135	0.7917716	0.8562079	0.9094823	ZEROES OF P SUB	27
0.9509006	0.9799235	0.9961793	0.0	0.0	ZEROES OF P SUB	27
0.0550793	0.1645693	0.2720616	0.3762515	0.4758742	ZEROES OF P SUB	28
0.5697205	0.6566511	0.7356109	0.8056414	0.8658925	ZEROES OF P SUB	28
0.9156330	0.9542593	0.9813032	0.9964425	0.0	ZERGES OF P SUB	28
0.1062782	0.2113523	0.3140316	0.4131529	0.5075930	ZEROES OF P SUB	29
0.5962818	0.6782145	0.7524629	0.8181855	0.8746378	ZERGES OF P SUB	29
0.9211802	0.9572856	0.9825455	0.9966794	0.0	ZEROES OF P SUB	29

0.0514719	0.1538699	0.2546369	0.3527047	0.4470338	ZEROES OF P SUB	30
0.5366241	0.6205262	0.6978505	0.7677774	0.8295658	ZEROES OF P SUB	30
0.8825605	0.9262000	0.9600219	0.9836681	0.9968935	ZEROES OF P SUB	30
0.0995553	0.1981212	0.2947181	0.3883859	0.4781938	ZEROES OF P SUB	31
0.5632492	0.6427067	0.7157768	0.7817331	0.8399203	ZEROES OF P SUB	31
0.8897600	0.9307570	0.9625039	0.9846859	0.9970875	ZEROES OF P SUB	31
0.0483077	0.1444720	0.2392874	0.3318686	0.4213513	ZEROES OF P SUB	32
0.5068999	0.5877158	0.6630443	0.7321821	0.7944838	ZEROES OF P SUB	32
0.8493676	0.8963212	0.9349061	0.9647623	0.9856115	ZEROES OF P SUB	32
0.9972639	0.0	0.0	0.0	0.0	ZEROES OF P SUB	32
0.0936311	0.1864393	0.2776091	0.3663393	0.4518500	ZEROES OF P SUB	33
0.5333899	0.6102423	0.6817320	0.7472305	0.8061624	ZEROES OF P SUB	33
0.8580097	0.9023168	0.9386944	0.9668229	0.9864557	ZEROES OF P SUB	33
0.9974247	0.0	0.0	0.0	0.0	ZEROES OF P SUB	33
0.0455098	0.1361524	0.2256667	0.3133111	0.3983593	ZEROES OF P SUB	34
0.4801065	0.5578755	0.6310217	0.6989391	0.7610649	ZEROES OF P SUB	34
0.8168842	0.8659346	0.9078097	0.9421624	0.9687083	ZEROES OF P SUB	34
0.9872278	0.9975718	0.0	0.0	0.0	ZEROES OF P SUB	34
0.0883713	0.1760511	0.2623529	0.3466016	0.4281375	ZEROES OF P SUB	35
0.5063228	0.5805453	0.6502244	0.7148145	0.7738103	ZEROES OF P SUB	35
0.8267499	0.8732191	0.9128543	0.9453451	0.9704376	ZEROES OF P SUB	35
0.9879358	0.9977066	0.0	0.0	0.0	ZEROES OF P SUB	35
0.0430182	0.1287361	0.2135009	0.2966850	0.3776725	ZEROES OF P SUB	36
0.4558639	0.5306803	0.6015677	0.6680012	0.7294892	ZEROES OF P SUB	36
0.7855762	0.8358472	0.8799298	0.9174978	0.9482730	ZEROES OF P SUB	36
0.9720277	0.9885865	0.9978305	0.0	0.0	ZEROES OF P SUB	36
0.0836704	0.1667539	0.2486678	0.3288374	0.4067005	ZEROES OF P SUB	37
0.4817109	0.5533424	0.6210926	0.6844863	0.7430788	ZEROES OF P SUB	37
0.7964592	0.8442530	0.8861250	0.9217814	0.9509723	ZEROES OF P SUB	37
0.9734930	0.9891860	0.9979446	0.0	0.0	ZEROES OF P SUB	37
0.0407851	0.1220840	0.2025705	0.2817088	0.3589724	ZEROES OF P SUB	38
0.4338472	0.5058347	0.5744560	0.6392544	0.6997987	ZEROES OF P SUB	38
0.7556859	0.8065442	0.8520350	0.8918557	0.9257413	ZEROES OF P SUB	38
0.9534663	0.9748463	0.9897395	0.9980499	0.0	ZEROES OF P SUB	38
0.0794438	0.1583853	0.2363255	0.3127716	0.3872402	ZEROES OF P SUB	39
0.4592605	0.5283773	0.5941535	0.6561732	0.7140444	ZEROES OF P SUB	39
0.7674012	0.8159063	0.8592529	0.8971671	0.9294091	ZEROES OF P SUB	39
0.9557752	0.9760987	0.9902515	0.9981474	0.0	ZEROES OF P SUB	39
0.0387724	0.1160841	0.1926976	0.2681522	0.3419941	ZEROES OF P SUB	40
0.4137792	0.4830758	0.5494671	0.6125539	0.6719567	ZEROES OF P SUB	40
0.7273183	0.7783057	0.8246122	0.8655595	0.9020988	ZEROES OF P SUB	40
0.9328124	0.9579168	0.9772599	0.9907262	0.9982377	ZEROES OF P SUB	40
0.0756233	0.1508134	0.2251396	0.2981763	0.3695050	ZEROES OF P SUB	41
0.4387173	0.5054166	0.5692209	0.6297648	0.6867015	ZEROES OF P SUB	41
0.7397048	0.7884711	0.8327212	0.8722015	0.9066859	ZEROES OF P SUB	41
0.9359770	0.9599069	0.9783387	0.9911671	0.9983216	ZEROES OF P SUB	41
0.0369489	0.1106450	0.1837368	0.2558251	0.3265161	ZEROES OF P SUB	42
0.3954239	0.4621719	0.5263957	0.5877446	0.6458834	ZEROES OF P SUB	42
0.7004946	0.7512799	0.7979621	0.8402860	0.8780206	ZEROES OF P SUB	42
0.9109597	0.9389236	0.9617594	0.9793425	0.9915773	ZEROES OF P SUB	42
0.9983996	0.0	0.0	0.0	0.0	ZEROES OF P SUB	42
0.0721530	0.1439298	0.2149562	0.2848620	0.3532826	ZEROES OF P SUB	43
0.4198614	0.4842512	0.5461163	0.6051343	0.6609973	ZEROES OF P SUB	43
0.7134142	0.7621117	0.8068360	0.8473537	0.8834538	ZEROES OF P SUB	43
0.9149479	0.9416720	0.9634866	0.9802782	0.9919596	ZEROES OF P SUB	43

0.9984723	0.0	0.0	0.0	0.0	ZEROES OF P SUB	43
0.0352892	0.1056919	0.1755680	0.2445695	0.3123525	ZEROES OF P SUB	44
0.3785794	0.4429202	0.5050544	0.5646725	0.6214773	ZEROES OF P SUB	44
0.6751861	0.7255311	0.7722615	0.8151445	0.8539666	ZEROES OF P SUB	44
0.3885342	0.9186753	0.9442395	0.9650997	0.9811518	ZEROES OF P SUB	44
0.9923164	0.9985402	0.0	0.0	0.0	ZEROES OF P SUB	44
0.0689870	0.1376452	0.2056475	0.2726698	0.3383927	ZEROES OF P SUB	45
0.4025029	0.4646951	0.5246728	0.5821502	0.6368534	ZEROES OF P SUB	45
0.6885217	0.7369088	0.7817843	0.8229342	0.8601625	ZEROES OF P SUB	45
0.8932917	0.9221639	0.9466417	0.9666083	0.9819687	ZEROES OF P SUB	45
0.9926500	0.9986036	0.0	0.0	0.0	ZEROES OF P SUB	45
0.0337722	0.1011625	0.1680912	0.2342529	0.2993458	ZEROES OF P SUB	46
0.3630729	0.4251433	0.4852739	0.5431903	0.5986263	ZEROES OF P SUB	46
0.6513348	0.7010695	0.7476054	0.7907301	0.8302468	ZEROES OF P SUB	46
0.8659754	0.8977527	0.9254338	0.9488924	0.9680214	ZEROES OF P SUB	46
0.9827337	0.9929623	0.9986630	0.0	0.0	ZEROES OF P SUB	46
0.0660869	0.1318849	0.1971061	0.2614655	0.3246815	ZEROES OF P SUB	47
0.3864778	0.4465841	0.5047376	0.5606840	0.6141787	ZEROES OF P SUB	47
0.6649877	0.7128890	0.7576729	0.7991438	0.8371201	ZEROES OF P SUB	47
0.8714360	0.9019413	0.9285027	0.9510040	0.9693468	ZEROES OF P SUB	47
0.9834510	0.9932552	0.9987187	0.0	0.0	ZEROES OF P SUB	47
0.0323802	0.0970047	0.1612224	0.2247638	0.2873625	ZEROES OF P SUB	48
0.3487559	0.4086865	0.4669029	0.5231610	0.5772247	ZEROES OF P SUB	48
0.6286674	0.6778724	0.7240341	0.7671590	0.8070662	ZEROES OF P SUB	48
0.8435883	0.8765720	0.9058791	0.9313867	0.9529877	ZEROES OF P SUB	48
0.9705916	0.9841246	0.9935302	0.9987710	0.0	ZEROES OF P SUB	48
0.0634207	0.1265860	0.1892416	0.2511352	0.3120175	ZEROES OF P SUB	49
0.3716435	0.4297730	0.4861719	0.5406132	0.5928777	ZEROES OF P SUB	49
0.6427548	0.6900438	0.7345543	0.7761069	0.8145344	ZEROES OF P SUB	49
0.8496821	0.8814084	0.9095857	0.9341003	0.9548537	ZEROES OF P SUB	49
0.9717622	0.9847579	0.9937887	0.9988202	0.0	ZEROES OF P SUB	49
0.0310983	0.0931747	0.1548906	0.2160072	0.2762882	ZEROES OF P SUB	50
0.3355002	0.3934143	0.4498063	0.5044581	0.5571583	ZEROES OF P SUB	50
0.6077029	0.6558965	0.7015525	0.7444943	0.7845558	ZEROES OF P SUB	50
0.8215821	0.8554296	0.8859680	0.9130786	0.9366566	ZEROES OF P SUB	50
0.9566110	0.9728644	0.9853541	0.9940320	0.9988664	ZEROES OF P SUB	50
0.0609611	0.1216954	0.1819770	0.2415817	0.3002876	ZEROES OF P SUB	51
0.3578765	0.4141340	0.4688509	0.5218237	0.5728552	ZEROES OF P SUB	51
0.6217557	0.6683432	0.7124445	0.7538954	0.7925417	ZEROES OF P SUB	51
0.8282398	0.8608567	0.8902712	0.9163739	0.9390675	ZEROES OF P SUB	51
0.9582678	0.9739034	0.9859160	0.9942613	0.9989100	ZEROES OF P SUB	51
0.0299141	0.0896352	0.1490355	0.2079023	0.2660248	ZEROES OF P SUB	52
0.3231950	0.3792083	0.4338641	0.4869667	0.5383262	ZEROES OF P SUB	52
0.5877586	0.6350870	0.6801419	0.7227621	0.7627950	ZEROES OF P SUB	52
0.8000973	0.8345354	0.8659862	0.8943369	0.9194861	ZEROES OF P SUB	52
0.9413439	0.9598318	0.9748839	0.9864462	0.9944776	ZEROES OF P SUB	52
0.9989511	0.0	0.0	0.0	0.0	ZEROES OF P SUB	52
0.0586851	0.1171678	0.1752467	0.2327214	0.2893939	ZEROES OF P SUB	53
0.3450688	0.3995542	0.4526622	0.5042098	0.5540193	ZEROES OF P SUB	53
0.6019190	0.6477437	0.6913356	0.7325442	0.7712277	ZEROES OF P SUB	53
0.8072525	0.8404946	0.8708393	0.8981821	0.9224286	ZEROES OF P SUB	53
0.9434954	0.9613097	0.9758102	0.9869470	0.9946819	ZEROES OF P SUB	53
0.9989899	0.0	0.0	0.0	0.0	ZEROES OF P SUB	53
0.0288167	0.0863545	0.1436054	0.2003793	0.2564875	ZEROES OF P SUB	54
0.3117437	0.3659643	0.4189693	0.4705824	0.5206323	ZEROES OF P SUB	54

0.5689528	0.6153832	0.6597694	0.7019639	0.7418265	ZEROES	OF	P	SUB	54
0.7792249	0.8140348	0.8461405	0.8754355	0.9018223	ZEROES	OF	P	SUB	54
0.9252134	0.9455310	0.9627076	0.9766863	0.9874206	ZEROES	OF	P	SUB	54
0.9948751	0.9990267	0.0	0.0	0.0	ZEROES	OF	P	SUB	54
0.0565728	0.1129643	0.1689940	0.2244823	0.2792516	ZEROES	OF	P	SUB	55
0.3331263	0.3859339	0.4375053	0.4876752	0.5362829	ZEROES	OF	P	SUB	55
0.5831727	0.6281945	0.6712040	0.7120634	0.7506419	ZEROES	OF	P	SUB	55
0.7868158	0.8204693	0.8514946	0.8797923	0.9052718	ZEROES	OF	P	SUB	55
0.9278514	0.9474589	0.9640313	0.9775157	0.9878689	ZEROES	OF	P	SUB	55
0.9950580	0.9990614	0.0	0.0	0.0	ZEROES	OF	P	SUB	55
0.0277970	0.0833052	0.1385558	0.1933782	0.2476029	ZEROES	OF	P	SUB	56
0.3010623	0.3535910	0.4050269	0.4552108	0.5039877	ZEROES	OF	P	SUB	56
0.5512068	0.5967222	0.6403931	0.6820846	0.7216678	ZEROES	OF	P	SUB	56
0.7590204	0.7940269	0.8265791	0.8565764	0.8839261	ZEROES	OF	P	SUB	56
0.9085436	0.9303529	0.9492865	0.9652859	0.9783017	ZEROES	OF	P	SUB	56
0.9882937	0.9952312	0.9990943	0.0	0.0	ZEROES	OF	P	SUB	56
0.0546072	0.1090513	0.1631701	0.2168018	0.2697866	ZEROES	OF	P	SUB	57
0.3219662	0.3731849	0.4232899	0.4721316	0.5195643	ZEROES	OF	P	SUB	57
0.5654464	0.6096410	0.6520162	0.6924456	0.7308083	ZEROES	OF	P	SUB	57
0.7669901	0.8008829	0.8323855	0.8614040	0.8878517	ZEROES	OF	P	SUB	57
0.9116497	0.9327270	0.9510206	0.9664761	0.9790472	ZEROES	OF	P	SUB	57
0.9886966	0.9953955	0.9991256	0.0	0.0	ZEROES	OF	P	SUB	57
0.0268470	0.0804636	0.1338483	0.1868470	0.2393069	ZEROES	OF	P	SUB	58
0.2910769	0.3420077	0.3919523	0.4407668	0.4883105	ZEROES	OF	P	SUB	58
0.5344463	0.5790411	0.6219664	0.6630984	0.7023186	ZEROES	OF	P	SUB	58
0.7395137	0.7745767	0.8074063	0.8379080	0.8659938	ZEROES	OF	P	SUB	58
0.8915827	0.9146009	0.9349821	0.9526676	0.9676062	ZEROES	OF	P	SUB	58
0.9797550	0.9890790	0.9955515	0.9991552	0.0	ZEROES	OF	P	SUB	58
0.0527735	0.1053999	0.1577325	0.2096255	0.2609342	ZEROES	OF	P	SUB	59
0.3115157	0.3612289	0.4099353	0.4574992	0.5037879	ZEROES	OF	P	SUB	59
0.5486724	0.5920277	0.6337330	0.6736719	0.7117331	ZEROES	OF	P	SUB	59
0.7478106	0.7818039	0.8136181	0.8431646	0.8703611	ZEROES	OF	P	SUB	59
0.8951317	0.9174074	0.9371262	0.9542330	0.9686802	ZEROES	OF	P	SUB	59
0.9804276	0.9894424	0.9956996	0.9991834	0.0	ZEROES	OF	P	SUB	59
0.0259598	0.0778093	0.1294491	0.1807400	0.2315436	ZEROES	OF	P	SUB	60
0.2817229	0.3311428	0.3796701	0.4271737	0.4735258	ZEROES	OF	P	SUB	60
0.5186014	0.5622789	0.6044406	0.6449728	0.6837663	ZEROES	OF	P	SUB	60
0.7207165	0.7557238	0.7886937	0.8195375	0.8481720	ZEROES	OF	P	SUB	60
0.8745199	0.8985103	0.9200785	0.9391663	0.9557223	ZEROES	OF	P	SUB	60
0.9697013	0.9810672	0.9897879	0.9958405	0.9992101	ZEROES	OF	P	SUB	60
0.0510589	0.1019846	0.1526442	0.2029056	0.2526377	ZEROES	OF	P	SUB	61
0.3017106	0.3499964	0.3973692	0.4437052	0.4888836	ZEROES	OF	P	SUB	61
0.5327866	0.5752997	0.6163118	0.6557160	0.6934096	ZEROES	OF	P	SUB	61
0.7292941	0.7632760	0.7952666	0.8251824	0.8529455	ZEROES	OF	P	SUB	61
0.8784832	0.9017292	0.9226226	0.9411090	0.9571402	ZEROES	OF	P	SUB	61
0.9706743	0.9816760	0.9901167	0.9959746	0.9992356	ZEROES	OF	P	SUB	61
0.0251293	0.0753244	0.1253292	0.1750175	0.2242636	ZEROES	OF	P	SUB	62
0.2729432	0.3209333	0.3681128	0.4143623	0.4595652	ZEROES	OF	P	SUB	62
0.5036071	0.5463769	0.5877664	0.6276713	0.6659906	ZEROES	OF	P	SUB	62
0.7026275	0.7374895	0.7704886	0.8015413	0.8305693	ZEROES	OF	P	SUB	62
0.9574992	0.8822630	0.9047981	0.9250476	0.9429604	ZEROES	OF	P	SUB	62
0.9584912	0.9716007	0.9822559	0.9904300	0.9961023	ZEROES	OF	P	SUB	62
0.9992599	0.0	0.0	0.0	0.0	ZEROES	OF	P	SUB	62
0.0494522	0.0967834	0.1478728	0.1966003	0.2448468	ZEROES	OF	P	SUB	63
0.2924941	0.3394255	0.3855264	0.4306838	0.4747872	ZEROES	OF	P	SUB	63

0.5177288	0.5594034	0.5997091	0.6385471	0.6758225	ZEROES OF P SUB	63
0.7114441	0.7453246	0.7773813	0.8075355	0.8357136	ZEROES OF P SUB	63
0.8618465	0.8858703	0.9077263	0.9273609	0.9447261	ZEROES OF P SUB	63
0.9597794	0.9724840	0.9828088	0.9907285	0.9962240	ZEROES OF P SUB	63
0.9992830	0.0	0.0	0.0	0.0	ZEROES OF P SUB	63
0.0243503	0.0729931	0.1214628	0.1696444	0.2174236	ZEROES OF P SUB	64
0.2646872	0.3113229	0.3572202	0.4022702	0.4463660	ZEROES OF P SUB	64
0.4894031	0.5312795	0.5718956	0.6111554	0.6489655	ZEROES OF P SUB	64
0.6852363	0.7198819	0.7528199	0.7839724	0.8132653	ZEROES OF P SUB	64
0.8406293	0.8659994	0.8893154	0.9105221	0.9295692	ZEROES OF P SUB	64
0.9464114	0.9610098	0.9733268	0.9833363	0.9910134	ZEROES OF P SUB	64
0.9963401	0.9993050	0.0	0.0	0.0	ZEROES OF P SUB	64
0.0479435	0.0957767	0.1433896	0.1906727	0.2375172	ZEROES OF P SUB	65
0.2838155	0.3294609	0.3743486	0.4183753	0.4614397	ZEROES OF P SUB	65
0.5034428	0.5442879	0.5838812	0.6221315	0.6589509	ZEROES OF P SUB	65
0.6942547	0.7279617	0.7599943	0.7902790	0.8187459	ZEROES OF P SUB	65
0.8453298	0.8699693	0.8926079	0.9131934	0.9316786	ZEROES OF P SUB	65
0.9480209	0.9621828	0.9741315	0.9838398	0.9912853	ZEROES OF P SUB	65
0.9964509	0.9993261	0.0	0.0	0.0	ZEROES OF P SUB	65
0.0236181	0.0708017	0.1178273	0.1645899	0.2109853	ZEROES OF P SUB	66
0.2569099	0.3022613	0.3469382	0.3908409	0.4338715	ZEROES OF P SUB	66
0.4759339	0.5169344	0.5567814	0.5953860	0.6326620	ZEROES OF P SUB	66
0.6685264	0.7028990	0.7357031	0.7668656	0.7963170	ZEROES OF P SUB	66
0.8239914	0.8498272	0.8737667	0.8957565	0.9157475	ZEROES OF P SUB	66
0.9336951	0.9495592	0.9633046	0.9749004	0.9843209	ZEROES OF P SUB	66
0.9915450	0.9965568	0.9993462	0.0	0.0	ZEROES OF P SUB	66
0.0465240	0.0929473	0.1391693	0.1850898	0.2306095	ZEROES OF P SUB	67
0.2756298	0.3200531	0.3637832	0.4067255	0.4487869	ZEROES OF P SUB	67
0.4898763	0.5299047	0.5687855	0.6064345	0.6427700	ZEROES OF P SUB	67
0.6777134	0.7111891	0.7431244	0.7734504	0.8021012	ZEROES OF P SUB	67
0.8290148	0.8541330	0.8774013	0.8987694	0.9181909	ZEROES OF P SUB	67
0.9356239	0.9510305	0.9643773	0.9756356	0.9847808	ZEROES OF P SUB	67
0.9917933	0.9966530	0.9993654	0.0	0.0	ZEROES OF P SUB	67
0.0229287	0.0687379	0.1144026	0.1598266	0.2049146	ZEROES OF P SUB	68
0.2495716	0.2937037	0.3372182	0.3800235	0.4220296	ZEROES OF P SUB	68
0.4631482	0.5032928	0.5423789	0.5803244	0.6170495	ZEROES OF P SUB	68
0.6524769	0.6865322	0.7191436	0.7502427	0.7797640	ZEROES OF P SUB	68
0.8076455	0.8338285	0.8582579	0.8808824	0.9016543	ZEROES OF P SUB	68
0.9205301	0.9374700	0.9524384	0.9654038	0.9763390	ZEROES OF P SUB	68
0.9852209	0.9920309	0.9967548	0.9993838	0.0	ZEROES OF P SUB	68
0.0451862	0.0902801	0.1351896	0.1798228	0.2240888	ZEROES OF P SUB	69
0.2678969	0.3111577	0.3537828	0.3956852	0.4367792	ZEROES OF P SUB	69
0.4769809	0.5162081	0.5543808	0.5914209	0.6272528	ZEROES OF P SUB	69
0.6618032	0.6950016	0.7267801	0.7570739	0.7858210	ZEROES OF P SUB	69
0.8129628	0.8384437	0.8622117	0.8842182	0.9044184	ZEROES OF P SUB	69
0.9227708	0.9392391	0.9537866	0.9663866	0.9770123	ZEROES OF P SUB	69
0.9856421	0.9922583	0.9968475	0.9994014	0.0	ZEROES OF P SUB	69
0.0222784	0.0667910	0.1111709	0.1553301	0.1991810	ZEROES OF P SUB	70
0.2426364	0.2856100	0.3280166	0.3697720	0.4107932	ZEROES OF P SUB	70
0.4509988	0.4903090	0.5286457	0.5659329	0.6020964	ZEROES OF P SUB	70
0.6370646	0.6707679	0.7031394	0.7341150	0.7636330	ZEROES OF P SUB	70
0.7916349	0.8180651	0.8428711	0.8660036	0.8874168	ZEROES OF P SUB	70
0.9070681	0.9249185	0.9409326	0.9550785	0.9673282	ZEROES OF P SUB	70
0.9776574	0.9860456	0.9924761	0.9969363	0.9994183	ZEROES OF P SUB	70
0.0439231	0.0877615	0.1314305	0.1748457	0.2179235	ZEROES OF P SUB	71

0.2605806	0.3027347	0.3443043	0.3852097	0.4253713	ZEROES OF P SUB	71
0.4647118	0.5031553	0.5406276	0.5770563	0.6123712	ZEROES OF P SUB	71
0.6465040	0.6793689	0.7109624	0.7411635	0.7699340	ZEROES OF P SUB	71
0.7972183	0.8229638	0.8471207	0.8696424	0.8904855	ZEROES OF P SUB	71
0.9096098	0.9269782	0.9425573	0.9563171	0.9682309	ZEROES OF P SUB	71
0.9782757	0.9864323	0.9926848	0.9970213	0.9994344	ZEROES OF P SUB	71
0.0216639	0.0649512	0.1081164	0.1510788	0.1937574	ZEROES OF P SUB	72
0.2360723	0.2779440	0.3192939	0.3600444	0.4001189	ZEROES OF P SUB	72
0.4394422	0.4779406	0.5155416	0.5521748	0.5877713	ZEROES OF P SUB	72
0.6222643	0.6555891	0.6876831	0.7184861	0.7479401	ZEROES OF P SUB	72
0.7759900	0.8025830	0.8276693	0.8512017	0.8731361	ZEROES OF P SUB	72
0.8934313	0.9120491	0.9289546	0.9441162	0.9575052	ZEROES OF P SUB	72
0.9690967	0.9788688	0.9868032	0.9928850	0.9971029	ZEROES OF P SUB	72
0.9994499	0.0	0.0	0.0	0.0	ZEROES OF P SUB	72
0.0427288	0.0853795	0.1278742	0.1701354	0.2120857	ZEROES OF P SUB	73
0.2536487	0.2947484	0.3353096	0.3752583	0.4145216	ZEROES OF P SUB	73
0.4530277	0.4907062	0.5274884	0.5633070	0.5980967	ZEROES OF P SUB	73
0.6317938	0.6643369	0.6956665	0.7257253	0.7544584	ZEROES OF P SUB	73
0.7818134	0.8077403	0.8321917	0.8551230	0.8764922	ZEROES OF P SUB	73
0.8962604	0.9143915	0.9308522	0.9456126	0.9586457	ZEROES OF P SUB	73
0.9699277	0.9794379	0.9871590	0.9930770	0.9971811	ZEROES OF P SUB	73
0.9994648	0.0	0.0	0.0	0.0	ZEROES OF P SUB	73
0.0210825	0.0632099	0.1052250	0.1470530	0.1886196	ZEROES OF P SUB	74
0.2298508	0.2706733	0.3110146	0.3508029	0.3899674	ZEROES OF P SUB	74
0.4284387	0.4661482	0.5030289	0.5390152	0.5740432	ZEROES OF P SUB	74
0.6080505	0.6409768	0.6727634	0.7033539	0.7326938	ZEROES OF P SUB	74
0.7607311	0.7874157	0.8127004	0.8365402	0.8588926	ZEROES OF P SUB	74
0.8797179	0.8989791	0.9166420	0.9326751	0.9470499	ZEROES OF P SUB	74
0.9597410	0.9707256	0.9799843	0.9875007	0.9932614	ZEROES OF P SUB	74
0.9972563	0.9994791	0.0	0.0	0.0	ZEROES OF P SUB	74
0.0415976	0.0831231	0.1245048	0.1656709	0.2065503	ZEROES OF P SUB	75
0.2470720	0.2871660	0.3267629	0.3657941	0.4041920	ZEROES OF P SUB	75
0.4418902	0.4788234	0.5149277	0.5501406	0.5844010	ZEROES OF P SUB	75
0.6176497	0.6498292	0.6808837	0.7107595	0.7394043	ZEROES OF P SUB	75
0.7667701	0.7928079	0.8174733	0.8407234	0.8625182	ZEROES OF P SUB	75
0.8828197	0.9015929	0.9188053	0.9344271	0.9484312	ZEROES OF P SUB	75
0.9607934	0.9714923	0.9805093	0.9878290	0.9934385	ZEROES OF P SUB	75
0.9973284	0.9994928	0.0	0.0	0.0	ZEROES OF P SUB	75
0.0205314	0.0615596	0.1024840	0.1432355	0.1837456	ZEROES OF P SUB	76
0.2239458	0.2637684	0.3031462	0.3420128	0.3803028	ZEROES OF P SUB	76
0.4179514	0.4548953	0.4910721	0.5264209	0.5608820	ZEROES OF P SUB	76
0.5943974	0.6269104	0.6583664	0.6887121	0.7178966	ZEROES OF P SUB	76
0.7458705	0.7725867	0.7980002	0.8220680	0.8447497	ZEROES OF P SUB	76
0.8660069	0.8858038	0.9041071	0.9208859	0.9361118	ZEROES OF P SUB	76
0.9497592	0.9618051	0.9722292	0.9810139	0.9881445	ZEROES OF P SUB	76
0.9936088	0.9973978	0.9995059	0.0	0.0	ZEROES OF P SUB	76
0.0405247	0.0809829	0.1213080	0.1614338	0.2012943	ZEROES OF P SUB	77
0.2408242	0.2799583	0.3186325	0.3567832	0.3943476	ZEROES OF P SUB	77
0.4312642	0.4674722	0.5029122	0.5375258	0.5712563	ZEROES OF P SUB	77
0.6040483	0.6358477	0.6666025	0.6962621	0.7247777	ZEROES OF P SUB	77
0.7521025	0.7781916	0.8030021	0.8264933	0.8486266	ZEROES OF P SUB	77
0.8693656	0.8886762	0.9065267	0.9228878	0.9377326	ZEROES OF P SUB	77
0.9510367	0.9627783	0.9729380	0.9814992	0.9884478	ZEROES OF P SUB	77
0.9937725	0.9974645	0.9995186	0.0	0.0	ZEROES OF P SUB	77
0.0200084	0.0599932	0.0998819	0.1396106	0.1791158	ZEROES OF P SUB	78

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0.2183341	0.2572028	0.2956596	0.3336429	0.3710919	ZEROES	OF	P	SUB	78
0.4079467	0.4441482	0.4796384	0.5143605	0.5482589	ZEROES	OF	P	SUB	78
0.5812793	0.6133688	0.6444761	0.6745514	0.7035464	ZEROES	OF	P	SUB	78
0.7314147	0.7581117	0.7835947	0.8078228	0.8307573	ZEROES	OF	P	SUB	78
0.8523614	0.8726005	0.8914422	0.9088564	0.9248151	ZEROES	OF	P	SUB	78
0.9392928	0.9522663	0.9637148	0.9736201	0.9819662	ZEROES	OF	P	SUB	78
0.9887397	0.9939300	0.9975286	0.9995308	0.0	ZEROES	OF	P	SUB	78
0.0395058	0.0789500	0.1182708	0.1574070	0.1962975	ZEROES	OF	P	SUB	79
0.2348814	0.2730986	0.3108894	0.3481947	0.3849565	ZEROES	OF	P	SUB	79
0.4211171	0.4566202	0.4914104	0.5254332	0.5586357	ZEROES	OF	P	SUB	79
0.5909660	0.6223735	0.6528092	0.6822257	0.7105769	ZEROES	OF	P	SUB	79
0.7378187	0.7639084	0.7888054	0.8124708	0.8348676	ZERGES	OF	P	SUB	79
0.8559609	0.8757176	0.8941071	0.9111005	0.9266713	ZEROES	OF	P	SUB	79
0.9407952	0.9534502	0.9646165	0.9742767	0.9824157	ZEROES	OF	P	SUB	79
0.9890207	0.9940816	0.9975904	0.9995425	0.0	ZEROES	OF	P	SUB	79
0.0195114	0.0585044	0.0974084	0.1361640	0.1747123	ZEROES	OF	P	SUB	80
0.2129945	0.2509524	0.2885281	0.3256644	0.3623048	ZEROES	OF	P	SUB	80
0.3983934	0.4338754	0.4686966	0.5028041	0.5361459	ZEROES	OF	P	SUB	80
0.5686713	0.6003306	0.6310758	0.6608599	0.6896376	ZEROES	OF	P	SUB	80
0.7173652	0.7440003	0.7695024	0.7938327	0.8169541	ZEROES	OF	P	SUB	80
0.8388315	0.8594314	0.8787226	0.8966756	0.9132631	ZEROES	OF	P	SUB	80
0.9264599	0.9422428	0.9545908	0.9654851	0.9749091	ZEROES	OF	P	SUB	80
0.9828486	0.9892913	0.9942275	0.9976499	0.9995538	ZEROES	OF	P	SUB	80
0.0385369	0.0770165	0.1153817	0.1535755	0.1915411	ZEROES	OF	P	SUB	81
0.2292221	0.2665626	0.3035071	0.3400006	0.3759890	ZERGES	OF	P	SUB	81
0.4114188	0.4462373	0.4803929	0.5138347	0.5465132	ZEROES	OF	P	SUB	81
0.5783797	0.6093869	0.6394887	0.6686405	0.6967988	ZEROES	OF	P	SUB	81
0.7239219	0.7499695	0.7749028	0.7986849	0.8212804	ZERGES	OF	P	SUB	81
0.8426557	0.8627791	0.8816206	0.8991523	0.9153482	ZEROES	OF	P	SUB	81
0.9301841	0.9436380	0.9556900	0.9663221	0.9755186	ZEROES	OF	P	SUB	81
0.9832657	0.9895520	0.9943682	0.9977072	0.9995647	ZEROES	OF	P	SUB	81
0.0190385	0.0570878	0.0950543	0.1328830	0.1705191	ZEROES	OF	P	SUB	82
0.2079079	0.2449952	0.2817274	0.3180511	0.3539136	ZEROES	OF	P	SUB	82
0.3892630	0.4240479	0.4582181	0.4917239	0.5245167	ZEROES	OF	P	SUB	82
0.5565491	0.5877745	0.6181476	0.6476246	0.6761625	ZEROES	OF	P	SUB	82
0.7037200	0.7302573	0.7557357	0.7801184	0.8033700	ZEROES	OF	P	SUB	82
0.8254567	0.8463467	0.8660095	0.8844167	0.9015416	ZEROES	OF	P	SUB	82
0.9173593	0.9318469	0.9449835	0.9567499	0.9671291	ZEROES	OF	P	SUB	82
0.9761061	0.9836678	0.9898033	0.9945038	0.9977624	ZERGES	OF	P	SUB	82
0.9995752	0.0	0.0	0.0	0.0	ZEROES	OF	P	SUB	82
0.0376143	0.0751754	0.1126301	0.1499253	0.1870084	ZEROES	OF	P	SUB	83
0.2238267	0.2603283	0.2964614	0.3321749	0.3674182	ZEROES	OF	P	SUB	83
0.4021415	0.4362956	0.4698322	0.5027038	0.5348639	ZERGES	OF	P	SUB	83
0.5662669	0.5968684	0.6266252	0.6554950	0.6834370	ZEROES	OF	P	SUB	83
0.7104117	0.7363609	0.7613079	0.7851573	0.8078953	ZERGES	OF	P	SUB	83
0.8294899	0.8499105	0.8691281	0.8871155	0.9038474	ZEROES	OF	P	SUB	83
0.9192999	0.9334513	0.9462815	0.9577723	0.9679075	ZEROES	OF	P	SUB	83
0.9766728	0.9840556	0.9900457	0.9946345	0.9978156	ZEROES	OF	P	SUB	83
0.9995853	0.0	0.0	0.0	0.0	ZEROES	OF	P	SUB	83
0.0185879	0.0557380	0.0928111	0.1297560	0.1665214	ZEROES	OF	P	SUB	84
0.2030568	0.2393115	0.2752354	0.3107790	0.3458930	ZEROES	OF	P	SUB	84
0.3805290	0.4146390	0.4481760	0.4810935	0.5133462	ZEROES	OF	P	SUB	84
0.5448893	0.5756794	0.6056738	0.6348311	0.6631111	ZERGES	OF	P	SUB	84
0.6904745	0.7168837	0.7423020	0.7666944	0.7900272	ZEROES	OF	P	SUB	84
0.8122681	0.8333864	0.8533529	0.8721399	0.8897216	ZEROES	OF	P	SUB	84

0.9060736	0.9211733	0.9349999	0.9475342	0.9587590	ZEROES OF P SUB	84
0.9686586	0.9772195	0.9844298	0.9902795	0.9947606	ZEROES OF P SUB	84
0.9978670	0.9995951	0.0	0.0	0.0	ZEROES OF P SUB	84
0.0367349	0.0734202	0.1100063	0.1464440	0.1826840	ZEROES OF P SUB	85
0.2186774	0.2543755	0.2897303	0.3246939	0.3592192	ZEROES OF P SUB	85
0.3932596	0.4267691	0.4597025	0.4920153	0.5236640	ZEROES OF P SUB	85
0.5546057	0.5847987	0.6142022	0.6427766	0.6704833	ZEROES OF P SUB	85
0.6972849	0.7231451	0.7480292	0.7719035	0.7947357	ZEROES OF P SUB	85
0.8164950	0.8371522	0.8566792	0.8750497	0.8922390	ZEROES OF P SUB	85
0.9082238	0.9229825	0.9364952	0.9487438	0.9597115	ZEROES OF P SUB	85
0.9693837	0.9777473	0.9847910	0.9905052	0.9948824	ZEROES OF P SUB	85
0.9979166	0.9996045	0.0	0.0	0.0	ZEROES OF P SUB	85
0.0181582	0.0544506	0.0906713	0.1267723	0.1627061	ZEROES OF P SUB	86
0.1984254	0.2338829	0.2690319	0.3038261	0.3382196	ZEROES OF P SUB	86
0.3721671	0.4056236	0.4385452	0.4708883	0.5026104	ZEROES OF P SUB	86
0.5336696	0.5640249	0.5936363	0.6224648	0.6504722	ZEROES OF P SUB	86
0.6776218	0.7038776	0.7292050	0.7535707	0.7769425	ZEROES OF P SUB	86
0.7992895	0.8205824	0.8407929	0.8598946	0.8778620	ZEROES OF P SUB	86
0.8946717	0.9103013	0.9247304	0.9379398	0.9499121	ZEROES OF P SUB	86
0.9606315	0.9700840	0.9782570	0.9851397	0.9907231	ZEROES OF P SUB	86
0.9949999	0.9979645	0.9996136	0.0	0.0	ZEROES OF P SUB	86
0.0358956	0.0717450	0.1075018	0.1431201	0.1785540	ZEROES OF P SUB	87
0.2137577	0.2486858	0.2832934	0.3175359	0.3513691	ZEROES OF P SUB	87
0.3847494	0.4176337	0.4499798	0.4817458	0.5128909	ZEROES OF P SUB	87
0.5433749	0.5731585	0.6022034	0.6304720	0.6579280	ZEROES OF P SUB	87
0.6845359	0.7102615	0.7350717	0.7589343	0.7818187	ZEROES OF P SUB	87
0.8036954	0.8245362	0.8443141	0.8630038	0.8805812	ZEROES OF P SUB	87
0.8970235	0.9123095	0.9264197	0.9393357	0.9510410	ZEROES OF P SUB	87
0.9615204	0.9707605	0.9787493	0.9854766	0.9909337	ZEROES OF P SUB	87
0.9951135	0.9980107	0.9996224	0.0	0.0	ZEROES OF P SUB	87
0.0177479	0.0532213	0.0886277	0.1239224	0.1590610	ZEROES OF P SUB	88
0.1939991	0.2286928	0.2630984	0.2971724	0.3308720	ZEROES OF P SUB	88
0.3641548	0.3969787	0.4293024	0.4610851	0.4922870	ZEROES OF P SUB	88
0.5228685	0.5527912	0.5820175	0.6105104	0.6382340	ZEROES OF P SUB	88
0.6651535	0.6912349	0.7164453	0.7407530	0.7641274	ZEROES OF P SUB	88
0.7865390	0.8079596	0.8283621	0.8477209	0.8660116	ZEROES OF P SUB	88
0.8832111	0.8992978	0.9142514	0.9280530	0.9406853	ZEROES OF P SUB	88
0.9521323	0.9623796	0.9714144	0.9792252	0.9858022	ZEROES OF P SUB	88
0.9911371	0.9952232	0.9980554	0.9996308	0.0	ZEROES OF P SUB	88
0.0350938	0.0701444	0.1051086	0.1399433	0.1746056	ZEROES OF P SUB	89
0.2090528	0.2432424	0.2771323	0.3106808	0.3438466	ZEROES OF P SUB	89
0.3765888	0.4088669	0.4406414	0.4718730	0.5025233	ZEROES OF P SUB	89
0.5325544	0.5619294	0.5906122	0.6185673	0.6457603	ZEROES OF P SUB	89
0.6721578	0.6977272	0.7224370	0.7462567	0.7691571	ZEROES OF P SUB	89
0.7911098	0.8120879	0.8320655	0.8510181	0.8689221	ZEROES OF P SUB	89
0.8857557	0.9014940	0.9161297	0.9296327	0.9419904	ZEROES OF P SUB	89
0.9531876	0.9632105	0.9720466	0.9796853	0.9861169	ZEROES OF P SUB	89
0.9913337	0.9953292	0.9980986	0.9996390	0.0	ZEROES OF P SUB	89
0.0173557	0.0520463	0.0866741	0.1211975	0.1555749	ZEROES OF P SUB	90
0.1897648	0.2237260	0.2574177	0.2907992	0.3238304	ZEROES OF P SUB	90
0.3564713	0.3886827	0.4204258	0.4516623	0.4823546	ZEROES OF P SUB	90
0.5124657	0.5419593	0.5707999	0.5989527	0.6263838	ZEROES OF P SUB	90
0.6530602	0.6789497	0.7040211	0.7282442	0.7515899	ZEROES OF P SUB	90
0.7740299	0.7955373	0.8160861	0.8356516	0.8542103	ZEROES OF P SUB	90
0.8717396	0.8882186	0.9036273	0.9179473	0.9311612	ZEROES OF P SUB	90

0.9432531	0.9542085	0.9640141	0.9726582	0.9801303	ZEROES	OF	P	SUB	90
0.9864214	0.9915239	0.9954318	0.9981404	0.9996470	ZEROES	OF	P	SUB	90
0.0343771	0.0686137	0.1028195	0.1369040	0.1708272	ZEROES	OF	P	SUB	91
0.2045490	0.2380297	0.2712299	0.3041103	0.3368323	ZEROES	OF	P	SUB	91
0.3687574	0.4004479	0.4316664	0.4623761	0.4925407	ZEROES	OF	P	SUB	91
0.5221248	0.5510934	0.5794124	0.6070485	0.6339690	ZEROES	OF	P	SUB	91
0.6601423	0.6855374	0.7101244	0.7338744	0.7567594	ZEROES	OF	P	SUB	91
0.7787523	0.7998273	0.8199595	0.8391252	0.8573018	ZEROES	OF	P	SUB	91
0.8744679	0.8906032	0.9056887	0.9197067	0.9326406	ZEROES	OF	P	SUB	91
0.9444751	0.9551964	0.9647917	0.9732499	0.9805608	ZEROES	OF	P	SUB	91
0.9867159	0.9917079	0.9955310	0.9981808	0.9996546	ZEROES	OF	P	SUB	91
0.0169805	0.0509220	0.0848047	0.1185896	0.1522377	ZEROES	OF	P	SUB	92
0.1857103	0.2189686	0.2519744	0.2846895	0.3170763	ZEROES	OF	P	SUB	92
0.3490974	0.3807159	0.4118952	0.4425995	0.4727933	ZEROES	OF	P	SUB	92
0.5024417	0.5315107	0.5599666	0.5877767	0.6149088	ZEROES	OF	P	SUB	92
0.6413317	0.6670149	0.6919288	0.7160446	0.7393345	ZEROES	OF	P	SUB	92
0.7617717	0.7833303	0.8039854	0.8237132	0.8424909	ZEROES	OF	P	SUB	92
0.8602969	0.8771107	0.8929129	0.9076851	0.9214104	ZEROES	OF	P	SUB	92
0.9340730	0.9456582	0.9561528	0.9655445	0.9738226	ZEROES	OF	P	SUB	92
0.9809775	0.9870009	0.9918860	0.9956271	0.9982199	ZEROES	OF	P	SUB	92
0.9996621	0.0	0.0	0.0	0.0	ZEROES	OF	P	SUB	92
0.0335931	0.0671483	0.1006277	0.1339935	0.1672081	ZEROES	OF	P	SUB	93
0.2002339	0.2330336	0.2655703	0.2978072	0.3297080	ZEROES	OF	P	SUB	93
0.3612365	0.3923573	0.4230351	0.4532354	0.4829241	ZEROES	OF	P	SUB	93
0.5120676	0.5406331	0.5685883	0.5959016	0.6225423	ZEROES	OF	P	SUB	93
0.6484802	0.6736860	0.6981314	0.7217887	0.7446312	ZEROES	OF	P	SUB	93
0.7666331	0.7877696	0.8080168	0.8273519	0.8457531	ZEROES	OF	P	SUB	93
0.8631995	0.8796715	0.8951505	0.9096190	0.9230607	ZEROES	OF	P	SUB	93
0.9354604	0.9468040	0.9570789	0.9662734	0.9743771	ZEROES	OF	P	SUB	93
0.9813809	0.9872769	0.9920584	0.9957200	0.9982578	ZEROES	OF	P	SUB	93
0.9996693	0.0	0.0	0.0	0.0	ZEROES	OF	P	SUB	93
0.0166212	0.0498452	0.0830141	0.1160913	0.1490402	ZEROES	OF	P	SUB	94
0.1818244	0.2144076	0.2467539	0.2788276	0.3105931	ZEROES	OF	P	SUB	94
0.3420154	0.3730597	0.4036917	0.4338777	0.4635841	ZEROES	OF	P	SUB	94
0.4927783	0.5214279	0.5495013	0.5769674	0.6037960	ZEROES	OF	P	SUB	94
0.6299572	0.6554224	0.6801632	0.7041524	0.7273635	ZEROES	OF	P	SUB	94
0.7497707	0.7713494	0.7920757	0.8119266	0.8308804	ZEROES	OF	P	SUB	94
0.8489159	0.8660133	0.8821537	0.8973192	0.9114931	ZEROES	OF	P	SUB	94
0.9246597	0.9368045	0.9479141	0.9579761	0.9669795	ZEROES	OF	P	SUB	94
0.9749143	0.9817717	0.9875442	0.9922254	0.9958101	ZEROES	OF	P	SUB	94
0.9982944	0.9996762	0.0	0.0	0.0	ZEROES	OF	P	SUB	94
0.0328899	0.0657442	0.0985273	0.1312038	0.1637384	ZEROES	OF	P	SUB	95
0.1960958	0.2282410	0.2601392	0.2917559	0.3230570	ZEROES	OF	P	SUB	95
0.3540085	0.3845769	0.4147291	0.4444326	0.4736552	ZEROES	OF	P	SUB	95
0.5023653	0.5305318	0.5581242	0.5851127	0.6114680	ZEROES	OF	P	SUB	95
0.6371618	0.6621660	0.6864538	0.7099987	0.7327754	ZEROES	OF	P	SUB	95
0.7547592	0.7759263	0.7962537	0.8157196	0.8343028	ZEROES	OF	P	SUB	95
0.8519833	0.8687418	0.8845608	0.8994217	0.9133098	ZEROES	OF	P	SUB	95
0.9262097	0.9381073	0.9489898	0.9588455	0.9676637	ZEROES	OF	P	SUB	95
0.9754347	0.9821503	0.9878032	0.9923871	0.9958973	ZEROES	OF	P	SUB	95
0.9983300	0.9996830	0.0	0.0	0.0	ZEROES	OF	P	SUB	95
0.0162767	0.0488130	0.0812975	0.1136959	0.1459737	ZEROES	OF	P	SUB	96
0.1780969	0.2100313	0.2417432	0.2731988	0.3043649	ZEROES	OF	P	SUB	96
0.3352085	0.3656969	0.3957976	0.4254790	0.4547094	ZEROES	OF	P	SUB	96
0.4834580	0.5116942	0.5393881	0.5665104	0.5930324	ZEROES	OF	P	SUB	96

0.6189258	0.6441634	0.6687183	0.6925645	0.7156768	ZEROES OF P SUB	96
0.7380306	0.7596023	0.7803690	0.8003087	0.8194003	ZEROES OF P SUB	96
0.8376235	0.8549590	0.8713885	0.8868945	0.9014606	ZEROES OF P SUB	96
0.9150714	0.9277125	0.9393703	0.9500327	0.9596883	ZEROES OF P SUB	96
0.9683268	0.9759392	0.9825173	0.9880541	0.9925439	ZEROES OF P SUB	96
0.9959818	0.9983644	0.9996895	0.0	0.0	ZEROES OF P SUB	96
0.0322155	0.0643975	0.0965127	0.1285276	0.1604092	ZEROES OF P SUB	97
0.1921242	0.2236398	0.2549232	0.2859419	0.3166639	ZEROES OF P SUB	97
0.3470570	0.3770899	0.4067313	0.4359505	0.4647171	ZEROES OF P SUB	97
0.4930012	0.5207736	0.5480053	0.5746681	0.6007344	ZEROES OF P SUB	97
0.6261770	0.6509695	0.6750863	0.6985022	0.7211930	ZEROES OF P SUB	97
0.7431351	0.7643057	0.7846828	0.8042454	0.8229730	ZEROES OF P SUB	97
0.8408463	0.8578467	0.8739565	0.8891591	0.9034386	ZEROES OF P SUB	97
0.9167801	0.9291700	0.9405952	0.9510440	0.9605055	ZEROES OF P SUB	97
0.9689699	0.9764283	0.9828730	0.9882974	0.9926959	ZEROES OF P SUB	97
0.9960638	0.9983977	0.9996958	0.0	0.0	ZEROES OF P SUB	97
0.0159463	0.0478226	0.0796504	0.1113971	0.1430305	ZEROES OF P SUB	98
0.1745184	0.2058287	0.2369298	0.2677898	0.2983775	ZEROES OF P SUB	98
0.3286616	0.3586114	0.3881965	0.4173868	0.4461524	ZEROES OF P SUB	98
0.4744643	0.5022935	0.5296119	0.5563915	0.5826052	ZEROES OF P SUB	98
0.6082263	0.6332287	0.6575871	0.6812765	0.7042730	ZEROES OF P SUB	98
0.7265531	0.7480942	0.7688744	0.7888725	0.8080682	ZEROES OF P SUB	98
0.8264420	0.8439751	0.8606498	0.8764490	0.8913568	ZEROES OF P SUB	98
0.9053579	0.9184381	0.9305841	0.9417835	0.9520250	ZEROES OF P SUB	98
0.9612981	0.9695935	0.9769026	0.9832180	0.9885334	ZEROES OF P SUB	98
0.9928433	0.9961433	0.9984301	0.9997020	0.0	ZEROES OF P SUB	98
0.0315682	0.0631048	0.0945786	0.1259581	0.1572121	ZEROES OF P SUB	99
0.1883093	0.2192188	0.2499098	0.2803517	0.3105141	ZEROES OF P SUB	99
0.3403670	0.3698806	0.3990255	0.4277727	0.4560934	ZEROES OF P SUB	99
0.4839595	0.5113432	0.5382171	0.5645546	0.5903292	ZEROES OF P SUB	99
0.6155155	0.6400881	0.6640228	0.6872955	0.7098831	ZEROES OF P SUB	99
0.7317630	0.7529136	0.7733136	0.7929427	0.8117815	ZEROES OF P SUB	99
0.8298110	0.8470133	0.8633714	0.8788688	0.8934901	ZEROES OF P SUB	99
0.9072208	0.9200471	0.9319564	0.9429366	0.9529769	ZEROES OF P SUB	99
0.9620672	0.9701986	0.9773628	0.9835527	0.9887623	ZEROES OF P SUB	99
0.9929862	0.9962203	0.9984615	0.9997079	0.0	ZEROES OF P SUB	99
0.0156290	0.0468717	0.0780686	0.1091892	0.1402031	ZEROES OF P SUB	100
0.1710801	0.2017899	0.2323025	0.2625891	0.2926172	ZEROES OF P SUB	100
0.3223603	0.3517885	0.3808730	0.4095853	0.4378974	ZEROES OF P SUB	100
0.4657816	0.4932108	0.5201580	0.5465970	0.5725019	ZEROES OF P SUB	100
0.5978475	0.6226089	0.6467619	0.6702830	0.6931492	ZEROES OF P SUB	100
0.7153381	0.7368281	0.7575981	0.7776279	0.7968979	ZEROES OF P SUB	100
0.8153892	0.8330839	0.8499645	0.8660147	0.8812187	ZEROES OF P SUB	100
0.8955616	0.9090296	0.9216093	0.9332885	0.9440559	ZEROES OF P SUB	100
0.9539003	0.9628137	0.9707858	0.9778094	0.9838775	ZEROES OF P SUB	100
0.9889844	0.9931249	0.9962951	0.9984920	0.9997137	ZEROES OF P SUB	100

7.2 Input for SITBB: (See page 117.)

199		32							
1	10.00	0.17	0.00002	0.0	0.0	TOTAL OZONE	0.250		
2	10.00	0.74	0.00016	0.0	0.0	TOTAL OZONE	0.250		
3	5.00	0.90	0.00290	1.00E+03	0.0	TOTAL OZONE	0.250		
4	5.00	1.53	0.00722	2.00E+03	0.0	TOTAL OZONE	0.250		
5	5.00	3.16	0.01750	5.00E+03	0.0	TOTAL OZONE	0.250		
6	5.00	6.55	0.03840	1.10E+04	0.0	TOTAL OZONE	0.250		
7	5.00	13.75	0.06650	3.40E+04	0.0	TOTAL OZONE	0.250		
8	1.00	4.30	0.01500	2.40E+04	0.0	TOTAL OZONE	0.250		
9	1.00	5.10	0.01460	4.50E+04	0.0	TOTAL OZONE	0.250		
10	1.00	6.00	0.01360	6.80E+04	0.0	TOTAL OZONE	0.250		
11	1.00	7.20	0.01220	1.00E+05	0.0	TOTAL OZONE	0.250		
12	1.00	8.30	0.01120	1.24E+05	0.0	TOTAL OZONE	0.250		
13	1.00	9.60	0.00920	1.24E+05	0.0	TOTAL OZONE	0.250		
14	1.00	11.20	0.00710	1.14E+05	0.0	TOTAL OZONE	0.250		
15	1.00	12.60	0.00510	1.03E+05	0.0	TOTAL OZONE	0.250		
16	1.00	14.50	0.00400	9.40E+04	0.0	TOTAL OZONE	0.250		
17	1.00	17.50	0.00240	8.50E+04	0.0	TOTAL OZONE	0.250		
18	1.00	21.50	0.00120	5.00E+04	1.00E+04	TOTAL OZONE	0.250		
19	1.00	24.50	0.00100	1.50E+04	3.00E+04	TOTAL OZONE	0.250		
20	1.00	27.50	0.00080	1.00E+03	6.00E+04	TOTAL OZONE	0.250		
21	1.00	31.50	0.00070	0.0	1.00E+05	TOTAL OZONE	0.250		
22	1.00	35.50	0.00065	0.0	1.00E+05	TOTAL OZONE	0.250		
23	1.00	40.50	0.00065	0.0	1.00E+05	TOTAL OZONE	0.250		
24	1.00	45.00	0.00080	0.0	1.00E+05	TOTAL OZONE	0.250		
25	1.00	51.00	0.00125	0.0	1.00E+05	TOTAL OZONE	0.250		
26	1.00	61.00	0.00150	0.0	1.00E+05	TOTAL OZONE	0.250		
27	1.00	69.00	0.00190	0.0	3.00E+05	TOTAL OZONE	0.250		
28	1.00	75.00	0.00230	0.0	6.00E+05	TOTAL OZONE	0.250		
29	1.00	87.00	0.00245	0.0	1.00E+06	TOTAL OZONE	0.250		
30	1.00	97.00	0.00265	0.0	3.00E+06	TOTAL OZONE	0.250		
31	1.00	100.00	0.00265	0.0	8.90E+06	TOTAL OZONE	0.250		
32	1.00	111.00	0.00240	0.0	2.55E+07	TOTAL OZONE	0.250		
1.00000		1.00000							
1	0.3125	1.0200	1.6700						
0.31250	1.50000	0.05000	45	2.01482E-09	7.34689E-10	HAZE : H			
9.99999E-01	2.31931E+00	3.02192E+00	3.16032E+00	3.08516E+00	1	0.31250			
2.85267E+00	2.52777E+00	2.20191E+00	1.84584E+00	1.53183E+00	6	0.31250			
1.24008E+00	9.84230E-01	7.80118E-01	5.94399E-01	4.64923E-01	11	0.31250			
3.41938E-01	2.64741E-01	1.89282E-01	1.45004E-01	1.01564E-01	16	0.31250			
7.68209E-02	5.30808E-02	3.95633E-02	2.71256E-02	1.98909E-02	21	0.31250			
1.35834E-02	9.80077E-03	6.67955E-03	4.74663E-03	3.22990E-03	26	0.31250			
2.26442E-03	1.53789E-03	1.06572E-03	7.21714E-04	4.95168E-04	31	0.31250			
3.33958E-04	2.27068E-04	1.52253E-04	1.02582E-04	6.82274E-05	36	0.31250			
4.54755E-05	2.98915E-05	1.96272E-05	1.26615E-05	8.11148E-06	41	0.31250			
0.31250	1.50000	0.05000	125	3.01283E-09	1.71144E-09	HAZE : L			
1.00000E+00	2.45213E+00	3.46431E+00	4.05385E+00	4.50899E+00	1	0.31250			
4.78294E+00	4.94793E+00	5.02117E+00	4.99381E+00	4.92181E+00	6	0.31250			
4.78130E+00	4.61482E+00	4.41865E+00	4.20012E+00	3.98373E+00	11	0.31250			
3.74525E+00	3.52819E+00	3.29165E+00	3.08409E+00	2.86257E+00	16	0.31250			
2.66988E+00	2.46981E+00	2.29476E+00	2.11822E+00	1.96181E+00	21	0.31250			
1.80826E+00	1.67053E+00	1.53819E+00	1.41831E+00	1.30500E+00	26	0.31250			
1.20200E+00	1.10524E+00	1.01667E+00	9.34350E-01	8.58904E-01	31	0.31250			
7.89051E-01	7.25028E-01	6.65875E-01	6.11691E-01	5.61689E-01	36	0.31250			
5.15911E-01	4.73706E-01	4.35079E-01	3.99495E-01	3.66928E-01	41	0.31250			

3.36945E-01	3.09501E-01	2.84254E-01	2.61134E-01	2.39878E-01	46	0.31250
2.20404E-01	2.02510E-01	1.86104E-01	1.71038E-01	1.57218E-01	51	0.31250
1.44528E-01	1.32684E-01	1.22191E-01	1.12377E-01	1.03366E-01	56	0.31250
9.50922E-02	8.74916E-02	8.05149E-02	7.41100E-02	6.82161E-02	61	0.31250
6.27990E-02	5.78208E-02	5.32441E-02	4.90368E-02	4.51676E-02	66	0.31250
4.16095E-02	3.83363E-02	3.53251E-02	3.25543E-02	3.00044E-02	71	0.31250
2.76571E-02	2.54962E-02	2.35064E-02	2.16740E-02	1.99859E-02	76	0.31250
1.84309E-02	1.69981E-02	1.56775E-02	1.44604E-02	1.33382E-02	81	0.31250
1.23038E-02	1.13496E-02	1.04636E-02	9.65778E-03	8.90880E-03	86	0.31250
8.21771E-03	7.57992E-03	6.99124E-03	6.44777E-03	5.94608E-03	91	0.31250
5.48299E-03	5.05519E-03	4.66022E-03	4.29520E-03	3.95801E-03	96	0.31250
3.64652E-03	3.35873E-03	3.09283E-03	2.84713E-03	2.62011E-03	101	0.31250
2.41034E-03	2.21651E-03	2.03739E-03	1.87189E-03	1.71897E-03	106	0.31250
1.57768E-03	1.44717E-03	1.32660E-03	1.21525E-03	1.11241E-03	111	0.31250
1.01747E-03	9.29842E-04	8.48968E-04	7.74362E-04	7.05556E-04	116	0.31250
6.42124E-04	5.83674E-04	5.29835E-04	4.80274E-04	4.34680E-04	121	0.31250

VIII. OUTPUT FROM A TEST RUN

8.1 Output from SITAA: Note: Only a selected portion of the output is reproduced in the following pages (see page 120).

INTEGRAL EXP(-TAU/MU) * P SUB 0 OF MU * DMU FOR TAU EQUAL TO

TAU	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	1.0000E+00	9.4966E-01	9.1311E-01	8.8167E-01	8.5354E-01	8.2783E-01	8.0405E-01	7.8184E-01	7.6096E-01	7.4124E-01
0.100	7.2254E-01	7.0475E-01	6.8778E-01	6.7154E-01	6.5598E-01	6.4104E-01	6.2667E-01	6.1284E-01	5.9951E-01	5.8664E-01
0.200	5.7420E-01	5.6217E-01	5.5054E-01	5.3926E-01	5.2833E-01	5.1773E-01	5.0744E-01	4.9745E-01	4.8774E-01	4.7830E-01
0.300	4.6912E-01	4.6018E-01	4.5148E-01	4.4301E-01	4.3476E-01	4.2671E-01	4.1887E-01	4.1122E-01	4.0376E-01	3.9648E-01
0.400	3.8937E-01	3.8243E-01	3.7565E-01	3.6903E-01	3.6255E-01	3.5623E-01	3.5005E-01	3.4400E-01	3.3809E-01	3.3230E-01
0.500	3.2664E-01	3.2111E-01	3.1569E-01	3.1038E-01	3.0519E-01	3.0010E-01	2.9512E-01	2.9024E-01	2.8546E-01	2.8077E-01
0.600	2.7618E-01	2.7169E-01	2.6728E-01	2.6295E-01	2.5872E-01	2.5456E-01	2.5048E-01	2.4649E-01	2.4257E-01	2.3872E-01
0.700	2.3495E-01	2.3124E-01	2.2761E-01	2.2405E-01	2.2055E-01	2.1711E-01	2.1374E-01	2.1043E-01	2.0718E-01	2.0399E-01
0.800	2.0085E-01	1.9777E-01	1.9475E-01	1.9178E-01	1.8886E-01	1.8600E-01	1.8318E-01	1.8042E-01	1.7770E-01	1.7503E-01
0.900	1.7240E-01	1.6982E-01	1.6729E-01	1.6480E-01	1.6235E-01	1.5994E-01	1.5757E-01	1.5525E-01	1.5296E-01	1.5071E-01
1.000	1.4850E-01	1.4632E-01	1.4418E-01	1.4208E-01	1.4001E-01	1.3797E-01	1.3597E-01	1.3400E-01	1.3206E-01	1.3016E-01
1.100	1.2828E-01	1.2644E-01	1.2462E-01	1.2283E-01	1.2108E-01	1.1935E-01	1.1765E-01	1.1597E-01	1.1432E-01	1.1270E-01
1.200	1.1110E-01	1.0953E-01	1.0799E-01	1.0646E-01	1.0496E-01	1.0349E-01	1.0204E-01	1.0061E-01	9.9197E-02	9.7811E-02
1.300	9.6446E-02	9.5101E-02	9.3778E-02	9.2475E-02	9.1191E-02	8.9927E-02	8.8683E-02	8.7457E-02	8.6250E-02	8.5061E-02
1.400	8.3890E-02	8.2736E-02	8.1600E-02	8.0481E-02	7.9379E-02	7.8293E-02	7.7223E-02	7.6169E-02	7.5131E-02	7.4108E-02
1.500	7.3101E-02	7.2103E-02	7.1130E-02	7.0166E-02	6.9216E-02	6.8281E-02	6.7359E-02	6.6450E-02	6.5555E-02	6.4673E-02
1.600	6.3803E-02	6.2946E-02	6.2102E-02	6.1270E-02	6.0450E-02	5.9641E-02	5.8845E-02	5.8059E-02	5.7285E-02	5.6523E-02
1.700	5.5771E-02	5.5029E-02	5.4299E-02	5.3579E-02	5.2869E-02	5.2169E-02	5.1479E-02	5.0799E-02	5.0128E-02	4.9467E-02
1.800	4.8815E-02	4.8173E-02	4.7539E-02	4.6915E-02	4.6299E-02	4.5691E-02	4.5093E-02	4.4502E-02	4.3920E-02	4.3346E-02
1.900	4.2780E-02	4.2222E-02	4.1672E-02	4.1129E-02	4.0594E-02	4.0066E-02	3.9546E-02	3.9032E-02	3.8526E-02	3.8027E-02
2.000	3.7534E-02	3.7049E-02	3.6570E-02	3.6097E-02	3.5631E-02	3.5172E-02	3.4718E-02	3.4271E-02	3.3830E-02	3.3395E-02
2.100	3.2966E-02	3.2543E-02	3.2126E-02	3.1714E-02	3.1307E-02	3.0907E-02	3.0511E-02	3.0121E-02	2.9737E-02	2.9357E-02
2.200	2.8983E-02	2.8613E-02	2.8249E-02	2.7889E-02	2.7535E-02	2.7185E-02	2.6839E-02	2.6499E-02	2.6162E-02	2.5831E-02
2.300	2.5504E-02	2.5181E-02	2.4862E-02	2.4548E-02	2.4238E-02	2.3932E-02	2.3630E-02	2.3332E-02	2.3038E-02	2.2748E-02
2.400	2.2461E-02	2.2179E-02	2.1900E-02	2.1625E-02	2.1353E-02	2.1085E-02	2.0821E-02	2.0560E-02	2.0303E-02	2.0048E-02
2.500	1.9798E-02	1.9550E-02	1.9306E-02	1.9065E-02	1.8827E-02	1.8592E-02	1.8360E-02	1.8132E-02	1.7906E-02	1.7683E-02
2.600	1.7463E-02	1.7246E-02	1.7032E-02	1.6820E-02	1.6611E-02	1.6405E-02	1.6202E-02	1.6001E-02	1.5803E-02	1.5608E-02
2.700	1.5414E-02	1.5224E-02	1.5036E-02	1.4850E-02	1.4667E-02	1.4486E-02	1.4307E-02	1.4131E-02	1.3957E-02	1.3785E-02
2.800	1.3615E-02	1.3448E-02	1.3282E-02	1.3119E-02	1.2958E-02	1.2799E-02	1.2642E-02	1.2487E-02	1.2334E-02	1.2183E-02
2.900	1.2034E-02	1.1886E-02	1.1741E-02	1.1597E-02	1.1456E-02	1.1316E-02	1.1177E-02	1.1041E-02	1.0906E-02	1.0773E-02
3.000	1.0642E-02	1.0512E-02	1.0384E-02	1.0258E-02	1.0133E-02	1.0010E-02	9.8881E-03	9.7680E-03	9.6493E-03	9.5322E-03
3.100	9.4165E-03	9.3023E-03	9.1895E-03	9.0781E-03	8.9681E-03	8.8596E-03	8.7523E-03	8.6464E-03	8.5419E-03	8.4386E-03
3.200	8.3366E-03	8.2359E-03	8.1365E-03	8.0383E-03	7.9413E-03	7.8456E-03	7.7510E-03	7.6576E-03	7.5654E-03	7.4743E-03
3.300	7.3843E-03	7.2955E-03	7.2078E-03	7.1211E-03	7.0355E-03	6.9510E-03	6.8676E-03	6.7852E-03	6.7038E-03	6.6234E-03
3.400	6.5440E-03	6.4655E-03	6.3881E-03	6.3116E-03	6.2360E-03	6.1614E-03	6.0877E-03	6.0149E-03	5.9430E-03	5.8720E-03
3.500	5.8019E-03	5.7326E-03	5.6642E-03	5.5966E-03	5.5299E-03	5.4639E-03	5.3988E-03	5.3345E-03	5.2710E-03	5.2082E-03
3.600	5.1462E-03	5.0850E-03	5.0245E-03	4.9648E-03	4.9058E-03	4.8475E-03	4.7899E-03	4.7331E-03	4.6769E-03	4.6214E-03
3.700	4.5666E-03	4.5124E-03	4.4589E-03	4.4061E-03	4.3539E-03	4.3024E-03	4.2514E-03	4.2011E-03	4.1514E-03	4.1023E-03
3.800	4.0538E-03	4.0059E-03	3.9586E-03	3.9118E-03	3.8657E-03	3.8200E-03	3.7750E-03	3.7304E-03	3.6864E-03	3.6430E-03
3.900	3.6000E-03	3.5576E-03	3.5157E-03	3.4743E-03	3.4334E-03	3.3930E-03	3.3531E-03	3.3137E-03	3.2747E-03	3.2363E-03
4.000	3.1982E-03	3.1607E-03	3.1236E-03	3.0869E-03	3.0507E-03	3.0149E-03	2.9795E-03	2.9446E-03	2.9101E-03	2.8760E-03
4.100	2.8423E-03	2.8090E-03	2.7761E-03	2.7436E-03	2.7115E-03	2.6798E-03	2.6484E-03	2.6175E-03	2.5869E-03	2.5566E-03
4.200	2.5268E-03	2.4973E-03	2.4681E-03	2.4393E-03	2.4108E-03	2.3827E-03	2.3549E-03	2.3275E-03	2.3003E-03	2.2735E-03
4.300	2.2470E-03	2.2209E-03	2.1950E-03	2.1695E-03	2.1442E-03	2.1193E-03	2.0946E-03	2.0702E-03	2.0462E-03	2.0224E-03
4.400	1.9989E-03	1.9757E-03	1.9527E-03	1.9301E-03	1.9077E-03	1.8855E-03	1.8636E-03	1.8420E-03	1.8207E-03	1.7996E-03
4.500	1.7787E-03	1.7581E-03	1.7377E-03	1.7176E-03	1.6977E-03	1.6780E-03	1.6586E-03	1.6394E-03	1.6205E-03	1.6017E-03
4.600	1.5832E-03	1.5649E-03	1.5468E-03	1.5290E-03	1.5113E-03	1.4938E-03	1.4766E-03	1.4595E-03	1.4427E-03	1.4261E-03
4.700	1.4096E-03	1.3933E-03	1.3773E-03	1.3614E-03	1.3457E-03	1.3302E-03	1.3149E-03	1.2997E-03	1.2848E-03	1.2700E-03
4.800	1.2554E-03	1.2409E-03	1.2267E-03	1.2125E-03	1.1986E-03	1.1848E-03	1.1712E-03	1.1578E-03	1.1445E-03	1.1313E-03
4.900	1.1183E-03	1.1055E-03	1.0928E-03	1.0802E-03	1.0679E-03	1.0556E-03	1.0435E-03	1.0315E-03	1.0197E-03	1.0080E-03
5.000	9.9647E-04									

INTEGRAL EXP(-TAU/MU) * P SUB 1 OF MU * DMU FOR TAU EQUAL TO

TAU	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	5.0000E-01	4.9028E-01	4.8097E-01	4.7200E-01	4.6332E-01	4.5492E-01	4.4676E-01	4.3883E-01	4.3112E-01	4.2361E-01
0.100	4.1629E-01	4.0916E-01	4.0219E-01	3.9540E-01	3.8876E-01	3.8228E-01	3.7594E-01	3.6974E-01	3.6368E-01	3.5775E-01
0.200	3.5195E-01	3.4626E-01	3.4070E-01	3.3525E-01	3.2991E-01	3.2468E-01	3.1956E-01	3.1453E-01	3.0961E-01	3.0478E-01
0.300	3.0004E-01	2.9540E-01	2.9084E-01	2.8637E-01	2.8198E-01	2.7767E-01	2.7344E-01	2.6929E-01	2.6522E-01	2.6122E-01
0.400	2.5729E-01	2.5343E-01	2.4964E-01	2.4591E-01	2.4226E-01	2.3866E-01	2.3513E-01	2.3166E-01	2.2825E-01	2.2490E-01
0.500	2.2160E-01	2.1837E-01	2.1518E-01	2.1205E-01	2.0897E-01	2.0595E-01	2.0297E-01	2.0004E-01	1.9717E-01	1.9434E-01
0.600	1.9155E-01	1.8881E-01	1.8612E-01	1.8347E-01	1.8086E-01	1.7829E-01	1.7577E-01	1.7328E-01	1.7084E-01	1.6843E-01
0.700	1.6606E-01	1.6373E-01	1.6144E-01	1.5918E-01	1.5695E-01	1.5477E-01	1.5261E-01	1.5049E-01	1.4840E-01	1.4635E-01
0.800	1.4432E-01	1.4233E-01	1.4037E-01	1.3844E-01	1.3653E-01	1.3466E-01	1.3281E-01	1.3099E-01	1.2920E-01	1.2744E-01
0.900	1.2570E-01	1.2399E-01	1.2231E-01	1.2065E-01	1.1901E-01	1.1740E-01	1.1581E-01	1.1425E-01	1.1271E-01	1.1119E-01
1.000	1.0969E-01	1.0822E-01	1.0677E-01	1.0533E-01	1.0392E-01	1.0253E-01	1.0116E-01	9.9814E-02	9.8484E-02	9.7173E-02
1.100	9.5881E-02	9.4607E-02	9.3352E-02	9.2115E-02	9.0895E-02	8.9693E-02	8.8508E-02	8.7340E-02	8.6189E-02	8.5054E-02
1.200	8.3935E-02	8.2831E-02	8.1744E-02	8.0672E-02	7.9615E-02	7.8572E-02	7.7545E-02	7.6532E-02	7.5533E-02	7.4548E-02
1.300	7.3576E-02	7.2619E-02	7.1674E-02	7.0743E-02	6.9825E-02	6.8919E-02	6.8026E-02	6.7145E-02	6.6277E-02	6.5420E-02
1.400	6.4575E-02	6.3742E-02	6.2921E-02	6.2110E-02	6.1311E-02	6.0523E-02	5.9745E-02	5.8978E-02	5.8222E-02	5.7476E-02
1.500	5.6739E-02	5.6013E-02	5.5297E-02	5.4591E-02	5.3894E-02	5.3206E-02	5.2528E-02	5.1859E-02	5.1199E-02	5.0548E-02
1.600	4.9906E-02	4.9272E-02	4.8647E-02	4.8030E-02	4.7421E-02	4.6821E-02	4.6228E-02	4.5644E-02	4.5067E-02	4.4498E-02
1.700	4.3937E-02	4.3383E-02	4.2836E-02	4.2297E-02	4.1764E-02	4.1239E-02	4.0721E-02	4.0210E-02	3.9705E-02	3.9207E-02
1.800	3.8716E-02	3.8231E-02	3.7752E-02	3.7280E-02	3.6814E-02	3.6354E-02	3.5900E-02	3.5452E-02	3.5010E-02	3.4574E-02
1.900	3.4143E-02	3.3718E-02	3.3299E-02	3.2885E-02	3.2476E-02	3.2073E-02	3.1675E-02	3.1282E-02	3.0894E-02	3.0511E-02
2.000	3.0133E-02	2.9760E-02	2.9392E-02	2.9029E-02	2.8670E-02	2.8316E-02	2.7967E-02	2.7622E-02	2.7282E-02	2.6945E-02
2.100	2.6614E-02	2.6286E-02	2.5963E-02	2.5644E-02	2.5328E-02	2.5017E-02	2.4710E-02	2.4407E-02	2.4108E-02	2.3812E-02
2.200	2.3521E-02	2.3233E-02	2.2948E-02	2.2668E-02	2.2391E-02	2.2117E-02	2.1847E-02	2.1580E-02	2.1317E-02	2.1057E-02
2.300	2.0800E-02	2.0547E-02	2.0297E-02	2.0050E-02	1.9806E-02	1.9565E-02	1.9327E-02	1.9092E-02	1.8860E-02	1.8631E-02
2.400	1.8405E-02	1.8182E-02	1.7962E-02	1.7744E-02	1.7529E-02	1.7317E-02	1.7108E-02	1.6901E-02	1.6696E-02	1.6495E-02
2.500	1.6295E-02	1.6099E-02	1.5904E-02	1.5713E-02	1.5523E-02	1.5336E-02	1.5151E-02	1.4969E-02	1.4789E-02	1.4611E-02
2.600	1.4435E-02	1.4261E-02	1.4090E-02	1.3921E-02	1.3754E-02	1.3588E-02	1.3425E-02	1.3264E-02	1.3105E-02	1.2948E-02
2.700	1.2793E-02	1.2640E-02	1.2489E-02	1.2339E-02	1.2192E-02	1.2046E-02	1.1902E-02	1.1760E-02	1.1619E-02	1.1481E-02
2.800	1.1344E-02	1.1208E-02	1.1075E-02	1.0943E-02	1.0812E-02	1.0684E-02	1.0556E-02	1.0431E-02	1.0307E-02	1.0184E-02
2.900	1.0063E-02	9.9433E-03	9.8252E-03	9.7085E-03	9.5933E-03	9.4794E-03	9.3669E-03	9.2558E-03	9.1461E-03	9.0377E-03
3.000	8.9306E-03	8.8249E-03	8.7204E-03	8.6172E-03	8.5152E-03	8.4145E-03	8.3150E-03	8.2167E-03	8.1197E-03	8.0238E-03
3.100	7.9290E-03	7.8354E-03	7.7430E-03	7.6516E-03	7.5614E-03	7.4723E-03	7.3842E-03	7.2972E-03	7.2113E-03	7.1264E-03
3.200	7.0425E-03	6.9596E-03	6.8778E-03	6.7969E-03	6.7170E-03	6.6381E-03	6.5601E-03	6.4830E-03	6.4069E-03	6.3317E-03
3.300	6.2574E-03	6.1840E-03	6.1115E-03	6.0399E-03	5.9691E-03	5.8992E-03	5.8301E-03	5.7618E-03	5.6944E-03	5.6277E-03
3.400	5.5619E-03	5.4969E-03	5.4326E-03	5.3691E-03	5.3064E-03	5.2444E-03	5.1831E-03	5.1226E-03	5.0628E-03	5.0037E-03
3.500	4.9454E-03	4.8877E-03	4.8307E-03	4.7744E-03	4.7188E-03	4.6638E-03	4.6095E-03	4.5558E-03	4.5028E-03	4.4504E-03
3.600	4.3986E-03	4.3475E-03	4.2969E-03	4.2470E-03	4.1976E-03	4.1489E-03	4.1007E-03	4.0531E-03	4.0060E-03	3.9595E-03
3.700	3.9136E-03	3.8682E-03	3.8233E-03	3.7790E-03	3.7352E-03	3.6919E-03	3.6492E-03	3.6069E-03	3.5651E-03	3.5239E-03
3.800	3.4831E-03	3.4428E-03	3.4030E-03	3.3636E-03	3.3247E-03	3.2863E-03	3.2483E-03	3.2108E-03	3.1737E-03	3.1371E-03
3.900	3.1009E-03	3.0651E-03	3.0297E-03	2.9948E-03	2.9602E-03	2.9261E-03	2.8924E-03	2.8590E-03	2.8261E-03	2.7935E-03
4.000	2.7614E-03	2.7296E-03	2.6981E-03	2.6671E-03	2.6364E-03	2.6061E-03	2.5761E-03	2.5465E-03	2.5172E-03	2.4883E-03
4.100	2.4597E-03	2.4314E-03	2.4035E-03	2.3759E-03	2.3486E-03	2.3217E-03	2.2950E-03	2.2687E-03	2.2427E-03	2.2170E-03
4.200	2.1916E-03	2.1664E-03	2.1416E-03	2.1171E-03	2.0928E-03	2.0689E-03	2.0452E-03	2.0218E-03	1.9986E-03	1.9758E-03
4.300	1.9531E-03	1.9309E-03	1.9087E-03	1.8869E-03	1.8653E-03	1.8440E-03	1.8230E-03	1.8021E-03	1.7815E-03	1.7612E-03
4.400	1.7411E-03	1.7212E-03	1.7016E-03	1.6822E-03	1.6630E-03	1.6440E-03	1.6253E-03	1.6067E-03	1.5884E-03	1.5703E-03
4.500	1.5524E-03	1.5348E-03	1.5173E-03	1.5000E-03	1.4829E-03	1.4660E-03	1.4494E-03	1.4329E-03	1.4166E-03	1.4005E-03
4.600	1.3845E-03	1.3684E-03	1.3532E-03	1.3379E-03	1.3227E-03	1.3076E-03	1.2928E-03	1.2781E-03	1.2636E-03	1.2492E-03
4.700	1.2351E-03	1.2211E-03	1.2072E-03	1.1935E-03	1.1800E-03	1.1666E-03	1.1534E-03	1.1403E-03	1.1274E-03	1.1146E-03
4.800	1.1020E-03	1.0895E-03	1.0772E-03	1.0650E-03	1.0529E-03	1.0410E-03	1.0292E-03	1.0176E-03	1.0060E-03	9.9467E-04
4.900	9.8342E-04	9.7230E-04	9.6131E-04	9.5045E-04	9.3971E-04	9.2909E-04	9.1859E-04	9.0822E-04	8.9796E-04	8.8782E-04
5.000	8.7780E-04									

INTEGRAL EXP(-TAU/MU) * P SUB 2 OF MU * DMU FOR TAU EQUAL TO

TAU	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	-3.6221E-15	1.7743E-02	2.8737E-02	3.7307E-02	4.4359E-02	5.0324E-02	5.5456E-02	5.9920E-02	6.3833E-02	6.7281E-02
0.100	7.0332E-02	7.3037E-02	7.5441E-02	7.7578E-02	7.9477E-02	8.1164E-02	8.2660E-02	8.3983E-02	8.5150E-02	8.6175E-02
0.200	8.7070E-02	8.7847E-02	8.8515E-02	8.9083E-02	8.9559E-02	8.9950E-02	9.0263E-02	9.0504E-02	9.0678E-02	9.0790E-02
0.300	9.0845E-02	9.0847E-02	9.0800E-02	9.0706E-02	9.0571E-02	9.0396E-02	9.0184E-02	8.9938E-02	8.9660E-02	8.9353E-02
0.400	8.9019E-02	8.8659E-02	8.8276E-02	8.7870E-02	8.7445E-02	8.7000E-02	8.6539E-02	8.6061E-02	8.5568E-02	8.5061E-02
0.500	8.4542E-02	8.4011E-02	8.3470E-02	8.2918E-02	8.2358E-02	8.1789E-02	8.1214E-02	8.0631E-02	8.0042E-02	7.9448E-02
0.600	7.8849E-02	7.8245E-02	7.7638E-02	7.7027E-02	7.6414E-02	7.5798E-02	7.5181E-02	7.4561E-02	7.3941E-02	7.3320E-02
0.700	7.2698E-02	7.2076E-02	7.1453E-02	7.0832E-02	7.0211E-02	6.9590E-02	6.8971E-02	6.8353E-02	6.7737E-02	6.7122E-02
0.800	6.6509E-02	6.5898E-02	6.5290E-02	6.4683E-02	6.4080E-02	6.3478E-02	6.2880E-02	6.2285E-02	6.1692E-02	6.1103E-02
0.900	6.0516E-02	5.9933E-02	5.9354E-02	5.8778E-02	5.8205E-02	5.7636E-02	5.7070E-02	5.6509E-02	5.5951E-02	5.5396E-02
1.000	5.4846E-02	5.4299E-02	5.3757E-02	5.3218E-02	5.2684E-02	5.2153E-02	5.1626E-02	5.1104E-02	5.0585E-02	5.0071E-02
1.100	4.9560E-02	4.9054E-02	4.8552E-02	4.8054E-02	4.7560E-02	4.7071E-02	4.6585E-02	4.6104E-02	4.5626E-02	4.5153E-02
1.200	4.4684E-02	4.4219E-02	4.3759E-02	4.3302E-02	4.2849E-02	4.2401E-02	4.1956E-02	4.1516E-02	4.1079E-02	4.0647E-02
1.300	4.0219E-02	3.9794E-02	3.9374E-02	3.8957E-02	3.8545E-02	3.8136E-02	3.7731E-02	3.7330E-02	3.6933E-02	3.6540E-02
1.400	3.6151E-02	3.5765E-02	3.5383E-02	3.5005E-02	3.4630E-02	3.4260E-02	3.3893E-02	3.3529E-02	3.3169E-02	3.2813E-02
1.500	3.2460E-02	3.2111E-02	3.1765E-02	3.1423E-02	3.1084E-02	3.0749E-02	3.0417E-02	3.0088E-02	2.9763E-02	2.9441E-02
1.600	2.9122E-02	2.8807E-02	2.8494E-02	2.8186E-02	2.7880E-02	2.7577E-02	2.7278E-02	2.6981E-02	2.6688E-02	2.6398E-02
1.700	2.6110E-02	2.5826E-02	2.5545E-02	2.5266E-02	2.4991E-02	2.4718E-02	2.4448E-02	2.4182E-02	2.3918E-02	2.3656E-02
1.800	2.3398E-02	2.3142E-02	2.2889E-02	2.2638E-02	2.2391E-02	2.2145E-02	2.1903E-02	2.1663E-02	2.1426E-02	2.1191E-02
1.900	2.0958E-02	2.0728E-02	2.0501E-02	2.0276E-02	2.0053E-02	1.9833E-02	1.9615E-02	1.9400E-02	1.9187E-02	1.8976E-02
2.000	1.8767E-02	1.8561E-02	1.8357E-02	1.8155E-02	1.7955E-02	1.7757E-02	1.7562E-02	1.7368E-02	1.7177E-02	1.6988E-02
2.100	1.6801E-02	1.6616E-02	1.6433E-02	1.6251E-02	1.6072E-02	1.5895E-02	1.5720E-02	1.5546E-02	1.5375E-02	1.5205E-02
2.200	1.5038E-02	1.4872E-02	1.4707E-02	1.4545E-02	1.4385E-02	1.4226E-02	1.4069E-02	1.3913E-02	1.3760E-02	1.3608E-02
2.300	1.3457E-02	1.3309E-02	1.3162E-02	1.3016E-02	1.2872E-02	1.2730E-02	1.2589E-02	1.2450E-02	1.2313E-02	1.2176E-02
2.400	1.2042E-02	1.1909E-02	1.1777E-02	1.1647E-02	1.1518E-02	1.1391E-02	1.1265E-02	1.1140E-02	1.1017E-02	1.0895E-02
2.500	1.0774E-02	1.0655E-02	1.0537E-02	1.0421E-02	1.0305E-02	1.0191E-02	1.0079E-02	9.9672E-03	9.8569E-03	9.7478E-03
2.600	9.6399E-03	9.5333E-03	9.4278E-03	9.3234E-03	9.2202E-03	9.1182E-03	9.0173E-03	8.9175E-03	8.8188E-03	8.7212E-03
2.700	8.6247E-03	8.5292E-03	8.4348E-03	8.3414E-03	8.2491E-03	8.1578E-03	8.0675E-03	7.9782E-03	7.8899E-03	7.8026E-03
2.800	7.7162E-03	7.6308E-03	7.5464E-03	7.4629E-03	7.3803E-03	7.2986E-03	7.2178E-03	7.1379E-03	7.0589E-03	6.9808E-03
2.900	6.9036E-03	6.8272E-03	6.7516E-03	6.6769E-03	6.6030E-03	6.5299E-03	6.4577E-03	6.3862E-03	6.3156E-03	6.2457E-03
3.000	6.1766E-03	6.1083E-03	6.0407E-03	5.9739E-03	5.9078E-03	5.8424E-03	5.7778E-03	5.7139E-03	5.6507E-03	5.5882E-03
3.100	5.5264E-03	5.4652E-03	5.4048E-03	5.3450E-03	5.2859E-03	5.2275E-03	5.1697E-03	5.1125E-03	5.0560E-03	5.0001E-03
3.200	4.9448E-03	4.8901E-03	4.8361E-03	4.7826E-03	4.7297E-03	4.6775E-03	4.6258E-03	4.5746E-03	4.5241E-03	4.4741E-03
3.300	4.4246E-03	4.3757E-03	4.3274E-03	4.2796E-03	4.2323E-03	4.1855E-03	4.1393E-03	4.0936E-03	4.0484E-03	4.0036E-03
3.400	3.9594E-03	3.9157E-03	3.8724E-03	3.8297E-03	3.7874E-03	3.7456E-03	3.7042E-03	3.6633E-03	3.6229E-03	3.5829E-03
3.500	3.5433E-03	3.5042E-03	3.4655E-03	3.4273E-03	3.3895E-03	3.3521E-03	3.3151E-03	3.2785E-03	3.2423E-03	3.2066E-03
3.600	3.1712E-03	3.1362E-03	3.1014E-03	3.0674E-03	3.0336E-03	3.0001E-03	2.9670E-03	2.9343E-03	2.9020E-03	2.8700E-03
3.700	2.8383E-03	2.8070E-03	2.7761E-03	2.7455E-03	2.7152E-03	2.6853E-03	2.6557E-03	2.6264E-03	2.5975E-03	2.5689E-03
3.800	2.5406E-03	2.5126E-03	2.4849E-03	2.4575E-03	2.4305E-03	2.4037E-03	2.3772E-03	2.3510E-03	2.3252E-03	2.2996E-03
3.900	2.2742E-03	2.2492E-03	2.2244E-03	2.2000E-03	2.1757E-03	2.1518E-03	2.1281E-03	2.1047E-03	2.0815E-03	2.0586E-03
4.000	2.0360E-03	2.0136E-03	1.9914E-03	1.9695E-03	1.9479E-03	1.9264E-03	1.9053E-03	1.8843E-03	1.8636E-03	1.8431E-03
4.100	1.8228E-03	1.8028E-03	1.7830E-03	1.7634E-03	1.7440E-03	1.7248E-03	1.7059E-03	1.6871E-03	1.6686E-03	1.6503E-03
4.200	1.6321E-03	1.6142E-03	1.5965E-03	1.5789E-03	1.5616E-03	1.5444E-03	1.5275E-03	1.5107E-03	1.4941E-03	1.4777E-03
4.300	1.4615E-03	1.4454E-03	1.4296E-03	1.4139E-03	1.3984E-03	1.3830E-03	1.3679E-03	1.3528E-03	1.3380E-03	1.3233E-03
4.400	1.3088E-03	1.2944E-03	1.2802E-03	1.2662E-03	1.2523E-03	1.2386E-03	1.2250E-03	1.2116E-03	1.1983E-03	1.1852E-03
4.500	1.1722E-03	1.1593E-03	1.1466E-03	1.1340E-03	1.1216E-03	1.1093E-03	1.0972E-03	1.0852E-03	1.0733E-03	1.0615E-03
4.600	1.0499E-03	1.0384E-03	1.0270E-03	1.0158E-03	1.0046E-03	9.9346E-04	9.8276E-04	9.7200E-04	9.6136E-04	9.5083E-04
4.700	9.4043E-04	9.3013E-04	9.1955E-04	9.0989E-04	8.9993E-04	8.9008E-04	8.8035E-04	8.7072E-04	8.6119E-04	8.5177E-04
4.800	8.4246E-04	8.3324E-04	8.2413E-04	8.1512E-04	8.0621E-04	7.9739E-04	7.8867E-04	7.8005E-04	7.7153E-04	7.6309E-04
4.900	7.5475E-04	7.4651E-04	7.3835E-04	7.3028E-04	7.2230E-04	7.1441E-04	7.0661E-04	6.9889E-04	6.9125E-04	6.8370E-04
5.000	6.7624E-04									

8.2 Output from SITBB: Note: Only a selected portion of the output is reproduced for the set no. 5 (page 127), and set no. 6 (pages 128, 129, and 130). (See page 124.)

LAYER NUMBER	GEOMETRIC THICKNESS	PRESSURE THICKNESS	OZONE AMOUNT	STRATOSPHERIC DUST CONTENT	TROPOSPHERIC DUST CONTENT
1	10.00	0.17	0.00002	0.0	0.0
2	10.00	0.74	0.00016	0.0	0.0
3	5.00	0.80	0.00290	1.00E+03	0.0
4	5.00	1.53	0.00722	2.00E+03	0.0
5	5.00	3.16	0.01750	5.00E+03	0.0
6	5.00	6.55	0.03840	1.10E+04	0.0
7	5.00	13.75	0.06650	3.40E+04	0.0
8	1.00	4.30	0.01500	2.40E+04	0.0
9	1.00	5.10	0.01460	4.50E+04	0.0
10	1.00	6.00	0.01360	6.80E+04	0.0
11	1.00	7.20	0.01220	1.00E+05	0.0
12	1.00	8.30	0.01120	1.24E+05	0.0
13	1.00	9.60	0.00920	1.24E+05	0.0
14	1.00	11.20	0.00710	1.14E+05	0.0
15	1.00	12.60	0.00510	1.03E+05	0.0
16	1.00	14.50	0.00400	9.40E+04	0.0
17	1.00	17.50	0.00240	8.50E+04	0.0
18	1.00	21.50	0.00120	5.00E+04	1.00E+04
19	1.00	24.50	0.00100	1.50E+04	3.00E+04
20	1.00	27.50	0.00080	1.00E+03	6.00E+04
21	1.00	31.50	0.00070	0.0	1.00E+05
22	1.00	35.50	0.00065	0.0	1.00E+05
23	1.00	40.50	0.00065	0.0	1.00E+05
24	1.00	45.00	0.00080	0.0	1.00E+05
25	1.00	51.00	0.00125	0.0	1.00E+05
26	1.00	61.00	0.00150	0.0	1.00E+05
27	1.00	69.00	0.00190	0.0	3.00E+05
28	1.00	75.00	0.00230	0.0	6.00E+05
29	1.00	87.00	0.00245	0.0	1.00E+06
30	1.00	97.00	0.00265	0.0	3.00E+06
31	1.00	100.00	0.00265	0.0	8.90E+06
32	1.00	111.00	0.00240	0.0	2.55E+07

LEGENDRE COEFFICIENTS REPRESENTING PHASE FUNCTION FOR THE STRATOSPHERIC AEROSOL AT WAVELENGTH OF 0.31250

L	L	L+1	L+2	L+3	L+4	L+5	L+6	L+7	L+8	L+9
0	1.0000E+00	2.3192E+00	3.0219E+00	3.1603E+00	3.0852E+00	2.8527E+00	2.5278E+00	2.2019E+00	1.8458E+00	1.5318E+00
10	1.2401E+00	9.8423E-01	7.8012E-01	5.9440E-01	4.6492E-01	3.4194E-01	2.6474E-01	1.8928E-01	1.4500E-01	1.0156E-01
20	7.6821E-02	5.3081E-02	3.9563E-02	2.7126E-02	1.9891E-02	1.3583E-02	9.8008E-03	6.6795E-03	4.7466E-03	3.2299E-03
30	2.2644E-03	1.5379E-03	1.0657E-03	7.2171E-04	4.9517E-04	3.3396E-04	2.2707E-04	1.5225E-04	1.0258E-04	6.8227E-05
40	4.5476E-05	2.9891E-05	1.9627E-05	1.2661E-05	8.1115E-06	0.0	0.0	0.0	0.0	0.0

LEGENDRE COEFFICIENTS REPRESENTING PHASE FUNCTION FOR THE TROPOSPHERIC AEROSOL AT WAVELENGTH OF 0.31250

L	L	L+1	L+2	L+3	L+4	L+5	L+6	L+7	L+8	L+9
0	1.0000E+00	2.4521E+00	3.4643E+00	4.0539E+00	4.5090E+00	4.7829E+00	4.9479E+00	5.0212E+00	4.9938E+00	4.9218E+00
10	4.7813E+00	4.6148E+00	4.4186E+00	4.2001E+00	3.9837E+00	3.7452E+00	3.5282E+00	3.2916E+00	3.0841E+00	2.8626E+00
20	2.6699E+00	2.4698E+00	2.2948E+00	2.1182E+00	1.9618E+00	1.8083E+00	1.6705E+00	1.5382E+00	1.4183E+00	1.3050E+00
30	1.2020E+00	1.1052E+00	1.0167E+00	9.3435E-01	8.5890E-01	7.8905E-01	7.2503E-01	6.6588E-01	6.1169E-01	5.6169E-01
40	5.1591E-01	4.7371E-01	4.3508E-01	3.9950E-01	3.6693E-01	3.3694E-01	3.0950E-01	2.8425E-01	2.6113E-01	2.3988E-01
50	2.2040E-01	2.0251E-01	1.8610E-01	1.7104E-01	1.5722E-01	1.4453E-01	1.3288E-01	1.2219E-01	1.1238E-01	1.0337E-01
60	9.5092E-02	8.7492E-02	8.0514E-02	7.4110E-02	6.8216E-02	6.2799E-02	5.7821E-02	5.3244E-02	4.9037E-02	4.5166E-02
70	4.1609E-02	3.8336E-02	3.5325E-02	3.2554E-02	3.0004E-02	2.7657E-02	2.5496E-02	2.3506E-02	2.1674E-02	1.9986E-02
80	1.8431E-02	1.6998E-02	1.5678E-02	1.4460E-02	1.3338E-02	1.2304E-02	1.1350E-02	1.0470E-02	9.6578E-03	8.9088E-03
90	8.2177E-03	7.5799E-03	6.9912E-03	6.4478E-03	5.9461E-03	5.4830E-03	5.0552E-03	4.6602E-03	4.2952E-03	3.9580E-03
100	3.6465E-03	3.3587E-03	3.0928E-03	2.8471E-03	2.6201E-03	2.4103E-03	2.2165E-03	2.0374E-03	1.8719E-03	1.7190E-03
110	1.5777E-03	1.4472E-03	1.3266E-03	1.2152E-03	1.1124E-03	1.0175E-03	9.2984E-04	8.4897E-04	7.7436E-04	7.0556E-04
120	6.4212E-04	5.8367E-04	5.2984E-04	4.8027E-04	4.3468E-04	0.0	0.0	0.0	0.0	0.0

VARIOUS NORMAL OPTICAL THICKNESSES OF THE ENTIRE ATMOSPHERIC MODEL : 199
 FOR THE INCIDENT RADIATION OF WAVELENGTH : 0.31250

RAYLEIGH SCATTERING	:	1.02000
OZONE ABSORPTION	:	0.41750
STRATOSPHERIC AEROSOL SCATTERING	:	0.00201
STRATOSPHERIC AEROSOL ABSORPTION	:	0.00073
TROPOSPHERIC AEROSOL SCATTERING	:	0.12051
TROPOSPHERIC AEROSOL ABSORPTION	:	0.06846
TOTAL	:	1.62922

ATMOSPHERIC MODEL NUMBER : 199

SURFACE PRESSURE (MB) : 1000.00

TOTAL OZONE AMOUNT (ATM-CM) : 0.250

D U S T D A T A

TYPE OF AEROSOLS	SIZE DISTRIBUTION FUNCTION	PART OF REFRACTIVE INDEX		TOTAL AMOUNT
		REAL	IMAGINARY	
STRATOSPHERIC	HAZE : H	1.500	0.050	1.00E+06
TROPOSPHERIC	HAZE : L	1.500	0.050	4.00E+07

THIS SET OF COMPUTATIONS IS DONE WITH

60

NUMBER OF TERMS.

CONDITIONING POINT	1	IS AT THE OPTICAL DEPTH	0.0	GIVEN BY THE LEVEL NUMBER	1
CONDITIONING POINT	2	IS AT THE OPTICAL DEPTH	0.14170	GIVEN BY THE LEVEL NUMBER	12
CONDITIONING POINT	3	IS AT THE OPTICAL DEPTH	0.27849	GIVEN BY THE LEVEL NUMBER	20
CONDITIONING POINT	4	IS AT THE OPTICAL DEPTH	0.41822	GIVEN BY THE LEVEL NUMBER	30
CONDITIONING POINT	5	IS AT THE OPTICAL DEPTH	0.54482	GIVEN BY THE LEVEL NUMBER	41
CONDITIONING POINT	6	IS AT THE OPTICAL DEPTH	0.68804	GIVEN BY THE LEVEL NUMBER	50
CONDITIONING POINT	7	IS AT THE OPTICAL DEPTH	0.82091	GIVEN BY THE LEVEL NUMBER	58
CONDITIONING POINT	8	IS AT THE OPTICAL DEPTH	0.96141	GIVEN BY THE LEVEL NUMBER	66
CONDITIONING POINT	9	IS AT THE OPTICAL DEPTH	1.08648	GIVEN BY THE LEVEL NUMBER	73
CONDITIONING POINT	10	IS AT THE OPTICAL DEPTH	1.22345	GIVEN BY THE LEVEL NUMBER	80
CONDITIONING POINT	11	IS AT THE OPTICAL DEPTH	1.37295	GIVEN BY THE LEVEL NUMBER	88
CONDITIONING POINT	12	IS AT THE OPTICAL DEPTH	1.51036	GIVEN BY THE LEVEL NUMBER	95
CONDITIONING POINT	13	IS AT THE OPTICAL DEPTH	1.62920	GIVEN BY THE LEVEL NUMBER	101

THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	2
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	3
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	4
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	5
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	6
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	7
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	8
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	9
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	10
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	11
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	12
THE TOP HALF OF THE F SUB J MATRIX INVERTED AFTER	2	ITERATIONS FOR THE CONDITIONING POINT NUMBER	13
LINEAR SYSTEM SOLVED FOR THETA SUB ZERO =	0.0	AFTER 2	NUMBER OF ITERATIONS.
LINEAR SYSTEM SOLVED FOR THETA SUB ZERO =	45.00	AFTER 2	NUMBER OF ITERATIONS.

MODEL : 199

WAVELENGTH : 0.3125

THETA SUB ZERO : 0.0

LAY. NUM.	DIRECT FLUX	DIFFUSE DOWNWARD	DIFFUSE UPWARD	NET FLUX	LAY. NUM.	DIRECT FLUX	DIFFUSE DOWNWARD	DIFFUSE UPWARD	NET FLUX
1	3.1416E+00	1.5638E-07	3.6659E-01	2.7750E+00	2	3.1409E+00	3.2266E-04	3.6638E-01	2.7749E+00
3	3.1377E+00	1.7289E-03	3.6558E-01	2.7739E+00	4	3.1200E+00	3.1970E-03	3.6746E-01	2.7558E+00
5	3.0778E+00	5.8734E-03	3.7283E-01	2.7108E+00	6	2.9795E+00	1.0916E-02	3.8723E-01	2.6032E+00
7	2.7757E+00	1.9831E-02	4.2313E-01	2.3724E+00	8	2.4492E+00	3.5415E-02	4.9831E-01	1.9863E+00
9	2.3780E+00	4.0289E-02	5.1774E-01	1.9005E+00	10	2.3083E+00	4.6239E-02	5.3755E-01	1.8170E+00
11	2.2423E+00	5.3449E-02	5.5661E-01	1.7392E+00	12	2.1804E+00	6.2477E-02	5.7396E-01	1.6689E+00
13	2.1213E+00	7.2986E-02	5.9023E-01	1.6040E+00	14	2.0679E+00	8.5471E-02	6.0315E-01	1.5502E+00
15	2.0196E+00	1.0042E-01	6.1195E-01	1.5081E+00	16	1.9764E+00	1.1755E-01	6.1634E-01	1.4776E+00
17	1.9339E+00	1.3719E-01	6.1772E-01	1.4534E+00	18	1.8916E+00	1.6112E-01	6.1413E-01	1.4386E+00
19	1.8466E+00	1.9010E-01	6.0555E-01	1.4311E+00	20	1.7977E+00	2.2144E-01	5.9439E-01	1.4247E+00
21	1.7451E+00	2.5488E-01	5.8057E-01	1.4194E+00	22	1.6871E+00	2.9088E-01	5.6356E-01	1.4145E+00
23	1.6246E+00	3.2837E-01	5.4313E-01	1.4099E+00	24	1.5564E+00	3.6730E-01	5.1849E-01	1.4053E+00
25	1.4839E+00	4.0583E-01	4.8993E-01	1.3998E+00	26	1.4051E+00	4.4348E-01	4.5675E-01	1.3918E+00
27	1.3164E+00	4.8144E-01	4.1528E-01	1.3826E+00	28	1.2213E+00	5.1587E-01	3.6686E-01	1.3703E+00
29	1.1239E+00	5.4378E-01	3.1271E-01	1.3549E+00	30	1.0194E+00	5.6547E-01	2.4714E-01	1.3377E+00
31	9.0636E-01	5.7759E-01	1.7198E-01	1.3120E+00	32	7.8131E-01	5.7753E-01	9.3211E-02	1.2656E+00
33	6.1601E-01	5.5908E-01	9.4376E-06	1.1751E+00					

MODEL : 199

WAVELENGTH : 0.3125

THETA SUB ZERO : 45.00

LAY. NUM.	DIRECT FLUX	DIFFUSE DOWNWARD	DIFFUSE UPWARD	NET FLUX	LAY. NUM.	DIRECT FLUX	DIFFUSE DOWNWARD	DIFFUSE UPWARD	NET FLUX
1	2.2214E+00	1.6494E-07	2.7050E-01	1.9509E+00	2	2.2208E+00	3.1107E-04	2.7028E-01	1.9508E+00
3	2.2176E+00	1.6666E-03	2.6939E-01	1.9499E+00	4	2.1999E+00	3.0730E-03	2.7057E-01	1.9324E+00
5	2.1580E+00	5.6112E-03	2.7420E-01	1.8894E+00	6	2.0612E+00	1.0300E-02	2.8429E-01	1.7872E+00
7	1.8649E+00	1.8262E-02	3.1005E-01	1.5731E+00	8	1.5626E+00	3.1348E-02	3.6488E-01	1.2291E+00
9	1.4989E+00	3.5319E-02	3.7914E-01	1.1551E+00	10	1.4373E+00	4.0141E-02	3.9365E-01	1.0838E+00
11	1.3796E+00	4.5941E-02	4.0757E-01	1.0179E+00	12	1.3262E+00	5.3176E-02	4.2014E-01	9.5923E-01
13	1.2757E+00	6.1535E-02	4.3186E-01	9.0534E-01	14	1.2306E+00	7.1437E-02	4.4099E-01	8.6109E-01
15	1.1904E+00	8.3283E-02	4.4686E-01	8.2680E-01	16	1.1545E+00	9.6786E-02	4.4933E-01	8.0198E-01
17	1.1197E+00	1.1219E-01	4.4940E-01	7.8253E-01	18	1.0855E+00	1.3088E-01	4.4552E-01	7.7081E-01
19	1.0492E+00	1.5337E-01	4.3763E-01	7.6490E-01	20	1.0102E+00	1.7745E-01	4.2768E-01	7.5998E-01
21	9.6878E-01	2.0278E-01	4.1568E-01	7.5588E-01	22	9.2375E-01	2.2965E-01	4.0122E-01	7.5218E-01
23	8.7586E-01	2.5713E-01	3.8423E-01	7.4876E-01	24	8.2442E-01	2.8510E-01	3.6419E-01	7.4532E-01
25	7.7079E-01	3.1202E-01	3.4143E-01	7.4138E-01	26	7.1368E-01	3.3744E-01	3.1556E-01	7.3556E-01
27	6.5089E-01	3.6195E-01	2.8403E-01	7.2881E-01	28	5.8555E-01	3.8270E-01	2.4817E-01	7.2008E-01
29	5.2367E-01	3.9770E-01	2.0917E-01	7.0919E-01	30	4.5378E-01	4.0690E-01	1.6327E-01	6.9741E-01
31	3.8432E-01	4.0767E-01	1.1214E-01	6.7985E-01	32	3.1161E-01	3.9751E-01	6.0007E-02	6.4911E-01
33	2.2287E-01	3.6843E-01	-3.3591E-05	5.9133E-01					

MODEL : 199

WAVELENGTH : 0.3125

THETA SUB ZERO : 79.60

LAY. NUM.	DIRECT FLUX	DIFFUSE DOWNWARD	DIFFUSE UPWARD	NET FLUX	LAY. NUM.	DIRECT FLUX	DIFFUSE DOWNWARD	DIFFUSE UPWARD	NET FLUX
1	5.6712E-01	1.2437E-07	4.2770E-02	5.2435E-01	2	5.6648E-01	2.8093E-04	4.2510E-02	5.2425E-01
3	5.6338E-01	1.4960E-03	4.1391E-02	5.2349E-01	4	5.4625E-01	2.7320E-03	4.0636E-02	5.0835E-01
5	5.0739E-01	4.8539E-03	3.9532E-02	4.7271E-01	6	4.2576E-01	8.3219E-03	3.8033E-02	3.9605E-01
7	2.9063E-01	1.2690E-02	3.6903E-02	2.6641E-01	8	1.4852E-01	1.6372E-02	3.7809E-02	1.2708E-01
9	1.2691E-01	1.7030E-02	3.8329E-02	1.0561E-01	10	1.0840E-01	1.7738E-02	3.8841E-02	8.7297E-02
11	9.3000E-02	1.8535E-02	3.9274E-02	7.2262E-02	12	8.0295E-02	1.9495E-02	3.9515E-02	6.0274E-02
13	6.9552E-02	2.0510E-02	3.9672E-02	5.0390E-02	14	6.0957E-02	2.1682E-02	3.9562E-02	4.3076E-02
15	5.4017E-02	2.3059E-02	3.9106E-02	3.7971E-02	16	4.8407E-02	2.4593E-02	3.8322E-02	3.4678E-02
17	4.3380E-02	2.6252E-02	3.7288E-02	3.2344E-02	18	3.8813E-02	2.8195E-02	3.5815E-02	3.1193E-02
19	3.4354E-02	3.0391E-02	3.3894E-02	3.0851E-02	20	2.9968E-02	3.2484E-02	3.1816E-02	3.0635E-02
21	2.5749E-02	3.4409E-02	2.9634E-02	3.0525E-02	22	2.1642E-02	3.6128E-02	2.7326E-02	3.0444E-02
23	1.7805E-02	3.7532E-02	2.4953E-02	3.0384E-02	24	1.4252E-02	3.8556E-02	2.2494E-02	3.0315E-02
25	1.1117E-02	3.9139E-02	2.0069E-02	3.0187E-02	26	8.3574E-03	3.9211E-02	1.7654E-02	2.9915E-02
27	5.9316E-03	3.8758E-02	1.5101E-02	2.9589E-02	28	3.9943E-03	3.7723E-02	1.2573E-02	2.9144E-02
29	2.5748E-03	3.6172E-02	1.0150E-02	2.8597E-02	30	1.5358E-03	3.4097E-02	7.6122E-03	2.8020E-02
31	8.2206E-04	3.1418E-02	5.0450E-03	2.7195E-02	32	3.7108E-04	2.8049E-02	2.6183E-03	2.5803E-02
33	1.0310E-04	2.3202E-02	-1.3750E-06	2.3307E-02					

MODEL : 199

WAVELENGTH : 0.3125

THETA SUB ZERO : 82.50

LAY. NUM.	DIRECT FLUX	DIFFUSE DOWNWARD	DIFFUSE UPWARD	NET FLUX	LAY. NUM.	DIRECT FLUX	DIFFUSE DOWNWARD	DIFFUSE UPWARD	NET FLUX
1	4.1006E-01	1.2831E-07	2.7085E-02	3.8297E-01	2	4.0944E-01	2.7837E-04	2.6822E-02	3.8289E-01
3	4.0642E-01	1.4808E-03	2.5686E-02	3.8222E-01	4	3.8966E-01	2.6952E-03	2.4785E-02	3.6757E-01
5	3.5254E-01	4.7378E-03	2.3352E-02	3.3393E-01	6	2.7804E-01	7.9053E-03	2.1151E-02	2.6479E-01
7	1.6598E-01	1.1373E-02	1.8671E-02	1.5868E-01	8	6.7258E-02	1.3270E-02	1.7279E-02	6.3250E-02
9	5.4491E-02	1.3443E-02	1.7256E-02	5.0679E-02	10	4.4151E-02	1.3613E-02	1.7255E-02	4.0509E-02
11	3.6019E-02	1.3807E-02	1.7242E-02	3.2584E-02	12	2.9601E-02	1.4070E-02	1.7162E-02	2.6569E-02
13	2.4550E-02	1.4341E-02	1.7070E-02	2.1822E-02	14	2.0663E-02	1.4687E-02	1.6883E-02	1.8467E-02
15	1.7666E-02	1.5135E-02	1.6569E-02	1.6231E-02	16	1.5346E-02	1.5653E-02	1.6126E-02	1.4872E-02
17	1.3334E-02	1.6213E-02	1.5589E-02	1.3959E-02	18	1.1565E-02	1.6885E-02	1.4874E-02	1.3575E-02
19	9.8847E-03	1.7635E-02	1.3982E-02	1.3538E-02	20	8.2835E-03	1.6302E-02	1.3047E-02	1.3538E-02
21	6.8014E-03	1.8859E-02	1.2090E-02	1.3570E-02	22	5.4199E-03	1.9285E-02	1.1106E-02	1.3599E-02
23	4.1960E-03	1.9547E-02	1.0122E-02	1.3622E-02	24	3.1303E-03	1.9630E-02	9.1362E-03	1.3624E-02
25	2.2554E-03	1.9514E-02	8.1752E-03	1.3594E-02	26	1.5458E-03	1.9182E-02	7.2308E-03	1.3497E-02
27	9.7940E-04	1.8626E-02	6.2383E-03	1.3368E-02	28	5.7845E-04	1.7858E-02	5.2498E-03	1.3187E-02
29	3.2208E-04	1.6923E-02	4.2883E-03	1.2957E-02	30	1.6143E-04	1.5808E-02	3.2585E-03	1.2711E-02
31	6.9850E-05	1.4476E-02	2.1873E-03	1.2358E-02	32	2.4930E-05	1.2880E-02	1.1485E-03	1.1755E-02
33	4.2218E-06	1.0652E-02	7.1703E-07	1.0655E-02					

MODEL : 199

WAVELENGTH : 0.3125

ISOTROPIC GROUND ILLUMINATION FROM BELOW.

LAY. NUM.	DIRECT FLUX	DIFFUSE DOWNWARD	DIFFUSE UPWARD	NET FLUX	LAY. NUM.	DIRECT FLUX	DIFFUSE DOWNWARD	DIFFUSE UPWARD	NET FLUX
1	3.0209E-01	2.5664E-06	4.6443E-01	7.6652E-01	2	3.0217E-01	9.6959E-05	4.6448E-01	7.6656E-01
3	3.0257E-01	5.1121E-04	4.6480E-01	7.6685E-01	4	3.0476E-01	9.4437E-04	4.6844E-01	7.7225E-01
5	3.1011E-01	1.7484E-03	4.7756E-01	7.8592E-01	6	3.2326E-01	3.3426E-03	5.0046E-01	8.2038E-01
7	3.5405E-01	6.5305E-03	5.5544E-01	9.0295E-01	8	4.1631E-01	1.3659E-02	6.7040E-01	1.0731E+00
9	4.3263E-01	1.6302E-02	7.0088E-01	1.1172E+00	10	4.4975E-01	1.9698E-02	7.3273E-01	1.1628E+00
11	4.6718E-01	2.3993E-02	7.6462E-01	1.2078E+00	12	4.8468E-01	2.9602E-02	7.9559E-01	1.2507E+00
13	5.0257E-01	3.6457E-02	8.2632E-01	1.2924E+00	14	5.1977E-01	4.5019E-02	8.5401E-01	1.3288E+00
15	5.3627E-01	5.5768E-02	8.7794E-01	1.3584E+00	16	5.5190E-01	6.8576E-02	8.9753E-01	1.3808E+00
17	5.6808E-01	8.3876E-02	9.1509E-01	1.3993E+00	18	5.8506E-01	1.0325E-01	9.2913E-01	1.4109E+00
19	6.0422E-01	1.2775E-01	9.4063E-01	1.4171E+00	20	6.2635E-01	1.5556E-01	9.5177E-01	1.4226E+00
21	6.5185E-01	1.8636E-01	9.6231E-01	1.4273E+00	22	6.8225E-01	2.2264E-01	9.7231E-01	1.4319E+00
23	7.1808E-01	2.6285E-01	9.8123E-01	1.4365E+00	24	7.6130E-01	3.0843E-01	9.8842E-01	1.4413E+00
25	8.1274E-01	3.5878E-01	9.9339E-01	1.4474E+00	26	8.7638E-01	4.1508E-01	9.9572E-01	1.4570E+00
27	9.5971E-01	4.8214E-01	9.9162E-01	1.4692E+00	28	1.0667E+00	5.5741E-01	9.7788E-01	1.4872E+00
29	1.2014E+00	6.3844E-01	9.4969E-01	1.5126E+00	30	1.3849E+00	7.3320E-01	8.9376E-01	1.5454E+00
31	1.6509E+00	8.3673E-01	7.8969E-01	1.6039E+00	32	2.0806E+00	9.3579E-01	5.9043E-01	1.7353E+00
33	3.1416E+00	1.0416E+00	3.7167E-05	2.1000E+00					

SBAR = 0.33155

MODEL NUMBER : 199

WAVELENGTH : 0.3125

0-TH FOURIER COMPONENT OF INTENSITY OF THE RADIATION EMERGENT AT THE TOP (R = 0.0) FOR THETA SUB ZERO =

THETA	AMU	0.0	45.00	60.00	70.00	75.60	79.60	82.50	84.70	86.70	90.00
0.0	1.000	1.378E-01	8.902E-02	5.557E-02	3.064E-02	1.739E-02	9.552E-03	5.376E-03	3.242E-03	2.008E-03	8.674E-04
3.5	0.998	1.377E-01	8.905E-02	5.562E-02	3.068E-02	1.742E-02	9.571E-03	5.389E-03	3.251E-03	2.014E-03	8.700E-04
6.9	0.993	1.374E-01	8.915E-02	5.578E-02	3.081E-02	1.751E-02	9.629E-03	5.426E-03	3.276E-03	2.031E-03	8.779E-04
10.4	0.984	1.371E-01	8.932E-02	5.604E-02	3.102E-02	1.766E-02	9.725E-03	5.489E-03	3.318E-03	2.060E-03	8.912E-04
13.8	0.971	1.366E-01	8.955E-02	5.641E-02	3.132E-02	1.787E-02	9.860E-03	5.577E-03	3.379E-03	2.101E-03	9.100E-04
17.3	0.955	1.361E-01	8.984E-02	5.687E-02	3.170E-02	1.813E-02	1.004E-02	5.692E-03	3.457E-03	2.154E-03	9.348E-04
20.8	0.935	1.354E-01	9.018E-02	5.743E-02	3.216E-02	1.846E-02	1.025E-02	5.836E-03	3.555E-03	2.221E-03	9.659E-04
24.3	0.911	1.345E-01	9.056E-02	5.809E-02	3.271E-02	1.885E-02	1.051E-02	6.008E-03	3.674E-03	2.302E-03	1.004E-03
27.9	0.884	1.335E-01	9.097E-02	5.882E-02	3.334E-02	1.930E-02	1.082E-02	6.213E-03	3.816E-03	2.400E-03	1.050E-03
31.5	0.853	1.323E-01	9.140E-02	5.964E-02	3.404E-02	1.982E-02	1.117E-02	6.451E-03	3.983E-03	2.516E-03	1.104E-03
35.1	0.818	1.309E-01	9.181E-02	6.051E-02	3.482E-02	2.040E-02	1.157E-02	6.727E-03	4.179E-03	2.653E-03	1.169E-03
38.8	0.780	1.292E-01	9.217E-02	6.141E-02	3.566E-02	2.104E-02	1.202E-02	7.046E-03	4.408E-03	2.814E-03	1.246E-03
42.5	0.737	1.272E-01	9.242E-02	6.232E-02	3.656E-02	2.175E-02	1.254E-02	7.414E-03	4.676E-03	3.005E-03	1.338E-03
46.4	0.690	1.247E-01	9.246E-02	6.316E-02	3.748E-02	2.251E-02	1.311E-02	7.839E-03	4.993E-03	3.234E-03	1.449E-03
50.3	0.639	1.217E-01	9.215E-02	6.385E-02	3.839E-02	2.332E-02	1.376E-02	8.335E-03	5.370E-03	3.511E-03	1.586E-03
54.4	0.582	1.177E-01	9.123E-02	6.424E-02	3.923E-02	2.417E-02	1.449E-02	8.919E-03	5.830E-03	3.855E-03	1.758E-03
58.7	0.519	1.123E-01	8.930E-02	6.406E-02	3.988E-02	2.502E-02	1.531E-02	9.625E-03	6.408E-03	4.306E-03	1.986E-03
63.3	0.449	1.044E-01	8.554E-02	6.278E-02	4.009E-02	2.579E-02	1.624E-02	1.051E-02	7.172E-03	4.906E-03	2.305E-03

CONTRIBUTION (MULTIPLIED BY (1-R*SBAR)/R) DUE TO ISOTROPIC ILLUMINATION FROM BELOW.

0.0	1.000	1.400E-01	7.043E-02	3.305E-02	1.355E-02	6.192E-03	2.776E-03	1.269E-03	6.219E-04	3.190E-04	1.181E-04
3.5	0.998	1.398E-01	7.032E-02	3.300E-02	1.353E-02	6.182E-03	2.772E-03	1.267E-03	6.209E-04	3.185E-04	1.179E-04
6.9	0.993	1.391E-01	6.998E-02	3.284E-02	1.346E-02	6.152E-03	2.758E-03	1.261E-03	6.179E-04	3.170E-04	1.173E-04
10.4	0.984	1.379E-01	6.941E-02	3.258E-02	1.336E-02	6.102E-03	2.736E-03	1.251E-03	6.129E-04	3.144E-04	1.163E-04
13.8	0.971	1.364E-01	6.861E-02	3.220E-02	1.320E-02	6.032E-03	2.704E-03	1.236E-03	6.058E-04	3.108E-04	1.150E-04
17.3	0.955	1.343E-01	6.757E-02	3.171E-02	1.300E-02	5.940E-03	2.663E-03	1.218E-03	5.966E-04	3.060E-04	1.133E-04
20.8	0.935	1.317E-01	6.627E-02	3.110E-02	1.275E-02	5.826E-03	2.612E-03	1.194E-03	5.852E-04	3.002E-04	1.111E-04
24.3	0.911	1.286E-01	6.471E-02	3.037E-02	1.245E-02	5.689E-03	2.551E-03	1.166E-03	5.714E-04	2.931E-04	1.085E-04
27.9	0.884	1.249E-01	6.287E-02	2.950E-02	1.210E-02	5.527E-03	2.478E-03	1.133E-03	5.552E-04	2.848E-04	1.054E-04
31.5	0.853	1.207E-01	6.074E-02	2.850E-02	1.169E-02	5.340E-03	2.394E-03	1.095E-03	5.363E-04	2.751E-04	1.018E-04
35.1	0.818	1.158E-01	5.928E-02	2.735E-02	1.121E-02	5.123E-03	2.297E-03	1.050E-03	5.146E-04	2.640E-04	9.769E-05
38.8	0.780	1.102E-01	5.547E-02	2.603E-02	1.067E-02	4.876E-03	2.186E-03	9.596E-04	4.898E-04	2.512E-04	9.297E-05
42.5	0.737	1.039E-01	5.227E-02	2.453E-02	1.006E-02	4.595E-03	2.060E-03	9.420E-04	4.616E-04	2.368E-04	8.762E-05
46.4	0.690	9.668E-02	4.865E-02	2.283E-02	9.360E-03	4.276E-03	1.917E-03	8.767E-04	4.295E-04	2.203E-04	8.154E-05
50.3	0.639	8.851E-02	4.454E-02	2.090E-02	8.569E-03	3.915E-03	1.755E-03	8.026E-04	3.933E-04	2.017E-04	7.465E-05
54.4	0.582	7.925E-02	3.986E-02	1.871E-02	7.672E-03	3.505E-03	1.572E-03	7.186E-04	3.521E-04	1.806E-04	6.684E-05
58.7	0.519	6.870E-02	3.457E-02	1.622E-02	6.651E-03	3.039E-03	1.363E-03	6.230E-04	3.053E-04	1.566E-04	5.795E-05
63.3	0.449	5.662E-02	2.849E-02	1.337E-02	5.481E-03	2.504E-03	1.123E-03	5.134E-04	2.516E-04	1.290E-04	4.775E-05

SBAR = 0.33155