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DEVELOPMENT OF THE RADIATIVE TRANSFER PORTION OF A 1-D PHOTOCHEMICAL DIFFUSIVE STRATOSPHERIC MODEL

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This report summarizes the development and implementation of an advanced state-of-the-art computer code, the Chlorine Model Study Program (CMSP), which models the trace gas composition of the atmosphere from the surface to 80 km employing over sixty relevant chemical reactions and parameterizing vertical transport by a selected eddy diffusion profile.

A significant feature is the computation of solar flux available for photolysis by a multiple scattering atmosphere including the effect of surface reflection.

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20. ABSTRACT (cont)

Program documentation includes a complete listing of the code, a detailed flow chart, and several test case results in addition to a detailed program description and users guide.

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1. Introduction

This report summarizes the implementation and further development of the Chlorine Model Study Program (CMSP) performed by Environmental Research & Technology, Inc. (ERT) under the sponsorship of the Electronic Systems Division, U.S.A.F. Systems Command, Hanscom AFB, Massachusetts.

The CMSP is an advanced state-of-the-art computer code which models the trace gas composition of the atmosphere from the surface to 80 km employing over sixty chemical reactions in addition to allowing for vertical transport parameterized by a selected set of eddy diffusion coefficients. In its original formulation, the model only computed photolysis for the one-way passage of solar radiation through the atmosphere (absorption only). In the present version the effects of multiple scattering and surface reflection have been incorporated into the radiative transfer section of the program thus allowing for more realistic simulation of the effects of injected pollutants into the atmosphere.

The text which follows constitutes a basic program description, documentation, and users guide. Section 2 discusses the theoretical basis of the model including the governing continuity and flux equations for the steady-state version in addition to the chemical system adopted. Section 3 provides a description of the development of the radiative transfer section including the technique employed to perform the multiple scattering calculation and some representative results (Appendix C). Section 4 constitutes a comprehensive program description utilizing a complete program listing (Appendix A) and a flow chart (Appendix B) to aid in the exposition of the detailed calculation. Finally, Section 5 is included as a basic users guide containing instructions for program implementation and execution.

2. Theoretical Basis

2.1 Governing Model Equations

The CMSP program is a 1-dimensional (vertical dependence), steady state (no time dependence) mathematical model of the trace gas chemical composition of the atmosphere from the surface to 80 km. Specifically, the species dealt with include odd oxygen (O, O_3), odd hydrogen (H, OH, HO_2, H_2O_2), odd nitrogen (NO, NO_2, HNO_3), and odd chlorine (Cℓ, HCℓ, CℓO). Physical processes which determine the local abundances of these and other minor species include chemical kinetics, photochemistry, and turbulent transport. Radiative transfer is indirectly involved since it determines the number of photons available for photodissociation. (See Section 3).

The model is similar to those of Wofsy, McElroy and Sze (1975) and Sze and McElroy (1975) with several modifications. The governing continuity and diffusion equations are:

$$\frac{\partial \phi_i}{\partial Z} = P_i - L_i N f_i \qquad (2\text{-}1)$$

and

$$\frac{\partial f_i}{\partial Z} = -\phi_i / KN \qquad (2\text{-}2)$$

where ϕ_i is the vertical flux (cm^{-2} sec^{-1}), N the atmospheric total number density (cm^{-3}), K the eddy coefficients (cm^2 sec^{-1}) and P_i and L_i are respectively the local production (cm^{-3} sec^{-1}) and loss frequency (sec^{-1}), i denotes the ith species, and f_i is the mixing ratio (v/v). Distinctions between long lived species (e.g. N_2O, CH_4, $CF_2C\ell_2$) and short lived species (e.g. Cℓ, OH, NO) lead to enormous simplication in calculations.

For instance, the time constants for apportionment of CℓX among various forms of odd chlorine (Cℓ, CℓO, HCℓ, CℓOO, $C\ell_2$) are rapid compared to the time constant for vertical motion. Densities of individual CℓX species

can be calculated with the equations of photochemical equilibrium, i.e.

$$P_i - L_i N f_i = 0 \text{ for each species} \qquad (2\text{-}3)$$

Likewise, photochemical equilibrium can be applied to the short lived hydrogen species (H, OH, HO_2, H_2O_2), to NO_x (NO, NO_2, HNO_3), to $O(^3P)$ and to $O(^1D)$. On the contrary, vertical flow is allowed for long-lived species such as CH_4, N_2O, CO, $CF_2C\ell_2$, $CFC\ell_3$, and O_3 (below 30 km) and the total family concentrations for HO_x, NO_x, and $C\ell x$. In this case, equations (2-1, 2-2) must be solved simultaneously.

Equations (2-1) and (2-2) are coupled differential equations with <u>two</u> point boundary conditions. They are usually solved by using the conventional finite difference method or the shooting method. However, more efficient schemes have recently been developed to improve computational efficiency. The numerical approach utilized is based on a Riccati scheme developed by Sze (1973) and subsequently applied to investigations relating to the Venus (Sze and McElroy, 1975) and Earth's atmosphere. In essence, the Riccati scheme transforms (2-1) and (2-2) into a non-coupled systen with a <u>one</u> point boundary condition. This technique greatly reduces the computational complexity of the problem and facilitates numerical solutions of differential equations of the type described here.

In the one-dimensional model, the crucial transport parameter is the vertical eddy diffusion coefficient K_{zz}. In the current model three options exist to vary the assumed K_{zz} profile to simulate measured data and perform sensitivity analyses. (See Section 4.3.2). The neutral atmosphere used in the calculation is summarized in Table 2-1 (a particular eddy diffusion profile is demonstrated). Photolysis processes for aeronomically significant molecules are summarized in Table 2-2. Computations of photodissociation rates (or J-values) are accomplished (See Section 3-1)

TABLE 2-1

ATMOSPHERIC MODEL

Altitude (km)	Eddy Diffusion Coefficient ($cm^2\ sec^{-1}$)	Number Density (cm^{-3})	Temperature (°K)
0	1.4000E 05	2.4110E 19	304.58
2	1.4000E 05	2.1050E 19	289.56
4	1.4000E 05	1.6510E 19	277.87
6	1.4000E 05	1.3400E 19	266.52
8	1.4000E 05	1.0880E 19	252.41
10	4.2000E 04	8.7330E 18	238.39
11	4.2000E 04	6.9130E 18	224.42
14	4.2000E 04	5.9310E 18	210.50
16	3.6400E 03	4.1030E 18	203.15
18	4.6200E 03	2.8240E 18	207.38
20	5.8800F 03	2.0000E 18	211.75
22	7.4200E 03	1.4290E 18	215.94
24	9.2400E 03	1.0320E 18	219.20
26	1.1620E 04	7.4450E 17	223.84
28	1.4140E 04	5.4230E 17	227.83
30	1.8200E 04	3.9700E 17	231.79
32	2.2400E 04	2.9240E 17	235.74
34	2.8700E 04	2.1590E 17	240.40
36	3.5700E 04	1.6040E 17	245.14
38	4.4800E 04	1.1980E 17	249.88
40	5.6000E 04	8.9990E 16	254.62
42	7.0000E 04	6.7980E 16	259.35
44	8.9600E 04	5.1610E 16	264.08
46	1.1200E 05	3.9390E 16	268.80
48	1.4000E 05	3.0350E 16	272.15
50	1.7920E 05	2.3720E 16	272.15
52	2.2400E 05	1.8600E 16	271.14
54	2.8000E 05	1.4710E 16	267.21
56	3.5000E 05	1.1590E 16	263.28
58	4.3400E 05	9.1050E 15	259.36
60	5.3200E 05	7.1440E 15	254.79
62	7.0000E 05	5.6360E 15	247.35
64	8.6800E 05	4.4160E 15	239.91
66	1.0500E 06	3.4350E 15	232.47
68	1.3440E 06	2.6620E 15	225.04
70	1.6800E 06	2.0260E 15	217.61
72	2.1000E 06	1.5350E 15	210.19
74	2.6600E 06	1.1520E 15	202.77
76	3.3600E 06	8.5540E 14	195.36
78	4.2000E 06	6.2810E 14	187.95
80	5.3200E 06	4.5560E 14	180.54

TABLE 2-2

PHOTOLYSIS PROCESSES (sec^{-1})

J_1	$O_2 + h\nu \rightarrow 2\ O$
J_2	$O_3 + h\nu \rightarrow O(^1D) + O_2$
J_3	$O_3 + h\nu \rightarrow O(^3P) + O_2$
J_4	$H_2O + h\nu \rightarrow H + OH$
J_5	$N_2O + h\nu \rightarrow N_2 + O$
J_6	$CH_4 + h\nu \rightarrow CH_3 + H$
J_7	$CH_3Cl + h\nu \rightarrow CH_3 + Cl$
J_8	$CFCl_3 + h\nu \rightarrow CFCl_2 + Cl$
J_9	$CF_2Cl_2 + h\nu \rightarrow CF_2Cl + Cl$
J_{10}	$CCl_4 + h\nu \rightarrow CCl_3 + Cl$
J_{11}	$HCl + h\nu \rightarrow H + Cl$
J_{12}	$NO_2 + h\nu \rightarrow NO + O$
J_{13}	$NO_3 + h\nu \rightarrow NO + O_2$
J_{14}	$NO_3 + h\nu \rightarrow NO_2 + O$
J_{15}	$N_2O_5 + h\nu \rightarrow NO_3 + NO_2$
J_{16}	$HNO_3 + h\nu \rightarrow OH + NO_2$
J_{17}	$NO + h\nu \rightarrow N + O$
J_{18}	$H_2O_2 + h\nu \rightarrow 2OH$
J_{19}	$HO_2 + h\nu \rightarrow H + O_2$
J_{20}	$ClO + h\nu \rightarrow Cl + O$
J_{21}	$HOCl + h\nu \rightarrow OH + Cl$
J_{22}	$ClONO_2 + h\nu \rightarrow ClO + NO_2$
J_{23}	$H_2CO + h\nu \rightarrow H_2 + CO$
J_{24}	$H_2CO + h\nu \rightarrow H + HCO$

using solar flux data obtained from the Handbook of Geophysics and Space Environments (1965). For the spectral region between 1750-3000Å flux measurements were adopted from Detwiler, et. al. (1961). Below 1750Å, the more recent data by Widing, et. al. (1970) are utilized. Computations are made using either a 24-hour averaged value of the solar flux or a single solar zenith angle (specified by ISWIT, Section 4.4). Table 2-3 contains the reactions and adopted rate constants for the relevant odd oxygen, hydrogen, nitrogen, and chlorine species. These rates are referenced to 80 km. Temperature dependence of the rate constants as a function of the temperature profile is given.

2.2 Summary of Relevant Stratospheric Chemistry

This section provides a brief review of the critical atmospheric species handled by the CMSP program.

The chemistry of atmospheric ozone was formulated by Chapman (1930). Chapman's model consists of four reactions involving only oxygen chemistry. He proposed that ozone is initiated by photolysis of O_2 in the Herzberg continuum below 2400 Å, as

$$O_2 + h\nu \rightarrow 2O \tag{2-4}$$

followed by the three body reaction

$$O + O_2 + M \rightarrow O_3 + M \tag{2-5}$$

Ozone may be recycled by

$$O_3 + h\nu \rightarrow O_2 + O \tag{2-6}$$

followed by (2-5). Odd oxygen (O, O_3) is removed by

$$O + O_3 \rightarrow 2O_2 \tag{2-7}$$

Using reactions (2-4) to (2-7), and assuming photochemical equilibrium conditions, ozone concentration may be expressed in a simple analytic form:

$$[O_3] = \left(\frac{J_1}{J_3}\right)^{1/2} \left(\frac{k_2}{k_4}\right)^{1/2} [O_2][M]^{1/2} \tag{2-8}$$

TABLE 2-3

REACTION RATE
(AS A FUNCTION OF ALTITUDE, Z) = A
* EXP (B/TEMP (Z))

No.	REACTION		A	B
1	OH + CH3CL	= CH2CL + H2O	1.66E-12	-1070.
2	H2O + O('D)	= 2OH	2.35E-10	0.
3	CH4 + O('D)	= CH3 + OH	1.40E-10	0.
4	H2 + O('D)	= OH + H	1.00E-10	0.
5	H + O2 + M	= HO2 + M	1.80E-32	340.
6	H + O3	= OH + O2	2.60E-11	0.
7	OH + O3	= HO2 + O2	2.30E-12	-1125.
8	OH + H2O2	= H2O + HO2	1.00E-11	-750.
9	HO2 + O3	= OH + 2O2	1.00E-13	-1525.
10	HO2 + O	= OH + O2	1.00E-10	-250.
11	HO2 + NO	= OH + NO2	1.10E-11	-1000.
12	HO2 + CLO	= HCLO + O2	0.0	0.
13	HO2 + HO2	= H2O2 + O2	5.00E-12	-500.
14	HO2 + OH	= H2O + O2	2.00E-11	0.
15	HO2 + CL	= HCL + O2	3.00E-11	0.
16	H + HO2	= H2 + O2	1.00E-11	0.
17	H + HO2	= 2OH	4.20E-10	-950.
18	OH + CO	= H + CO2	2.10E-13	-115.
19	OH + O	= H + O2	1.00E-10	-250.
20	OH + HCL	= H2O + CL	2.00E-12	-313.
21	OH + CH4	= H2O + CH3	2.36E-12	-1710.
23	OH + HNO3	= H2O + NO3	1.00E-12	-600.
24	OH + OH	= H2O + O	1.70E-12	0.
25	OH + H2	= H2O + H	6.70E-12	-2010.
26	CL + H2	= HCL + H	5.70E-11	-2400.
27	CL + H2O2	= HCL + HO2	6.00E-13	0.
28	CLO + NO2 + M	= CLNO3 + M	3.80E-33	1055.
29	CL + O3	= CLO + O2	2.70E-11	-257.
30	C1 + CH4	= HCL + CH3	7.29E-12	-1260.
31	CLO + O	= CL + O2	1.07E-10	-224.
32	CLO + NO	= CL + NO2	2.00E-11	0.
33	O + HCL	= OH + CL	0.0	0.
34	O + O2 + M	= O3 + M	1.05E-34	520.
35	O + O3	= 2O2	1.30E-11	-2140.
36	NO2 + NO3	= N2O5*	1.00E-12	0.
38	N2O5* + M	= N2O5 + M	3.70E-11	0.
39	N2O5 + M	= N2O5* + M	9.00E-06	-9700.
40	NO + O3	NO2 +o2	2.30#-12	-1450.
41	NO2 + o3	= NO3 + O2	1.20E-13	-2450.
42	NO2 + O	= NO + o2	9.12E-12	0.
43	N2O + O('D)	= N2 + O2	5.00E-11	0.
44	N2O + O('D)	= 2NO	7.00E-11	0.
45	N + NO	= N2 + O	2.00E-11	0.
46	N + O2	= NO + O	5.50E-12	-3200.
47	O('D) + CFCL3	= PRODUCTS	3.00#-10	0.
48	O('D) + CF2CL3	= PRODUCTS	3.00E-10	0.
49	O('D) + CH3CL	= OH + CH2CL	0.0	0.
50	O('D) + CCL4	= PRODUCTS	0.0	0.
51	O('D) + M	= O + M	2.00E-11	107.

Reactions Whose Rates Are Calculated By Different Formulae Are:

22	OH + NO2 + M	= HNO3 + M	R = 2.3E-13*EXP(880./Temp.(Z)/(2.6E18 + M(Z))
37	N2O5*	= NO2 + NO3	R + 1.0E+8*M(Z)/(2.6E19+M(Z)) + 1.0E7

where J_1 and J_3 are the photolysis rates for reaction (2-4) and (2-5) and k_2 and k_4 are the rate constants for reactions (2-5) and (2-7), respectively.

Equation (2-8) gives a good first order model of the vertical distribution of atmospheric ozone. It successfully predicts the ozone peak at around 25 km. However, it predicts too much ozone at all altitudes above 22 km, and it overestimates the total ozone abundance by about a factor of 2. Furthermore, Chapman's simple model does not include atmospheric transport processes and cannot account for the observed latitudinal distribution of ozone - low values at low latitudes and high values at high latitudes.

Bates and Nicolet (1950) first attempted to remove the discrepancies between observations and Chapman's theory by introducing catalytic hydrogen chemistry. (the HO_x family). Catalysis of odd oxygen recombination by hydrogen species (H, OH, HO_2) may take place either through

$$H + O_3 \rightarrow OH + O_2 \qquad (2\text{-}9)$$

followed by

$$OH + O \rightarrow O_2 + H; \qquad (2\text{-}10)$$

or through

$$H + O_2 + M \rightarrow HO_2 + M \qquad (2\text{-}11)$$

followed by

$$HO_2 + O \rightarrow OH + O_2 \qquad (2\text{-}12)$$

These reactions are important above 50 km, and account for a reduction by about a factor of 2 to 3 in the concentration of ozone calculated by Equation (2-8).

Atmospheric odd hydrogen (H, OH, HO_2, H_2O_2) is mainly formed by reactions involving H_2O molecules;

$$H_2O + O(^1D) \rightarrow 2\ OH \qquad (2\text{-}13)$$

and

$$H_2O + h\nu \rightarrow OH + H \tag{2-14}$$

They are mainly removed by reactions

$$OH + HO_2 \rightarrow H_2O + O_2 \tag{2-15}$$

and

$$OH + H_2O_2 \rightarrow HO_2 + H_2O \tag{2-16}$$

For a given H_2O concentration, the abundance of odd hydrogen is mainly controlled by reactions (2-13) to (2-16). Reaction (2-15) is the dominant loss process for odd hydrogen above 35 km.

The principal stratospheric sink for O_3 was not identified until 1970 when Crutzen (1970) and Johnston (1971) suggested that nitric oxide (NO) can catalytically recombine O and O_3 through the reaction

$$NO + O_3 \rightarrow NO_2 + O_2 \tag{2-17}$$

followed by

$$NO_2 + O \rightarrow NO + O_2 \tag{2-18}$$

Oxides of nitrogen, NO_x (NO, NO_2, NO_3, N_2O_5, HNO_3) are formed in the stratosphere by photochemical decomposition of N_2O (McElroy and McConnell, 1971):

$$N_2O + O(^1D) \rightarrow 2NO \tag{2-19}$$

Nitrous oxide (N_2O) is mainly produced in soil as a by-product of the denitrification process, with some contribution from high temperature combustion processes.

The possible importance of chlorine chemistry in the stratosphere was noted by Wofsy and McElroy (1974) and by Stolarski and Cicerone (1974). They suggested that free chlorine may play a role similar to NO_x in the recombination of O and O_3 through the reactions

$$C\ell + O_3 \rightarrow C\ell O + O_2 \tag{2-20}$$

followed by

$$C\ell O + O \rightarrow C\ell + O_2 \qquad (2\text{-}21)$$

A source of stratospheric $C\ell$ was not identified until Molina and Rowland (1974) suggested the photolysis of flourocarbons (F-11, F-12) through the reactions

$$CFC\ell_3 + h\nu \rightarrow CFC\ell_2 + C\ell \qquad (2\text{-}22)$$

and

$$CF_2C\ell_2 + h\nu \rightarrow CF_2C\ell + C\ell \qquad (2\text{-}23)$$

These reactions constitute the basis of the $C\ell X$ family of the CMSP program.

Theoretical model calculations [Wofsy et. al. (1975), Crutzen (1974)] have shown that continued release of flourocarbons (CFMs) at 1973 production rates might lead to approximately 7 to 12 percent ozone reduction in the year 2200. These results have led to the current concern regarding the effects of CFMs on stratospheric ozone.

Prior to 1976, it was thought that $HC\ell$ was the only inert form of odd chlorine species. The chemistry of chlorine nitrate, $C\ell ONO_2$, was ignored until Rowland et. al. (1976) measured the absorption cross section of $C\ell ONO_2$, which suggested its appreciable life time ($\sim$ 1 day) in the mid-stratosphere. Chlorine nitrate is formed by a three body reaction

$$C\ell O + NO_2 + M \rightarrow C\ell ONO_2 + M \qquad (2\text{-}24)$$

with a rate constant

$$k_{24} = 5.1 \times 10^{-33} \exp(-900/T)$$

Formation of $C\ell ONO_2$ would tie up the active $C\ell$ and NO_x -species, and could lower the catalytic efficiency of <u>both</u> the $C\ell X$ and NO_x cycles.

3. Development of the Radiative Transfer Section

3.1 Discussion

In the basic version of the CMSP program only the most elementary radiative transfer process, that of absorption by molecular oxygen and ozone, is incorporated within the calculation of photodissociation rates. However, surface reflection and atmospheric multiple scattering of incident solar radiation by molecules and aerosols can significantly enhance the photolysis rates of certain stratospheric species (Luther and Gelinas, 1976) and may have an appreciable effect on stratospheric photochemistry (Sze and Tripp, 1977).

The photodissociation rate (sec^{-1}) of species i at altitude z is given by:

$$J_i(t,z) = \int_\lambda \pi F_\lambda (t,z)\, \sigma_{\lambda,i}\, \Phi_{\lambda,i}\, d\lambda \qquad (3\text{-}1)$$

where

$\sigma_{\lambda,i}$ = absorption cross section of species i at wavelength λ (cm^2)

$\Phi_{\lambda,i}$ = quantum yield of species i at wavelength λ (dimensionless)

$\pi F_\lambda(t,z)$ = flux at level z available for photodissociations at a time t (photons cm^{-2} sec^{-1} $\mathring{A}^{-1}$).

In the pure absorption model, the available photons are calculated based on attenuation of the direct solar beam by O_2 and O_3 or:

$$\pi F_\lambda (t,z) = \pi F_o \exp\left[-\tau(z)/\mu_o\right] \qquad (3\text{-}2)$$

where

πF_o = unattenuated solar flux

μ_o = cosine of the solar zenith angle

$$\tau(z) = \int_z^\infty \sum_i \sigma_{i,a}\, n_i (z)\, dz \qquad (3\text{-}3)$$

$\sigma_{i,a}$: absorption cross section of species i. (cm^2)

n_i: local number of density of species i. (cm^{-3})

The flux depends on time through variation of the solar zenith angle with time of day:

$$\mu_o = \cos\theta \cos\delta \cos\left(\frac{t}{240}\right) + \sin\theta \sin\delta \qquad (3\text{-}4)$$

where

θ = latitude (deg.)

δ = solar declination angle (deg.)

t = local time (sec)

The single solar zenith angle photolysis rate is given by (3-1).

The 24 hour averaged photolysis rate is given by:

$$\overline{J}_i(z) = \frac{1}{86400} \int_0^{86400} J_i(t,z)\, dt \qquad (3\text{-}5)$$

In order to account for the effects of multiple scattering, the radiative transfer equation:

$$\mu \frac{dI(\tau,\mu)}{d\tau} = I(\tau,\mu) - S(\tau,\mu) \qquad (3\text{-}6)$$

must be solved at each level of the atmosphere for each frequency.

The flux available for photodissociation πF is then given by:

$$F(\tau) = 2 \int_{-1}^{+1} I(\tau,\mu)\, d\mu \qquad (3\text{-}7)$$

In Eqn (3-6), $S(\tau,\mu)$ is the source function which obeys the integral equation:

$$S(\tau) = \frac{\omega_0(\tau)}{4} F_0 \cdot \exp(-\tau/\mu_0) + \frac{\omega_0(\tau)}{2} \int_0^{\tau^*} S(t) E_1(|t-\tau|)\, dt + 2 \cdot \frac{\omega_0(\tau)}{2} \cdot R \cdot E_2(\tau^*-\tau) \int_0^{\tau^*} S(t)\, E_2(\tau^*-t)\, dt \qquad (3\text{-}8)$$

$$+ \frac{\omega_0(\tau)}{2} \cdot \mu_0 \cdot F_0 \cdot R \cdot E_2(\tau^* - \tau) \cdot \exp(-\tau^*/\mu_0)$$

where

$$E_n(x) = \int_0^1 \exp(-x/\mu)\, \mu^{(n-1)} \frac{d\mu}{\mu}$$

R = ground reflectivity

τ^* = (total) optical depth = $\int_0^\infty \sum_i \sigma_i\, n_i(z)\, dz$

and ω_0 = single scattering albedo

$$\omega_0(z) = \frac{\sum_i \sigma_{s,i}\, n_i(z)}{\sum_i \sigma_{s,i}\, n_i(z) + \sum_i \sigma_{a,i} n_i(z)}$$

In Eqn (3-8) the optical depth τ is computed using the extinction cross section ($\sigma_i = \sigma_{s,i} + \sigma_{a,i}$) where $\sigma_{s,i}$ is the scattering cross section of species i as compared with the absorption cross section only in Eqn (3-3)

Sources of scattering opacity include both atmospheric gases (Rayleigh scattering) and polydisperse aerosol distributions (Mie scattering). Evaluation of the Rayleigh scattering cross section at each level is accomplished using (McClatchey, et. al., 1972)

$$\sigma_{s,\text{Rayleigh}}(z) = \left(9.807 \times 10^{-25} \nu^{4.0117}\right) \frac{N(z)}{N(z=0)} \qquad (3.9)$$

where: ν = frequency in wave numbers (cm^{-1})

$N(z)$ = total number density at level z (cm^{-3})

Aerosol models have been adopted from Shettle and Fenn (1976) which provides the wavelength dependence of the absorption and extinction cross sections for four characteristic aerosol models: maritime, urban, rural, and tropospheric. The first three are, strictly speaking, boundary layer models while the tropospheric model is more characteristic of the atmosphere above the boundary

layer. The altitude variation of the aerosol number densities (Table 3-1) is assumed to be the same for all models and is taken from Elterman (1968).

The surface is assumed to be Lambertian. The reflectivity (R) is defined as the ratio between the incoming and outgoing fluxes at the surface and the reflection is isotropic (i.e. no angle preference for the outgoing radiance). The reflected intensity at surface $I(\tau^*,\mu)$ can be written as

$$I(\tau^*,\mu) = 2 \cdot R \int_0^{\tau^*} S(t)\, E_2(\tau^*-t)\,dt \qquad (3\text{-}10)$$

3.2 Implementation of the Variational-Iterative (VI) Technique

Once equation (3-8) is solved for the source function, the total flux available for photodissociation $\pi F(\tau)$ in the fully scatering case is given by:

$$F(\tau) = F_o \exp(-\tau/\mu_o) + 2\int_0^{\tau^*} S(t)E_1(|t-\tau|)\,dt$$

$$+ 2\,\mu_o\, F_o\, R\, E_2(\tau^*-t)\exp(-\tau^*/\mu_o)$$

$$+ 4\,R \cdot E_2(\tau^*-t)\int_0^{\tau^*} S(t)\,E_2(\tau^*-t)\,dt \qquad (3\text{-}11)$$

The physical meaning of each term in Equation (3-11) is as follows:

1) the first term represents the attenuated direct beam. (This is the only term used in a pure absorption model).

2) the second term represents the diffuse radiation in the atmosphere due to scattering of the direct beam;

3) the third term represents the attenuated direct beam reflected from the surface with reflectivity R;

4) the fourth term represents the diffuse radiation due to scattering of the reflected beam.

This may be substituted into (3-1) to evaluate the photodissociation rates.

TABLE 3-1

ALTITUDE VARIATION OF AEROSOL NUMBER DENSITIES

Altitude (km)	Aerosol Number Density (cm^{-3})	Altitude (km)	Aerosol Number Density (cm^{-3})
0	2.8280E+03	42	7.9600E-02
2	5.3710E+02	44	5.7040E-02
4	1.1920E+02	46	2.8290E-02
6	6.3370E+01	48	2.0990E-02
8	6.7690E+01	50	1.0780E-02
10	5.6750E+01	52	5.5800E-03
12	5.5850E+01	54	4.1140E-03
14	5.1480E+01	56	2.0780E-03
16	4.5110E+01	58	1,4950E-03
18	4.3140E+01	60	7.7350E-04
20	2.6670E+01	62	4.0030E-04
22	1.4555E+01	64	2.8800E-04
24	8.1260E+00	66	1.4900E-04
26	5.7060E+00	68	1.0720E-04
28	3.5740E+00	70	5.5500E-05
30	2.2380E+00	72	2.1440E-05
32	1.1480E+00	74	1.3320E-05
34	8.2230E-01	76	5.1440E-06
36	4.2190E-01	78	3.1960E-06
38	3.0220E-01	80	1.2340E-06
40	1.5500E-01		

To solve the integral equation, (3-8), the variational-interative technique introduced by Sze (1976) was used. This method, in essence, provides a direct way for constructing an approximate source function for equation (3-8) and allows for arbitrary inhomogeneity in the atmosphere. It has been shown by Burke and Sze (1977) that the variational-iterative approach requires relatively little computational time to achieve satisfactory accuracy in comparison to other standard methods.

In the variational-iterative technique, the approximated source function can be expressed as:

$$S_a(\tau) = U_a(\tau) \sqrt{\omega_o(\tau)} , \tag{3-12}$$

where

$$U_a(\tau) = \Sigma_i C_i V_i(\tau) , \tag{3-13}$$

and $V_i(\tau)$ is trial function for the ith layer.

The total optical depth τ^* is divided into (N-1) layers with an average single scattering albedo ω_j assigned to each layer j. The simplest piece-wise continuous trial functions are the step functions defined by

$$V_j(\tau) = \begin{cases} 1 & \tau_j \leq \tau \leq \tau_j + 1 \\ 0 & \tau < \tau_j ; \tau > \tau_j + 1 . \end{cases} \tag{3-14}$$

It can be shown (Sze, 1976) that the C_i are solutions to the following set of linear algebraic equations:

$$\sum_{j=1}^{N} M_{ij} C_j = f_i . \tag{3-15}$$

The M_{ij} are simply given by

$$M_{ij} = \delta_{ij}\,\Delta\tau_j - \frac{\sqrt{\omega_i\,\omega_j}}{2} \int_{\tau_i}^{\tau_{i+1}} B_j(\tau)\,d\tau\,, \qquad (3\text{-}16)$$

where

$$\delta_{ij} = \begin{cases} 1 & \text{for } i=j \\ 0 & \text{for } i\neq j, \end{cases}$$

$$B_j(\tau) = \int_{\tau_j}^{\tau_{j+1}} E_i(|\tau-t|)\,dt\,,$$

and f_i is

$$f_i = \frac{F_o}{4}\,\mu_o\,\sqrt{\omega_i}\,\left[\exp(-\tau_i/\mu_o) - \exp(-\tau_{i+1}/\mu_o)\right]$$

The smoothed approximated source function including the ground reflection can be written as

$$S_1(\tau) = \frac{\omega_o(\tau)}{4}\,F_o\exp(-\tau/\mu_o) + \frac{\omega_o(\tau)}{2}\sum_{j=1}^{N-1} C_j\,\sqrt{\omega_j}\,B_j(\tau)$$

$$+\ \frac{\omega_o(\tau)}{2}\cdot R\cdot E_2(\tau^*-\tau)\left[2\sum_{j=1}^{N-1} C_j\sqrt{\omega_j}\,D_j + \mu_o\exp(-\tau^*/\mu_o)\right] \qquad (3\text{-}17)$$

where

$$D_j = \int_{\tau_j}^{\tau_{j+1}} E_2(\tau^*-t)\,dt$$

Subsequent iterations

$$S_{n+1}(\tau) = \frac{\omega_o(\tau)}{4} F_o \exp(-\tau/\mu_o) + \frac{\omega_o(\tau)}{2} \int_0^{\tau_*} E_1(|\tau-t|)\, S_n(t)\, dt$$

$$+ \frac{\omega_o(\tau)}{2} \cdot R \cdot E_2(\tau^*-\tau)\left[2 \int_0^{\tau_*} E_2(\tau^*-t)\, S_n(t)\, dt + \mu_o \exp(-\tau^*/\mu_o)\right] \tag{3-18}$$

would bring the source function to the desired accuracy.

3.3 Results

The results of two relevant calculations using the models described in the previous sections are contained in Appendix C. (A complete description of the output format is given in Section 4.5.) The first set of profiles is for an absorption only model where net fluxes are calculated using Eqn. (3-2). The second set is for a complete multiple scattering calculation [using equation (3-11)] where a surface reflectivity of 0.2 is assumed. Both calculations use a single solar zenith angle given by $\cos^{-1}(.707)$.

Several comparisons can be made between the calculations. In particular, the effect of multiple scattering and surface reflection on the photodissociation rate of O_3 be seen. Figure 3-1 illustrates the percent increase in the value of CJ03 for the two cases cited. A second curve (for a surface reflectivity of 0.8) indicates that highly reflecting surfaces and/or large expanses of cloud deck may have a significant impact on stratospheric photochemistry.

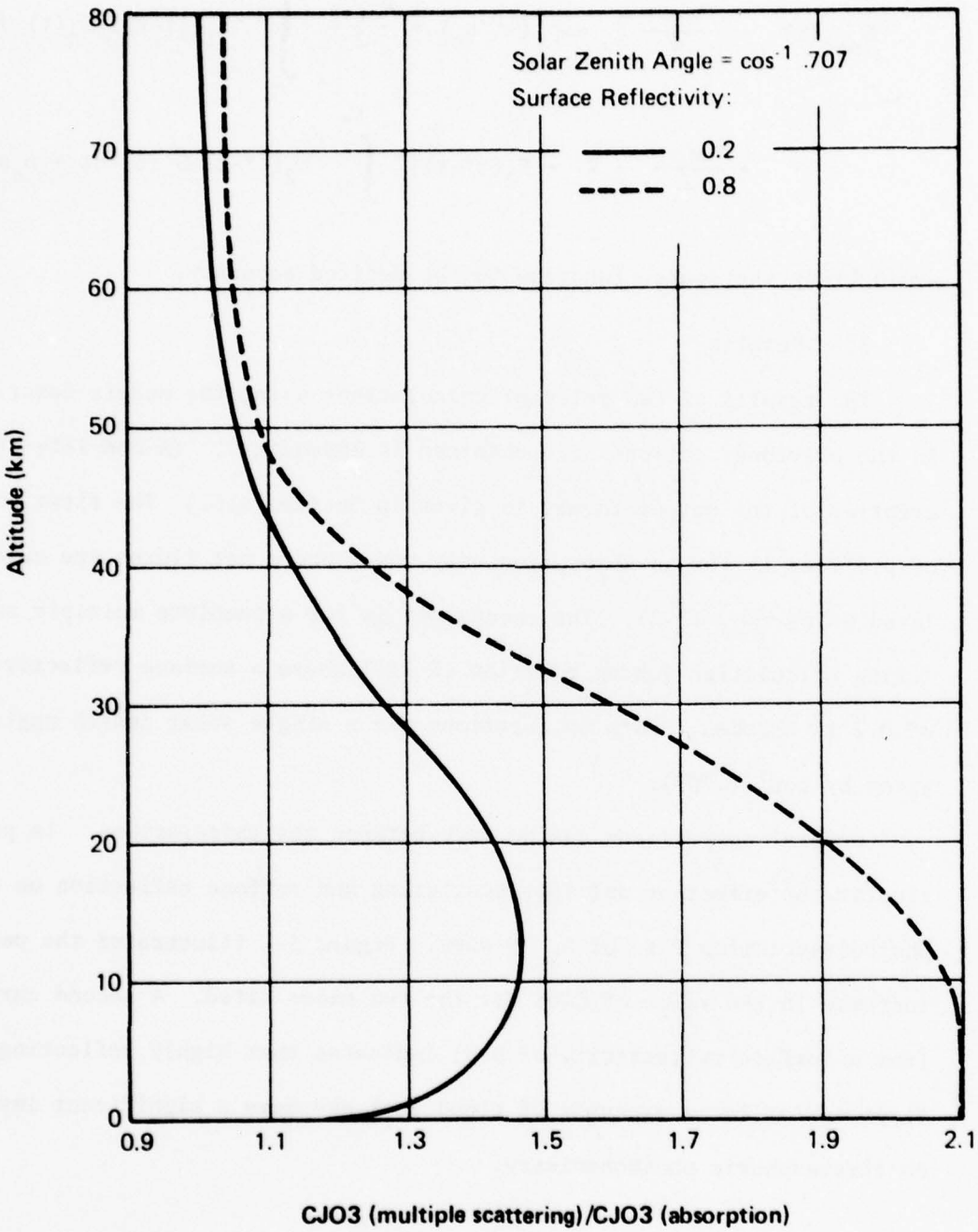

Figure 3-1 Percent Increase in Value of CJO3

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4. Program Description

4.1 Summary

The Chlorine Model Study Program (CMSP) computer code consists of a main program (MAIN), forty subroutines, function subprograms, and a subprogram Block Data of initialization and model parameters. The primary function of the main program is to select one of two operational modes determined by "keywords" read from the input set (see Section 5). Specification of the keyword PARAMETER calls subroutine INPARM which establishes the initial constants for each case. The keyword "RUN" directs the main program to call subroutine PHOCHM which conducts the actual photochemical calculation for each case. A keyword of "ENDJOB" causes the program to terminate.

Since the sequence of program logic is somewhat complex due to the nature of the problem, this section provides a narrative description including considerable detail within many of the relevant subroutines. For clarity, housekeeping subroutines found in the program listing (Appendix A) are neither included in the flow chart (Appendix B) nor discussed further in this section. (These subroutines such as INPUT, PAGE, LINE, DAY, ERRM, etc. perform such functions as page turning and reading, line count, date writing, and error flagging.) The reader is urged to utilize the program listing and flow chart in following through this program description.

Table 4-1 provides a schematic view of the CMSP logic which may be helpful. Here the most important subroutines are listed according to their calling order and priority within the program. Priority is designated by levels: Level 0 is assigned to the MAIN program, while numerically higher levels are more distant from the MAIN program. A level 3 subroutine, for example, will return to a level 2 subroutine and may call a level 4 subroutine. The overall function of each block of coding is designated

TABLE 4-1

SCHEMATIC PRESENTATION OF THE CHLORINE

MODEL STUDY PROGRAM COMPUTER CODE

Level 0	Level 1	Level 2	Level 3	Level 4	Function
MAIN					
	ALTGEN				
	INPARM				
		WEIGHT			
		QSCATT			Initialize
		CPHI1			
		SETUP			
			EDC1/EDC2		
		RCONST			
	PHOCHM				
		SETUP2			
		RJITER			
			COLDEN		
			COMPJ		Compute J Values
				COMTAU	
				OMEGA	
				VIM	
		INITAL			
			PCLOX		
			PNOX		
				QUAD	"Short-Lived" Species
		SOLVE			
			JACOB		
				QUAD	
			LINEQN		
			PNOX		
		CFLOW			
			RINTER		
			CSPEC		
				CXL	
				COEF	
				TRIDIA	"Long-Lived Species
			REPCN		
				PNOX	
				PCLOX	
			RINTER		
			SETUP 2		

at the right of the table. For example, PHOCHM (Level 1) calls RJITER (Level 2) and its higher level subroutines which compute photodissociation rates (so-called "J" values).

4.2 Initialization: BLOCK DATA

Although not contained explicitly within the flow chart, the BLOCK DATA section constitutes a significant source of input data and contains many of the run parameters which are required for model calculations. These data are introduced by DATA statements which are made accessible to the user subroutines by means of labeled COMMON statements. Table 4-2 lists the important model variables contained within BLOCK DATA including species mixing ratio or number density profiles, rate constant data, photodissociation cross section and rate values, and model atmosphere. Additionally, the corresponding labeled COMMON name is given. Values are compiled into their respective array locations based on their dependence on altitude or wavelength. Quantities characterizing the atmospheric model such as temperature (TEMP) and mixing ratios (H,OH, etc.) are given as level values at 2 km intervals from the surface to 80 km. Wavelength dependent quantities such as the solar flux (FL) and photodissociation cross sections (QO2, QO3 etc.) are digitized at wavelengths given by the array WL such that WL(1) is the wavelength at which the cross section of O_2 is QO2(1), etc.

In addition to vertical profiles and wavelength dependent spectra, BLOCK DATA also contains a large number of default values for branching parameters and other initial conditions specifiable for a particular case such as the boundary conditions on the fluxes or mixing ratios of certain species. These BLOCK DATA default values may be changed by utilizing the NAMELIST $INPUT (see Section 4.3.2) if desired, otherwise the default values are used. A complete description of these data is given in Section 5.2.

TABLE 4-2

BLOCK DATA SUPPLIED VALUES AND LABELED COMMON NAMES

Labeled Common Name	Variable Name	Identity	Units
MODEL	TEMP	temperature	^{o}K
	DM	total number density	cm^{-3}
	DID	$O(^1D)$ number density	cm^{-3}
	DA23	aerosol number density	cm^{-3}
RATES	RA	first rate constant	$cm^{3n}sec^{-1}$
	RB	second rate constant	^{o}K
RLOW	RN20	mixing ratio of N_2O at bottom	v/v
	RNOX	flux of NO_x at bottom	$cm^{-2}sec^{-1}$
	RCH4	mixing ratio of CH_4 at bottom	v/v
	RF11	flux of flourocarbon 11	$cm^{-2}sec^{-1}$
	RF12	flux of flourocarbon 12	$cm^{-2}sec^{-1}$
	RCH3C	mixing ratio of CH_3Cl at bottom	v/v
	RCLX	mixing ratio of Cl_x at bottom	v/v
	RCCL4	flux of CCl_4 at bottom	$cm^{-2}sec^{-1}$
	RO3	mixing ratio of O_3 at bottom	v/v
SOLCON	WL	wavelength	Å
	FL	solar flux	$cm^{-2}sec^{-1}$
	QO2	photodissociation cross section O_2	cm^2
	QO3	photodissociation cross section O_3	cm^2
SOLCN1	QCF2	photodissociation cross section CF_2Cl_2	cm^2
	QCF3	photodissociation cross section $CFCl_3$	cm^2
	QCCL4	photodissociation cross section CCl_4	cm^2
	QCH3C	photodissociation cross section CH_3Cl	cm^2
	QCLNO3	photodissociation cross section $ClONO_2$	cm^2
	QN2O	photodissociation cross section N_2O	cm^2
	QHNO3	photodissociation cross section HNO_3	cm^2
	QH2O2	photodissociation cross section H_2O_2	cm^2
	QN2O5	photodissociation cross section N_2O_5	cm^2
	QHCL	photodissociation cross section HCl	cm^2
	QHOCL	photodissociation cross section HOCl	cm^2
	QNO2	photodissociation cross section NO_2	cm^2
	QH2O	photodissociation cross section H_2O	cm^2

TABLE 4-2 (Continued)

BLOCK DATA SUPPLIED VALUES AND LABELED COMMON NAMES

Labeled Common Name	Variable Name	Identity	Units
SPECIE	H	H number density	cm^{-3}
	OH	OH number density	cm^{-3}
	HO2	HO_2 number density	cm^{-3}
	H202	H_2O_2 number density	cm^{-3}
	03	O_3 number density	cm^{-3}
	0	0 number density	cm^{-3}
	NO	NO number density	cm^{-3}
	NO2	NO_2 number density	cm^{-3}
	HNO3	HNO_3 number density	cm^{-3}
	NOX	NO_x mixing ratio	v/v
	CO	CO mixing ratio	v/v
	CH4	CH_4 mixing ratio	v/v
	H2O	H_2O mixing ratio	v/v
	H2	H_2 mixing ratio	v/v
	CLX	Clx mixing ratio	v/v
PHRATE	JHCL	photodissociation rate HCl	sec^{-1}
	JCH4	photodissociation rate CH_4	sec^{-1}
	JN2O	photodissociation rate N_2O	sec^{-1}
	JN2O5	photodissociation rate N_2O_5	sec^{-1}
	JHNO3	photodissociation rate HNO_2	sec^{-1}
	JH202	photodissociation rate H_2O_2	sec^{-1}
	JNO2	photodissociation rate NO_2	sec^{-1}
	JCF2	photodissociation rate CF_2Cl_2	sec^{-1}
	JCF3	photodissociation rate $CFCl_3$	sec^{-1}
	JH2O	photodissociation rate H_2O	sec^{-1}
	JO3	photodissociation rate O_3	sec^{-1}
	JO2	photodissociation rate O_2	sec^{-1}
	JHOCL	photodissociation rate HOCℓ	sec^{-1}

4.3 Initialization Subroutines: ALTGEN, INPARM

4.3.1 Subroutine ALTGEN

Upon entering the MAIN program, subroutine ALTGEN is called. The primary function of this code is to fill the array ALT which is contained in labeled COMMON, MODEL and gives the altitude of each level in 2 km (2.0×10^5 cm) increments from 0.0 to 80.0 km. However, ALTGEN also provides revised solar flux data (overiding the values specified in BLOCK DATA) in the 1900 to 2250Å wavelength region and photodissociation cross sections for chlorine nitrate. Additionally, the aerosol model number density distribution with height is specified by the parameter IAERO[= 0 (23 km) or = 1 (5 km)] and the integrated total number density of molecules DMINT, and aerosols DAINT are computed above a given level. These integrated densities are later used in the evaluation of optical depth. After ALTGEN is called control is returned to MAIN.

4.3.2 Subroutine INPARM

The keyword PARAMETERS read from the input set directs the program to call subroutine INPARM. INPARM establishes the basic input parameters required to run the model calculation. This is accomplished both by direct modification of previously stored values in BLOCK DATA and by calling higher level subroutines to perform additional computations on the basic input set. A NAMELIST statement is provided which may be used (see Section 5) to change the values of any of the formatted parameters from the default values.

For example, ISWIT which determines whether a single sun angle (=0) or a 24 hour average (=1) is used in the J-value computation may be changed from the default value (1) to zero by using the NAMELIST $INPUT. The subroutine listing (Appendix A) illustrates which parameters may be changed.

Certain basic calculations are performed by calling subroutines WEIGHT, QSCATT, CPHI1, SETUP, and RCONST.

Subroutine WEIGHT computes the length of the day using the parameters LAT and DEL. The day is then divided into twelve equal time intervals (one hour at equinox) and the cosine of the solar zenith angle is computed at the midpoint of these intervals. Six values (those on either side of noon are equal) of the reciprocal of the cosine of the solar zenith angle are stored in array A. These are used to compute the 24 hour average model in subroutine COMTAU (Section 4.4.1).

Subroutine QSCATT computes the Rayleigh scattering coefficient QRAY, aerosol extinction coefficient QAE, and aerosol absorption coefficient QAA at the surface (z=0) as a function of wavelength. A particular aerosol size distribution is specified by the parameter ISIZE which selects one of four given models or a user's own model. (See Section 5.3). These values are later used in subroutine OMEGA to compute optical depth and the single scattering albedo profile when multiple scattering is considered.

Subroutine CPHI1 allows a quantum yield PHI1 to be introduced into the evaluation of the photodissociation rate for $ClONO_2$. Furthermore, it may be given one value P11 for wavelengths WL(1) to WL(I1), inclusive, and a second value P22 from WL(I1+1) to the upper wavelength limit. Default values in BLOCK DATA are I1 = 59, P11 = P22 = 1.0, so that the quantum yield is unity.

Subroutine SETUP establishes the eddy coefficient model to be used and operates on the basic 41 level model atmosphere data. Upon entering the subroutine, Hunten's eddy coefficients are read into array EK by a DATA statement. If NEDDY is zero, these values are used.

I NEDDY is either one or two, subroutine EDC1 or EDC2, respectively, is called which substitutes either Chang's or an analytic form for these values. NEDDY has a default value of zero and may be changed in the NAMELIST $INPUT. A factor FKK (default value - 1.0) may be specified to multiply any of these profiles by a constant value. The basic model atmosphere data (TEMP, DM, and EK) are then interpolated to produce arrays (CTEMP, CDM, and CEK) of 81 levels of 1 km thickness from the data arrays containing 41 levels of 2 km thickness. These results are printed out at 2 km intervals.

Subroutine RCONST calculates the reaction rates of each of the chemical reactions as a function of temperature at the 81 levels of the atmosphere. The required input consists of the model atmosphere temperature profile and the first and second Arrhenius rate constants RA and RB from BLOCK DATA or NAMELIST $INPUT For each reaction I and atmospheric level J the reaction rate RATE is given by:

```
RATE(I,J) = RA(I) * EXP(RB(I)/CTEMP(J))
```

Rates are computed explicitly for reactions which do not obey the above relation. A table of reactions and rate constant information is printed. (see listing, Appendix A). After execution of RCONST control reverts to INPARM which returns to MAIN.

4.4 Main Calculation: PHOCHM

As indicated in the flow chart the keyword RUN calls the subroutine PHOCHM. PHOCHM controls the remainder of the calculation for a particular case and may be considered as the main program for most purposes.

As PHOCHM is entered the steady state version is selected by specifying FT = 0., FA = 2., FB = 0. and FM = 0. (these values will be used by subroutine COEF in performing the long-lived species calculations. (see 4.4.3).

The functions performed within PHOCHM may be divided into three areas: (a) computation of photodissociation rates; (b) calculations for short-lived species (no diffusion); and (c) calculations for long-lived species (vertical diffusion). Most evaluations are made external to PHOCHM by calling appropriate higher level subroutines.

4.4.1 Subroutine RJITER: Computation of Photodissociation Rates

Subroutine RJITER functions as a calling program to facilitate the calculation of photodissociation rates at each atmospheric level. Its two arguments ISWIT and ISCATT are carried in COMMON to PHOCHM and specify the nature of the time averaging (single solar zenith angle vs. 24 hour average) and whether multiple scattering is considered, respectively. The upper limit for the wavelength integration IU is set in RJITER. For the absorption only model, the integration stops at 4025Å and the contributions to the dissociation of O_3 from the visible are included as a constant factor PJO3. (set in BLOCK DATA). When multiple scattering is considered, however, the integration is extended through the visible region.

RJITER calls subroutine COLDEN which computes the column densities of ozone from a given level to the top of the atmosphere. These values, DO3INT, are used in the computation of optical depth.

Subroutine COMPJ called from RJITER performs the actual wavelength integration. The specific details of the calculation depend on the parameters ISWIT and ISCATT. For the simplest case ISWIT = 0, ISCATT = 0, a fixed solar zenith angle GMU = .707 is used and the number of photons $cm^{-2}sec^{-1}$ available for photodissociation at a particular level is based on simple attenuation of the direct solar beam by O_2 and O_3 above the level. That is, optical depth TAU is computed as:

TAU = QO3 * DO3INT + QO2 * DMINT * PO2) and DMINT is the integrated total number density.

J values are then computed in a straightforward manner by taking the product of available flux (= FL * EXP (-TAU/GMU)), cross section (QO2, QO3, QHCl, etc.), and quantum yield if required (PHI1) at a given wavelength and integrating over the wavelength interval. Flux is reduced by a factor of 0.5 (RDF) for the single angle calculation to account for night and day.

When ISWIT = 1 and a 24 hour average model is required, the transmissivity from the top of the atmosphere to a given level is weighted by calling a subroutine COMTAU which uses the array of coefficients A computed by WEIGHT to simulate the variation of solar zenith angle over a day. The subroutine COMTAU essentially performs the calculation:

$$\text{TRAN (24 hr average)} = \frac{1}{24} \sum_{I=1}^{12} \text{EXP (-TAU * A (I))}$$

When a multiple scattering calculation is desired (ISCATT = 1) two additional subroutines OMEGA and VIM are utilized. (see Section 3 for details of the scattering model). OMEGA computes optical depth from a given level to space as the sum of both attenuation (molecular and aerosol and scattering (aerosol and Rayleigh). Aerosol absorption and extinction and Rayleigh scattering coefficients QAA, QAE, QRAY are carried in COMMON from subroutine QSCATT. Additionally, a single scattering albedo profile as a function of level is computed. An interpolation scheme creates a single scattering albedo profile as a function of optical depth which is input to subroutine VIM which performs a variational-iterative method multiple scattering calculation and returns the net flux available for photodissociation at a given optical depth normalized to the solar flux. This mean intensity includes contributions from the attenuated direct solar beam (absorption only case) and diffuse contributions reflected from the surface and scattered by molecules and aerosol particles. The surface reflectivity REF is contained in NAMELIST.

Subroutine OMEGA uses its knowledge of the altitude variation of optical depth to reinterpolate the net flux vs. optical depth profile to a net flux at altitude level profile. These values are placed in array F and returned to COMPJ for integration into the J value calculation. Subroutine VIM calls its own family of higher order subroutines which function somewhat independently of the overall CMSP code. A schematic presentation of the VIM subroutine heirarchy is presented in Table 4-3 in relation to the total CMSP sequence.

In order to account for the desired time averaging, OMEGA must be called for each GMU desired. Therefore, if a 24 hour average model is required (ISWIT = 1), OMEGA is called for each GMU using the solar zenith angles computed by WEIGHT (= 1/A) and averaging over 24 hours as was done for the absorption only case.

4.4.2 Subroutines INITAL, SOLVE: Short-lived Species

After photodissociation rates based on the first guess ozone concentrations are returned to PHOCHM by RJITER, calculations of the species concentration profiles begin. As noted in Table 4.1 the PHOCHM code sequence from this point can be divided into segments handling the short-lived species and the long-lived species. An iteration counter I is incremented by statement 10 in PHOCHM after initialization to zero. This index keeps account of the number of times the program is executed to reach convergence. An upper limit of 50 iterations is assigned. For all iterations after the first the old OH and O_3 profiles (OLDOH,003) are saved for convergence testing before being recomputed. The computed photodissociation rates of O_2, O_3, HNO_3, H_2O_2, and N_2O_5 are substituted for the BLOCK DATA values at each level and the concentration profile of

TABLE 4-3 SCHEMATIC PRESENTATION OF SUBROUTINE VIM SEQUENCE

```
MAIN
    PHOCHM
        RJITER
            COMPJ
                OMEGA
                    VIM
                        RMATRI
                        LINEQN
                        SG
                        S11
                        SE
                        S1NT
                        E
                        E2
                        E3
```

$O(^1D)$, DID, is computed based on equilibrium between the reactions;

$$O_3 + h\nu \rightarrow O_2 + O(^1D) \qquad J = CJO31$$

$$O(^1D) + M \rightarrow O + M \qquad k = RATE\ (51)$$

this yields the relationship:

DID = CJO31 *O3/RATE(51) * DM

at each level.

The calculation continues with a DO loop from statement 60 to statement 100 in PHOCHM. For each level in the atmosphere concentrations of the short-lived species are computed using the INITAL and SOLVE subroutines. At a given level, INITAL sets up a non-linear system of simultaneous equations in four variables: Y(1) = H, Y(2) = OH, Y(3) = HO2, and Y(4) = O3. The Y array gives the concentration of these four species at a given level. (Note: O_3 is short-lived above 30 km and long-lived below 30 km.) Initial concentrations of CO, O_2, H_2, CH_4, ClX, NO_x, H_2O, OH, and HO2 are first evaluated from input profiles. On subsequent iterations the computed values are used. For example, mixing ratio is converted to number density by multiplying by the total number density. An iteration counter (J) is set to monitor convergence and subroutine PCLOX is called.

Subroutine PCLOX computes the level concentrations of CL, CLO, and HCL by assuming equilibrium of production and loss mechanisms. The following ratios are computed:

RRC1 = CLO/CL I

RRC2 = HCL/CL II

RRC3A = CLNO3/CLO III

RRC3B = CLNO3/CL = RRC3A * RRC1

the corresponding reaction schemes assuming steady state at each level are:

$$Cl + O_3 \rightarrow ClO + O_2 \qquad k = RATE(29)$$

$$ClO + O \rightarrow Cl + O_2 \qquad k = RATE(31) \qquad I$$

$$ClO + NO \rightarrow Cl + NO_2 \qquad K = RATE(32)$$

$O + HCl \rightarrow OH + Cl$	k = RATE(33)	
$HCl + h\nu \rightarrow H + Cl$	J = JHCL	
$Cl + CH_4 \rightarrow HCl + CH_3$	k = RATE(30)	
$Cl + H_2 \rightarrow HCl + H$	k = RATE(26)	II
$Cl + H_2O_2 \rightarrow HCl + HO_2$	k = RATE(27)	
$HO_2 + Cl \rightarrow HCl + O_2$	k = RATE(15)	
$OH + HCl \rightarrow H_2O + Cl$	k = RATE(20)	
$ClONO_2 + h\nu \rightarrow ClO + NO_2$	J = CJC103	
$ClO + NO_2 + M \rightarrow ClONO_2 + M$	k = RATE(28)	III

After PCLOX returns to INITAL, PNOX is called and an anologous computation of the level values of NO, NO2, HNO3, NO3, N205, and CLNO3 is made. The following ratios are computed:

RR1 = NO/NO2	I
RR2 = HNO3/NO2	II
RR3 = NO3/NO2	III
RR4 = N205/NO2 * NO2	IV
RR9 = CLNO3/NO2	V

Reaction schemes determining these ratios assuming steady state at each level of the atmosphere are:

$NO_2 + h\nu \rightarrow NO + O$	J = $CJNO_2$	
$NO_2 + O \rightarrow NO + O_2$	k = RATE(42)	
$ClO + NO \rightarrow Cl + NO_2$	k = RATE(32)	I
$NO + O_3 \rightarrow NO_2 + O_2$	k = RATE(40)	
$OH + NO_2 + M \rightarrow HNO_3 + M$	k = RATE(22)	
$HNO_3 + h\nu \rightarrow OH + NO_2$	J = JHNO3	II
$OH + HNO_3 \rightarrow H_2O + NO_3$	k = RATE(23)	
$NO_2 + O_3 \rightarrow NO_3 + O_2$	k = RATE(41)	III
$NO_3 + h\nu \rightarrow NO + O_2$	J = JNO3	
$N_2O_5 * + M \rightarrow N_2O_5 + M$	k = RATE(38)	
$N_2O_5 * \rightarrow NO_2 + NO_3$	k = RATE(37)	
$N_2O_5 + h\nu \rightarrow NO_2 + NO_3$	J = JN205	IV
$N_2O_5 + M \rightarrow N_2O_5 + M$	k = RATE(39)	
$NO_2 + NO_3 \rightarrow N_2O_5 *$	k = RATE(36)	

$$ClONO_2 + h\nu \rightarrow ClO + NO_2 \qquad J = CJCLO3$$
$$ClO + NO_2 + M \rightarrow ClONO_2 + M \qquad k = RATE(28)$$

In the course of its calculation PNOX calls subroutine QUAD which solves the quadratic equation. PNOX returns control to INITAL where a convergence test is made based on comparison of the old and new values of NO, NO2, and HNO3. If convergence occurs (within approximately 0.5%), INITAL is exited and returns to PHOCHM.

PHOCHM calls subroutine SOLVE which organizes the solution of the chemical system for the short-lived species concentrations at a given level. Basically, the quantities Y (N), N = 1,4 are solved for using the convergent values returned from PNOX and PCLOX for the odd nitrogen and odd chlorine species, respectively. An iteraction counter KK is established and the previous values of H, OH, HO2, and O3 are saved for convergence testing. Subroutine SOLVE calls subroutine JACOB which organizes the coefficients of the system of chemical equations and calculates certain relevant production and loss terms. Production and loss terms are designated by double alphabetic variable names with a single subscript, while system coefficients to be solved by LINEQN are stored in the doubly subscripted array, A. Total production terms for a given species are subscripted variables PP while loss (sink) terms are subscripted variables SS. Table 4.4 presents a key to the variables defined in JACOB, identifying each by the corresponding reactions. Note that below 30 km O_3 is treated as a long-lived species, while at or above 30 km its equilibrium chemistry is treated explicitly. Subroutine JACOB returns to SOLVE where the net imbalance:

B (J,4) = PP(J) - SS(J)

is computed for H, OH, and HO2 in addition to the cumulative error:

TABLE 4-4

CHEMICAL ORIGIN OF VARIABLES DESCRIBED IN SUBROUTINE JACOB

Variable	Definition	Reaction	
ALP	O/O_3	$O + O_2 + M \rightarrow O_3 + M$	k = RATE(34)
		$O_3 + h\nu \rightarrow O_2 + O$	J = JO3
AA(1)	Production of H	$H_2 + O(^1D) \rightarrow OH + H$	k = RATE(4)
		$H_2O + h\nu \rightarrow OH + H$	J = JH20
AA(2)		$OH + O \rightarrow H + O_2$	k = RATE(19)
AA(3)		$OH + CO \rightarrow H + CO_2$	k = RATE(18)
AA(4)		$OH + CH_4 \rightarrow H_2O + CH_3$	k = RATE(21)
AA(5)		$OH + H_2 \rightarrow H_2O + H$	k = RATE(25)
PP(1) = AA (1) + AA(2) + AA(3) + AA(4) + AA(5)			
BB(1)	Loss of H	$H + O_2 + M \rightarrow HO_2 + M$	k = RATE(5)
BB(2)		$H + O_3 \rightarrow OH + O_2$	k = RATE(6)
BB(3)		$H + HO_2 \rightarrow H_2 + O_2$	k = RATE(16)
		$\rightarrow 2OH$	k = RATE(17)
	SS(1) = BB(1) + BB(2) + BB(3)		
CC(1)	Production of OH	$H_2O + O(^1D) \rightarrow 2OH$	k = RATE(2)
CC(2)		$CH_4 + O(^1D) \rightarrow CH_3 + OH$	k = RATE(3)
CC(3)		$O + HO_2 \rightarrow OH + O_2$	k = RATE(10)
CC(4)		$HO_2 + O_3 \rightarrow OH + 2O_2$	k = RATE(9)
CC(5)		$NO + HO_2 \rightarrow NO_2 + OH$	k = RATE(11)
CC(6)		$H_2O_2 + h\nu \rightarrow 2OH$	J = JH202
CC(7)		$H + O_3 \rightarrow O_2 + OH$	k = RATE(6)
CC(8)		$HNO_3 + h\nu \rightarrow NO_2 + OH$	J = JHNO3
CC(9)		$H + HO_2 \rightarrow 2OH$	k = RATE (17)
CC(10) = AA(1)			
	PP(2) = CC(1) + CC(2) + CC(3) + CC(4) + CC(5) + CC(6) + CC(7) + CC(8) + CC(9) + CC(10)		
DD(1)	Loss of OH	$OH + O_3 \rightarrow O_2 + HO_2$	k = RATE(7)
DD(2)		$H_2O_2 + OH \rightarrow H_2O + HO_2$	k = RATE(8)
DD(3)		$HO_2 + OH \rightarrow H_2O + O_2$	k = RATE(14)
DD(4) = AA(3)			
DD(5) = AA(2)			

TABLE 4-4 (Continued)

CHEMICAL ORIGIN OF VARIABLES DESCRIBED IN SUBROUTINE JACOB

Variable	Definition	Reaction	
DD(6)		$OH + HCl \rightarrow H_2O + Cl$	k = RATE(20)
DD(7)		$OH + CH_4 \rightarrow CH_3 + H_2O$	k = RATE(21)
DD(8)		$OH + NO_2 + M \rightarrow HNO_3 + M$	k = RATE(22)
DD(9)		$HNO_3 + OH \rightarrow H_2O + NO_3$	k = RATE(23)
DD(10)		$OH + OH \rightarrow H_2O + O$	k = RATE(24)
DD(11)		$OH + H_2 \rightarrow H_2O + H$	k = RATE(25)
	SS(2) = DD(1) + DD(2) + DD(3) + DD(4) + DD(5) + DD(6) + DD(7) + DD(8) + DD(9) + DD(10) + DD(11)		
EE(1)	Production of HO_2	$H + O_2 + M \rightarrow HO_2 + M$	k = RATE(5)
EE(2)		$OH + O_3 \rightarrow HO_2 + O_2$	k = RATE(7)
EE(3)		$Cl + H_2O_2 \rightarrow ClO + H_2O$	k = RATE(27)
EE(4) = DD(2)			
	PP(3) = EE(1) + EE(2) + EE(3) + EE(4)		
GG(1)	Loss of HO_2	$HO_2 + O_3 \rightarrow OH + 2O_2$	k = RATE(9)
GG(2) = CC(3)			
GG(3) = CC(5)			
GG(4)		$ClO + HO_2 \rightarrow HClO + O_2$	k = RATE(12)
GG(5)		$HO_2 + HO_2 \rightarrow H_2O_2 + O_2$	k = RATE(13)
GG(6) = DD(3)			
GG(7)		$Cl + HO_2 \rightarrow HCl + O_2$	k = RATE(15)
GG(8) = BB(3)			
	SS(3) = GG(1) + GG(2) + GG(3) + GG(4) + GG(5) + GG(6) + GG(7) + GG(8)		
	PP(4) Production of O	$O_2 + h\nu \rightarrow 2O$	J = J02
HH(1) = BB(2)	Loss of Odd O		
HH(2) = DD(1)			
HH(3) = CC(4)			
HH(4) = CC(3)			
HH(5) = AA(2)			
HH(6)		$NO_2 + O \rightarrow NO + O_2$	k = RATE(42)
HH(7)		$ClO + O \rightarrow Cl + O_2$	k = RATE(31)
HH(8)		$O + O_3 \rightarrow 2O_2$	k = RATE(35)

TABLE 4-4 (Continued)

CHEMICAL ORIGIN OF VARIABLES DESCRIBED IN SUBROUTINE JACOB

Variable	Definition	Reaction	
	SS(4) = HH(1) + HH(2) + HH(3) + HH(4) + HH(5) + HH(6) + HH(7) + HH(8)		

COEFFICIENTS OF SYSTEM OF EQUATIONS

A(1,1) = - SS(1)/y(1)

A(1,2) = (AA(2) + AA(3) + AA(4) + AA(5))/y(2)

A(1,3) = -BB(3)/y(3)

A(2,1) = (CC(7) + CC(9)/y(1)

A(2,2) = -(SS(2) + DD(10))/y(2)

A(2,3) = (CC(3) + CC(4) + CC(5) + CC(9) -DD(3))/y(3)

A(3,1) = (EE(1) -GG(8))/y(1)

A(3,2) = (EE(2) + EE(4) -GG(6))/y(2)

A(3,3) = -(SS(3) + GG(5))/y(3)

At levels < 30 km y(4) = 03(k)

At levels $\geq$ 30 km:

T1	Loss of 0	$NO_2 + 0 \rightarrow NO + O_2$	k = RATE(42)
T2		$OH + O \rightarrow O_2 + H$	k = RATE(19)
T3		$HO_2 + 0 \rightarrow OH + O_2$	k = RATE(10)
T4		$O + ClO \rightarrow Cl + O_2$	k = RATE(31)
	TT1 = (T1 +T2 + T3 + T4) ALP		
T5	Loss of O_3	$H + O_3 \rightarrow OH + O_2$	k = RATE(6)
T6		$OH + O_3 \rightarrow HO_2 + O_2$	k = RATE(7)
T7		$HO_2 + O_3 \rightarrow OH + 2O_2$	k = RATE(9)
T8		$NO_2 + O_3 \rightarrow NO_3 + O_2$	k = RATE(41)
	TT2 = T5 + T6 + T7 + T8		
	B1 = TT1 + TT2		

$$ERR = \sum_{N=1}^{3} \left(\frac{PP(N) - SS(N)}{SS(N)} \right)^2$$

Logical function LINEQN is called to solve the system of equations B where B(J,I) for J,I = 1,3 are the A(I,J) computed in JACOB using Gaussian elimination. If the matrix of coefficients is singular, values of H, OH, and HO_2 are scaled by a factor of 0.9 to remove the singularity and the calculation is repeated from the call to subroutine JACOB in statement 1 (This is permitted up to three times). If the parameter ERR is not less than 10^{-5} the concentrations are corrected by the magnitude of the net imbalance and the calculation is repeated from statement 1. (A maximum of 20 iterations are permitted.) If neither of the above error conditions occurs, the equilibrium concentrations of H, OH, HO_2 and 03 have been found. The 0 concentration is computed using the parameter ALP from JACOB and the H202 concentration follows from the set of reactions:

$$HO_2 + HO_2 \rightarrow H_2O_2 + O_2 \qquad k = RATE(13)$$

$$OH + H_2O_2 \rightarrow H_2O + HO_2 \qquad k = RATE(18)$$

$$H_2O_2 + h\nu \rightarrow 2OH \qquad J = JH202$$

H202 = RATE(13) * HO2 * HO2/(RATE(8) *OH + JH202)

Subroutines PNOX and PCLOX are called to compute the apportionment of nitrogen and chlorine species. Finally, the old and new values of H, OH, HO2, and 03 are compared. If the solutions do not compare within 1/2%, the calculation is repeated. If the solution is found, however, subroutine JACOB is called again to recompute the production and loss terms given by its coefficients (for printing purposes at final solution). Subroutine SOLVE then returns the PHOCHM. This sequence is repeated for each 2 km level in the atmosphere.

4.4.3 Subroutine CFLOW: Long-lived Species

At this stage in the calculation, concentration profiles have been computed for the short-lived species, that is the individual members of the HO_x, NO_x and ClX families, which are consistent with calculated J-values and input profiles for the long-lived species. Upon returning to PHOCHM, the values of 03 are saved for comparison and subroutine CFLOW is called to accomplish the evaluation of profiles for the long-lived species: N_2O, HO_x, NO_x, ClX, CH_4, and O_3 below 30 km. In these cases (as discussed in Section 2) it is not adequate to equate production and loss processes at each level. These species, on the contrary, have longer chemical lifetimes and their profiles must be consistent both with chemical sources and sinks at each level and the gradient of vertical flux parameterized in terms of the eddy diffusion coefficient profile. The resultant equation which must be solved for the mixing ratio f_i as a function of z is of second order with coefficients given by the vertical profiles of both production and loss and the eddy coefficients. Therefore, boundary conditions at the top (designated U) and at the bottom (designated L) of the atmosphere must be specified. Certain basic coefficients are evaluated in entry SETUP 2 of subroutine SETUP (Section 4.3.2) which is called at the beginning of PHOCHM. These arrays are essentially the product NK which appears in the definition of vertical flux (equation2.2)or in coding: CEK(I) * CDM(I). Also, at the beginning of PHOCHM are definitions for the factors PPL, PPU, and QQU which are used to specify lower and upper boundary conditions. The program offers the versatility of specifying either flux (proportional to $\frac{df_i}{dz}$ or mixing ratio (i.e. f_i boundary conditions, the basic relationship being in the form:

$$P_{L,U} \frac{df_i}{dz} + Q_{L,U} f_i = R_{L,U}$$

where f_i is the mixing ratio of the ith species at the lower (L) or upper (U) boundary. For example, if a fixed mixing ratio is to be specified at both boundaries, then $P_{L,U} = 0$, $Q_{L,U} = 1$ and $f_i = R_{L,U}$ where $R_{L,U}$ is the mixing ratio of the ith species at the lower and upper boundaries, respectively. All of the cases in the program (subroutine CFLOW) use: $P_U = 1$, Q_U = QQU * XL(N), $R_U = 0$. where QQU = 6.0E + 05/CEK(N) * CDM(N), XL(N) is the loss frequency of level N, and N = 81 is the uppermost level or:

$$\frac{df_i}{dz} = Q_U f_i$$

for the upper boundary condition. The corresponding lower boundary condition is given by specifying R_L as either mixing ratio or flux:

(a) R_L(flux): $Q_L = 0.$, P_L = PPL = -CEK(1) * CDM(1):

$$P_L \frac{df_i}{dz} = R_K$$

(b) R_L (mixing ratio): $Q_L = 1$, $P_L = 0$:

$$f_i = R_L$$

After CFLOW is called by PHOCHM, a series of layer interpolations is accomplished using subroutine RINTER for the species: DID, OH, HO2, NO2, NO, 03, CLO, CL, H, and H20 and photodissociation rates: CJN20, CJCF3, CJCF2, CJCH3C, CJO2, CJO3, and CJCCL4. RINTER increases the vertical resolution from 2 km to 1 km using square root interpolation. The next sequence in CFLOW is a series of subroutine calls to CSPEC, each of which provides the calculation of the flow dependent (but time independent) vertical profile of a particular species. A test on the magnitude of the specified lower boundary condition (given in BLOCK DATA or namelist; see Section 4.2, TABLE 4.2 LABELLED COMMON: RLOW) determines whether flux or mixing ratio has been specified (i.e. a value greater than 1.0 is a flux while one less than 1.0 is a mixing ratio.) The appropriate boundary condition parameter is then set (Q = 0. for flux; Q = 1. for mixing ratio) for the CSPEC calculation

The order in which the individual long-lived species are handled is as follows: N_2O, NO_x, CH_4, F11, F12, CH_3Cl, CCl_4, ClX, and H_2. The arguments of subroutine CSPEC (see program listing, Appendix A) relate to the previous boundary conditions discussion and are in order: (P_U, R_U, P_L, Q_L, RLOW, DFP, XL, CXL). As noted above, the upper boundary conditions require $P_U = 1.$ and $R_U = 0.$ As can be seen from the listing, the first two arguments are 1. and 0., respectively. The quantity P_L is set equal to PPL (defined in (a) above) and CSPEC changes this to zero if Q_L is equal to one (for fixed lower boundary mixing ratio). The next argument is the lower boundary condition value (either flux or mixing ratio as given by Q_L. The term DFP is the time dependent term which is set equal to zero for the steady state case (in each CXL subroutine). XL is the loss frequency returned and CXL is a family of subroutines (CXL1, CXL2, etc.) which computes the level-by-level production PR and loss frequency and returns these values to CSPEC. As a reference, Table 4.5 identifies the particular species dependent reaction schemes relevant to each CXL subroutine. Next, CSPEC calls subroutine COEF which utilizes the level production and loss frequency data and the particular type of boundary conditions specified to compute the necessary coefficients to solve the system of equations resulting for a given species. The arrays AA(I) and T(I) used here can be found in SETUP2. Once, the relevant coefficients are evaluated, the system is solved by subroutine TRIDIA which computes the mixing ratio (X_i) profile for each species i. Finally, CSPEC calculates the net production and loss and returns this value (XL) to CFLOW:

XL = PR - XL *X

This procedure is carried out for each long-lived species with two exceptions. There is a convergence test for the solution of the NO_x profile

TABLE 4-5

SUBROUTINE FAMILY CXL

Subroutine	Species	Production	Loss
CXL1	N_2O	From Surface	$N_2O + O(^1D) \rightarrow N_2 + O_2$ $\rightarrow 2NO$ $N_2O + h\nu \rightarrow N_2 + O$
CXL2	NO_x	$N_2O + O(^1D) \rightarrow 2NO$	$NO + h\nu \rightarrow N + O$ $N + NO \rightarrow N_2 + O$
CXL3	CH_4	From Surface	$CH_4 + O(^1D) \rightarrow CH_3 + OH$ $CH_4 + OH \rightarrow CH_3 + CH_3 + H_2O$ $CH_4 + Cl \rightarrow CH_3 + HCl$
CXL4	$CFCl_3$	From Surface	$CFCl_3 + h\nu \rightarrow CFCl_2\ Cl$ $CFCl_3 + O(^1D) \rightarrow$ PRODUCTS
CXL5	CF_2Cl_2	From Surface	$CF_2Cl_2 + h\nu \rightarrow CF_2Cl + Cl$ $CF_2Cl_2 + O(^1D) \rightarrow$ PRODUCTS
CXL6	CH_3Cl	From Surface	$CH_3Cl + h\nu \rightarrow CH_3 + Cl$ $CH_3Cl + OH \rightarrow CH_2Cl + H_2O$
CXL7	ClX	$CFCl_3 + h\nu \rightarrow CFCl_2 + Cl$ $CF_2Cl_2 + h\nu \rightarrow CF_2Cl + Cl$ $CH_3Cl + h\nu \rightarrow CH_3 + Cl$ $CCl_4 + h\nu \rightarrow CCl_3 + Cl$	
CXL8	O_3	$O_2 + h\nu \rightarrow 2O$ $HO_2 + NO \rightarrow OH + NO_2$	$HO_2 + O_3 \rightarrow OH + 2O_2$ $OH + O_3 \rightarrow HO_2 + O_2$ $NO_2 + O \rightarrow NO + O_2$ $HO_2 + O \rightarrow OH + O_2$ $OH + O \rightarrow H + O_2$ $ClO + O \rightarrow Cl + O_2$ $O + O_3 \rightarrow 2O_2$ $NO_2 + O_3 \rightarrow NO_3 + O_2$
CXL9	CCl_4	From Surface	$CCl_4 + h\nu \rightarrow CCl_3 + Cl$
CXL11	H_2	$H_2O + O(^1D) \rightarrow 2OH$ $H + HO_2 \rightarrow H_2 + O_2$	$Cl + H_2 \rightarrow HCl + H$ $OH + H_2 \rightarrow H_2O + H$ $H_2 + O(^1D) \rightarrow OH + H$

above level 40 (39 km) where the mixing ratio profile for NO_x is given by X2. Additionally, the calculations for O3 are limited to the region from the surface to 30 km above which it is considered short-lived. There is also a convergence test for O3 whose mixing ratio profile is given by X8. If convergence is reached, subroutine REPCN is called which repeats the calculation of NO_x and ClX apportionment using the new O3 values below 30 km by calling PNOX and PClOX. The values of ClO and NO2 are compared and if they have not converged, the O3 computations are repeated using the new ClX, NOX values. If convergence is reached, the values of the concentration profiles are computed from the resultant mixing ratios for NOX, CH4, CLX, H2, and O3 ($z \leq 30$ km), and control is returned to PHOCHM.

4.4.4 Final Convergence Testing

After return from CFLOW, the calculation is complete except for final verification of convergence. First, the previous O3 values from the short-lived calculation and those resulting from the long-lived calculation are averaged for a new profile. This is to help quicker convergence. Second, previous J values are saved since new ones (consistent with the new species profiles) will be computed for comparison. RJITER is called to accomplish this.

The final comparison is made level by level between previous and new JO3 and OH values. An accuracy of 1/10% is accepted in the latter. If not achieved, the program is directed back to statement 10 in PHOCHM which increments the iteration index by one and restarts the calculation. After successful accomplishment of the desired accuracy, the program computes the integrated O3 density (O3INT) and the integrated odd O loss from levels 9-36 (by calling O3LINT). Finally, the major output subroutine PRINTX is called before the program is terminated.

4.5 Subroutine PRINTX: Output Profiles

Before terminating a particular run PHOCHM calls subroutine PRINTX. For each case run, thirteen pages of results are generated. (There are also a few pages of input parameters to identify the case printed out. See sample test cases Appendix C.) The beginning of the output is identifiable by the keyword RUN printed on a separate page.

Pages 1 and 2 of the output print J-values used in the final iteration of PHOCHM. They are headed with the note: "LAST ITERATION = I" where I is the final iteration index from PHOCHM. Page 1 gives the vertical profiles of the J values: CJO2, CJO3, CJCF2, CJCF3, CJO31 and in addition gives the O_3 number density, integrated O_3, integrated total number density, and the OH number density for the previous iteration. Page 2 gives the profiles of the J values: CJCLO3, CJN20, CJHNO3, CJH202, CJN205, CHCCL4, and CJCH3CL.

Pages 3-4 labelled "LAST ITERATION + 1" refer to results for the computation of J values using the final program results. Page 5 contains number densities of H,OH, HO2,H202, O, O_3, and $O(^1D)$ in addition to the integrated O_3 density (HOX and odd oxygen families). Page 6 contains number densities of NO, NO2, HNO3, NO3, N205, and NOX (NOX family). Page 7 contains number densities and mixing ratios for CL, CLO, HCL, CLNO3, and CLX (CLX family).

Beginning on page 8 are level profiles of production and loss rates for particular reactions defined in PHOCHM and subroutine JACOB. (ref. Table 4-4). Page 8 in particular describes processes concerned with production and loss of odd oxygen. At the bottom of the page the integrated values of these rates are presented (they were calculated by O3LINT in PHOCHM). Page 9 gives the rates for reactives producing odd hydrogen in addition to the reaction Cl + CH_4. Page 10 gives the complementary losses of odd hydrogen.

Page 11 contains a listing of mixing ratio profiles for N20, NOX, CH_4, FC11, FC12, CH3C, CLX and CCL_4 and H2. At the bottom of this page integrated fluxes for these long-lived species are provided by integrating the net production and loss terms from subroutines CXL using by a trapezoidal rule (subroutine TRAP). These should not differ substantially from the initial flux lower boundary conditions. Page 12 gives the mixing ratio of oxygen and the number densities of FC11, FC12, CH3CL, CCL4, and CLX. Page 13 continues with N20, NOX, and CH4.

If the keyword PARAMETERS appears next in the input stream to initialize constants for the next case to continue, the program is entered and the calculation repeated for the new case. However, the keyword ENDJOB will cause the program to print "NORMAL JOB END" and it will then terminate.

5. Users Guide

5.1 Program Initiation

The input deck required to initiate a model calculation using the CMSP program is relatively simple due to its modular, self-contained nature. As discussed in Section 4.2, the basic vertical profiles, wavelength dependent spectra, and rate constants required for the calculation are incorporated within BLOCK DATA and, consequently, need not be specified for each case (unless a change is desired.) Table 5-1 illustrates the configuration of the input deck which consists for the most part of keywords specification and a title to identify the output for the case run. For added versatility, however, the user can take advantage of the NAMELIST provision of subroutine INPARM in order to modify any of the listed (Table 5.2) variables for a particular case. For a single model run including one card of NAMELIST changes, a total of eight input cards are necessary. Note that multiple cases may be run by stacking cards 3-6 for each new case before the ENDJOB card.

5.2 Default Parameter Values

In addition to listing the parameters which may be changed during input by the NAMELIST provision, Table 5-2 provides the current BLOCK DATA provided default values and subroutine location of primary utilization for each variable. Generally, these parameters may be divided into two subgroups: (1) branching parameters which control the type of calculation being made, and (2) run variables which are input data to the calculation.

The primary branching parameters are: INSWIT, ISCATT, NEDDY, and ISIZE. These have been discussed in Section 4 under the headings of their respective subroutines.

The various run variables include rate constants (RA, RB), profile multiplicative constants (FCL, FH2O, etc.), boundary condition data (RN2O, RF11, etc.), and multiple scattering factors (=1.0, they are not used)

5.3 Aerosol Model Specification

As discussed in Section 3.1, the user may select one of four internal aerosol models by specifying the parameter ISIZE which chooses a set of optical constants (extinction and absorption coefficients) in subroutine QSCATT (Section 4.3.2). An additional provision allows the user to substitute another size distribution by using ISIZE = 5 and adding the necessary extinction QE(5,J) and absorption QA(5,J) coefficients as a function of wavelength ALAM(J) within the subroutine. The height distribution specified by IAERO (Table 3-1) will be utilized for either IAERO = 0 (23 km visibility) or IAERO = 1 (5 km visibility). This parameter is set in subroutine ALTGEN (Section 4.3.1). The height distribution may be changed by amending the BLOCK DATA array DA23.

TABLE 5-1

CMSP INPUT DECK CONFIGURATION

Card Number	Description	Columns Used
1	the word TITLE	1-5
2	any title desired	1-80
3	the word PARAMETERS	1-10
4	$ INPUT	beginning in column 2
4a 4b	as many cards as necessary to input, in NAMELIST format any constants which differ from the default values set in BLOCK DATA	
5	$ END	beginning in column 2
6	the work RUN	1-3
. . .	(cards 3-6 may be repeated for any number of runs with changed constants)	
Last Card	the word ENDJOB	1-6

TABLE 5-2

PARAMETERS WHICH MAY BE SPECIFIED IN NAMELIST

Name	BLOCK DATA Default Value	Subroutine Used
FCL	1.0	INITAL
FCLNO3	1.0	PNOX
FH2O	1.0	INITAL
FNO	1.0	(not used)
FKK	1.0	SETUP
I1	59	CPHI1
P11	1.0	CPHI1
P22	1.0	CPHI1
PJO3	1.80×10^{-4}	JACOB
FJ	1.0	CXL
FJFC	1.0	CXL
TL	3.15×10^{13}	CXL
RN2O	2.50×10^{-7}	CSPEC
RNOX	2.00×10^{10}	CSPEC
RCH4	1.50×10^{-6}	CSPEC
RF11	9.30×10^{6}	CSPEC
RF12	1.30×10^{7}	CSPEC
RCH3C	1.50×10^{-9}	CSPEC
RCLX	1.00×10^{10}	CSPEC
RCCL4	1.30×10^{-10}	CSPEC
NEDDY	0	SETUP
RO3	3.00×10^{-8}	CSPEC
SCNO2	1.0	PNOX
SCCLO3	1.0	COMPJ
SCH2O2	1.0	COMPJ
SCN2O5	1.0	COMPJ
PH2O	0	CXL11
RH2	5.00×10^{-7}	CSPEC
LAT	30.	WEIGHT
DEL	0.	WEIGHT
JNO3	1.3×10^{-2}	PNOX
RA	BLOCK DATA	RCONST
RB	ARRAY	RCONST
ISWIT	1	RJITER
ISIZE	4	QSCATT
ISCATT	1	RJITER
REF	0.2	VIM

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APPENDIX A

PROGRAM LISTING

```
      PROGRAM MAIN(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
C.......................................................................
C
C..............CHLORINE MODEL STUDY PROGRAM - VERSION 5
C
C.....MAIN ROUTINE..READS KEYWORDS, CALLS SUBROUTINES
C
C.....VERSION 5.0        LEVEL 771001
C.....E.R.T.,INC.        N.D.SZE, N.TRIPP, R.G. ISAACS, H.K.BURKE
C
C
C.......................................................................
C
      REAL TITL(10),TITLE(6)
      INTEGER KEYS(10), XT(13)
      COMMON /HEAD/ TITLE,ICODE,VERS,LEVEL,DATE,IRUN,NPAGE,NLOG
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      DATA KEYS/4HTITL,3HRUN/
C
      ICODE=117
      VERS=5.0
      LEVEL=771001
      CALL DAY
C
C.....READ KEYWORDS
C
  100 CALL INPUT(KEYS,10,IC,IFORM,XT,KWN),RETURNS(999)
      GO TO (200,250,700), KWN
C
C.....TITLE - TITLE FOR OUTPUT - INITIALIZE RUN
C
  200 READ(1C,1) TITL
      WRITE (6,3) TITL
      CALL ALTGEN
      GO TO 100
C
C.....STEADY-STATE CALCULATIONS
C
  250 CALL PHOCHM
      GO TO 100
C
  700 GO TO 100
C
  999 WRITE (6,4)
C
      STOP
    1 FORMAT(10A8)
    3 FORMAT(//T10,10A8)
    4 FORMAT(//T10,' NORMAL JOB END.')
C
C
       END
      SUBROUTINE ALTGEN
C.......................................................................
C
C..............CHLORINE MODEL STUDY PROGRAM
C
C.....SUBROUTINE ALTGEN - FILLS UP ALT(-) ARRAY
C
C.....VERSION 4.0        LEVEL 770214
C.....E.R.T.,INC.        L.PERRY, N.TRIPP
C
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
      COMMON /INTDEN/ DO3INT(41),DMINT(41),DAINT(41)
      COMMON  /MODEL/ ALT(41),TEMP(41),DM(41),DIU(41),DA23(41)
      COMMON /SOLCON/ WL(100),FL(100),QO2(100),QO3(100)
      COMMON /SOLCN1/ QCF2(100),QCF3(100),QCCL4(100),QCH3C(100),
     X QCLNO3(100),QN2O(100),QHNO3(100),QH2O2(100),QN2O5(100),
     Y QHCL(100),QHOCL(100),QNO2(100),QH2O(100)
      REAL DA05(3)
      DATA DA05/1.378E04,1.844E03,2.453E02/
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C
      ALT(1)=0.0
      DO 10 I=2,41
   10 ALT(I)=ALT(I-1)+2.0E5
C
      FL(29) = 1.09E+12
      FL(30) = 2.40E+12
      FL(31) = 3.75E+12
      FL(32) = 5.70E+12
      FL(33) = 1.47E+13
      FL(34) = 2.09E+13
      FL(35) = 2.59E+13
      FL(36) = 3.20E+13
C
      QC_NO3(33) =  3.48E-18
      QC_NO3(34) = 3.75E-18
      QC_NO3(35) = 3.76E-18
      QC_NO3(36) = 3.07E-18
      QC_NO3(37) = 2.31E-18
      QC_NO3(38) = 1.60E-18
      QC_NO3(39) = 1.18E-18
      QC_NO3(40) = 8.54E-19
      QC_NO3(41) = 6.57E-19
      QCL NO3(42) = 5.09E-19
      QC_NO3(43) = 5.09E-19
      QC_NO3(44) = 4.07E-19
      QC_NO3(45) = 3.28E-19
      QCL NO3(46) = 2.61E-19
      QC_NO3(47) = 2.02E-19
      QC_NO3(48) = 1.45E-19
      QC_NO3(49) = 1.05E-19
      QCL NO3(50) = 7.34E-20
      QC_NO3(51) = 5.10E-20
      QC_NO3(52) = 3.90E-20
      QC_NO3(53) = 2.89E-20
      QC_NO3(54) = 2.02E-20
      QC_NO3(55) = 1.49E-20
      QC_NO3(56) = 1.07E-20
      QC_NO3(57) = 8.00E-21
      QC_NO3(58) = 5.10E-21
      QC_NO3(59) = 4.80E-21
      QCL NO3(60) = 3.80E-21
      QC_NO3(61) = 3.20E-21
      QCL NO3(62) = 2.90E-21
      QC_NO3(63) = 2.60E-21
      QC_NO3(64) = 2.30E-21
      QC_NO3(65) = 2.10E-21
      QCL NO3(66) = 1.90E-21
      QC_NO3(67) = 1.70E-21
      QC_NO3(68) = 1.50E-21
      QC_NO3(69) = 1.30E-21
      QCL NO3(70) = 1.10E-21
      QC_NO3(71) = 9.7E-22
      QC_NO3(72) = 4.0E-21
C
C     AEROSOL HEIGHT MODEL  IAERO=0(23KM), =1(5KM)
C     COMPUTE INTEGRATED AEROSOL DENSITY
```

```
      IAERO=0
      IF(IAERO.EQ.0)GO TO 16
      DO 15 J=1,3
15    DA23(J)=DA05(J)
16    NT = 41
      DAINT(NT)=DA23(NT)*3.78E05
      NTM1 = NT - 1
      DELZ = 2.0E05
      DMINT (NT) = DM(NT) * 5.0E05
      DO 20 J = 1,NTM1
      I = NT - J
      IP1 = I + 1
      DAINT(I)=DAINT(IP1)+(DA23(IP1)+DA23(I))*DELZ*.5
   20 DMINT(I) = DMINT(IP1) + (DM(IP1) + DM(I)) * DELZ*.5
C
      CALL PAGE
C
      WRITE (6,601)
      WRITE (6,602) (J,WL(J),FL(J),QO2(J),QO3(J),QCF2(J),QCF3(J),
     1              QCCL4(J),QCH3C(J),J=1,99)
      CALL PAGE
      WRITE (6,603)
      WRITE (6,604) (J,WL(J),FL(J),QCLNO3(J),QN2O(J),QHNO3(J),QH2O2(J),
     1              QN2O5(J),J=1,99)
C
  601 FORMAT(1H0,12X,*WL*,11X,*FL*,10X,*QO2*,10X,*QO3*,10X,*QCF2*, 9X,
     1 *QCF3*, 8X,*QCCL4*, 8X,*QCH3C*/)
  602 FORMAT (1H ,I5,1P8E13.4)
  603 FORMAT (1H0,12X,*WL*,11X,*FL*, 9X,*QCLNO3*, 8X,*QN2O*, 8X,*QH2O2*,
     1  8X,*QN2O5*/)
  604 FORMAT (1H ,I5,1P7E13.4)
C
      RETURN
      END
      SUBROUTINE INPARM
C.....................................................................
C
C.....CMS04 - CHLORINE MODEL STUDY PROGRAM
C
C.....SUBROUTINE INPARM - READS AND WRITES RUN VARIABLES
C
C.....VERSION 4.0       LEVEL 770214
C.....E.R.T.,INC.       N.TRIPP
C
C.....................................................................
C
      COMMON /EDDY/ FKK,I1,P11,P22,NEDDY
      COMMON /MSCAT/ SCNO2,SCCLO3,SCH2O2,SCN2O5
      COMMON /MOLAYD/ XH(81),XH2O(81),PH2O,RH2,X11(81)
      COMMON /PARM/ ISWIT,ISTEP,ISTOP,TLOOP,ITPRNT,ISIZE,ISCATT
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SFACT/ FCL,FH2O,FCLNO3,FNO
      COMMON /RLOW/ RN2O,RNOX,RCH4,RF11,RF12,RCH3C,RCLX,RCCL4,RO3
      COMMON /SPECON/ FJ,FJFC,TL
      REAL LAT
      COMMON /WT/ A(6),DL,LAT,DEL
      COMMON /PARA/ U0,N,N1,N2,NN,NNP1,REF
C
      NAMELIST /INPUT/ FCL,FCLNO3,FH2O,FNO,FKK,I1,P11,P22,PJO3,ISWIT,
     1  FJ,FJFC,TL,RN2O,RNOX,RCH4,RF11,RF12,RCH3C,RCLX,RCCL4,
     2 NEDDY,RO3,SCNO2,SCCLO3,SCH2O2,SCN2O5,PH2O,RH2,LAT,DEL,JNO3,RA,RB
     3 ,ISIZE,ISCATT,REF
      READ (5,INPUT)
C
      CALL PAGE
```

```
      IF (ISWIT.EQ.0) WRITE(6,510) ISWIT
  510 FORMAT (1H0,3X, *FIXED SUN ANGLE MODEL - ISWITCH =*,I2)
      IF (ISWIT.EQ.1) WRITE(6,511) ISWIT
  511 FORMAT (1H0,3X,*24 HOUR AVERAGED MODEL - ISWITCH =*,I2)
C
      CALL WEIGHT
      WRITE (6,514) LAT,DEL,A,DL
  514 FORMAT (1H0/4X,*COMTAU FACTORS FOR THIS RUN:*//4X,*FOR LATITUDE =*
     1,F5.1,*  & SOLAR DECLINATION =*,F6.1,3X,*A**S =*,6(F9.4,*,*)/
     2 55X,*DL  =*,F9.1,* SECS.*)
      IF(ISCATT.EQ.0)GO TO 10
      WRITE(6,520)ISCATT
520   FORMAT(1H0/,4X,*MULTIPLE SCATTERING CALCULATION, ISCATT=*,I2)
      CALL PAGE
      CALL QSCATT
10    CONTINUE
C
      WRITE (6,504)
  504 FORMAT (1H0/4X,*FLUXES AND MIXING RATIOS FOR THIS RUN:*)
      WRITE (6,506) RN2O,RNOX,RCH4,RFL1,RF12,RCH3C,RCLX,RCCL4,RO3,RH2
  506 FORMAT (1H0,3X,*RN2O =*,1PE9.2,2X,*RNOX =*,E9.2,2X, *RCH4 =*,E9.2,
     1                2X,*RF11 =*,E9.2,2X,*RF12 =*,E9.2,2X,*RCH3C =*,E9.2,
     2                2X,*RCLX =*,E9.2/ 4X,*RCCL4 =*,E9.2,2X,*RO3= *,E9.2,
     3                2X,*RH2 =*,E9.2)
      WRITE (6,505) JNO3,PJO3,PH2O
  505 FORMAT (1H0//4X,*JNO3 =*,1PE9.2,4X,*PJO3 =*,E9.2,4X,*PH2O =*,E9.2)
C
      WRITE (6,500)
  500 FORMAT (1H0/4X,*S-FACTORS FOR THIS RUN:*)
      WRITE (6,501) FCL,FCLNO3,FH2O,FNO
  501 FORMAT(1H0,3X,*FCL =*,F5.2,2X,*FCLNO3 =*,F5.2,2X,*FH2O =*,F5.2,
     1 2X,*FNO =*,F5.2)
C
      WRITE (6,512)
  512 FORMAT (1H0/,4X,*MULTIPLE SCATTERING FACTORS FOR THIS RUN:*)
      WRITE (6,513) SCNO2,SCCLO3,SCH2O2,SCN2O5
  513 FORMAT (1H0,3X,*SCNO2 =*,F5.2,2X,*SCCLO3 =*,F5.2,2X,*SCH2O2 =*,
     1 F5.2,2X,*SCN2O5 =*,F5.2)
C
      CALL CPHI1 (P11,P22,I1)
C
      CALL SETUP (STEP,81)
C
      CALL RCONST
      RETURN
      END
      SUBROUTINE SETUP (STEP,N)
C.......................................................................
C
C.....CMS03 - CHLORINE MODEL STUDY PROGRAM
C
C SUBROUTINE SETUP TO TRANSFER RAW DATA WITH 41 LEVELS TO A SET OF
C     NEW DATA WITH 81 LEVELS
C ENTRY SETUP2 TO COMPUTE CERTAIN BASIC COEFFICIENTS
C
C.....VERSION 3.2        LEVEL 761222
C.....F.R.T.,INC.        N.D.SZE, N.TRIPP
C
C.......................................................................
C
      COMMON /COEF1/AA(81),BB(81),CC(81),DL(81),DU(81),U(81)
      COMMON /EDDY/ FKK,I1,P11,P22,NEDDY
      COMMON  /MODEL/ ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      COMMON /TFCTR/ FT,FA,FB,FM
      REAL EK(41),E(81)
```

```
C  HUNTEN'S EDDY DIFFUSION COEFFICIENTS (MODIFIED) - UP TO 50 KMS.
      DATA EK/10.00,10.00,10.00,10.00,10.00,3.00,3.00,3.00,0.26,0.33,
     10.42,0.53,0.66,0.83,1.01,1.30,1.60,2.05,2.55,3.20,4.00,5.00,6.40,
     28.00,10.00,12.80,16.00,20.00,25.00,31.00,38.00,50.00,62.00,75.00,
     396.00,120.00,150.00,190.00,240.00,300.00,380.00/
      IF (NEDDY.EQ.1) CALL EDC1 (EK)
      IF (NEDDY.EQ.2) CALL EDC2 (EK)
      DO 10 I=1,41
      J=2*I-1
      CEK(J)=EK(I)*1.0E 4*FKK
      CDM(J)=DM(I)
      CDA(J)=DA23(I)
   10 CTEMP(J)=TEMP(I)
      DO 15 I=1,40
      J=2*I
      IP1=I+1
       CEK(J)=SQRT(EK(I)*EK(IP1))*1.0E4*FKK
      CDM(J)=SQRT(DM(I)*DM(IP1))
      CDA(J)=SQRT(DA23(I)*DA23(IP1))
   15 CTEMP(J)=SQRT(TEMP(I)*TEMP(IP1))
      CALL PAGE
      IF (NEDDY.EQ.0) WRITE (6,60) FKK
      IF (NEDDY.EQ.1) WRITE (6,61) FKK
      IF (NEDDY.EQ.2) WRITE (6,62) FKK
      WRITE (6,65)
      WRITE (6,66) (I,ALT(I),CEK(2*I-1),CDM(2*I-1),CTEMP(2*I-1),
     1 CDA(2*I-1),I=1,41)
   60 FORMAT (1H0,9X,*FKK =*,F5.2,*, FACTOR MULTIPLYING HUNTEN'S EDDY DI
     1FFUSION COEFFICIENTS*)
   61 FORMAT (1H0,9X,*FKK =*,F5.2,*, FACTOR MULTIPLYING ANALYTIC EDDY DI
     1FFUSION COEFFICIENTS*)
   62 FORMAT (1H0,9X,*FKK =*,F5.2,*, FACTOR MULTIPLYING CHANG 'S EDDY DI
     1FFUSION COEFFICIENTS*)
   65 FORMAT (1H0/10X,*ALT*,10X,*EK*,13X,*DM*,11X,*TEMP*,13X,*DA*/)
   66 FORMAT (2X,I2,0PF11.0,1P2E15.4,0PF11.2,1PE15.4)
      RETURN
C
      ENTRY SETUP2
      NM1=N-1
      NM2=N-2
      DT=3.15576E7*STEP
      DO 32 I=1,N
      E(I)=CEK(I)*CDM(I)
   32 U(I)=0.5E-10*DT/CDM(I)
      DO 33 I=2,NM1
   33 CC(I)=SQRT(E(I+1)*E(I))
      DO 34 I=2,NM2
   34 BB(I+1)=CC(I)
      BB(2)=SQRT(E(2)*E(1))
      DO 35 I=2,NM1
   35 AA(I)=CC(I)+BB(I)
      DO 40 I=2,NM1
      DL(I)=U(I)*BB(I)*FA
   40 DU(I)=U(I)*CC(I)*FA
      RETURN
      END
      SUBROUTINE WEIGHT
C.......................................................................
C
C.....CMS03 - CHLORINE MODEL STUDY PROGRAM
C
C.....VERSION 3.3        LEVEL 770201
C.....E.R.T.,INC.        N.D.SZE, N.TRIPP
C
C.......................................................................
C
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```
      REAL LAT
      COMMON /WT/ A(6),DL,LAT,DEL
      DIMENSION T(6)
      DATA DTOR,RTOD/.01745329,57.29579/
C
      LAT = LAT * DTOR
      DEL = DEL * DTOR
      X1 = COS(LAT) * COS(DEL)
      X2 = SIN(LAT) * SIN(DEL)
      DDL = ACOS(-TAN(LAT)*TAN(DEL))
      DDL = 240. * DDL * RTOD
      DT = DDL/6.
      DO 10 I = 1,6
      T(I) = DT/2. + (I-1)*DT
      T(I) = (T(I)/240.) * DTOR
      COSANG = X1*COS(T(I)) + X2
   10 A(I) = 1.0/COSANG
      DL = 2.*DDL
      LAT = LAT * RTOD
      DEL = DEL * RTOD
      RETURN
      END
      SUBROUTINE SPHI1 (P11,P22,I1)
      COMMON /PHIS/ PHI1(100)
C
      DO 10 J = 1,I1
   10 PHI1(J) = P11
C
      I11 = I1 + 1
      DO 20 J = I11,72
   20 PHI1(J) = P22
C
      RETURN
      END
      SUBROUTINE EDC1 (EK)
C
C  ANALYTIC EDDY DIFFUSION COEFFICIENTS (* 1.E-4)
      DIMENSION EK(41)
      DO 10 I=1,5
   10 EK(I)=10.
      EK(6)=3.
      EK(7)=3.
      EK(8)=3.
      DO 20 I=9,41
   20 EK(I)=.35*EXP((2*(I-1)-14)/9.55)
       RETURN
      END
      SUBROUTINE EDC2 (EK)
C
C  CHANG'S EDDY DIFFUSION COEFFICIENTS - UP TO 50 KMS.(* 1.E-4)
C
      DIMENSION EK(41),CK(41)
      DATA CK/6*30. ,
     1  1.8,1.2,.97,.74,.60,.50,.42,.39,.37,.37,.39,.42,.50,.61,.80,
     2  1.1,1.5,2.2,3.3,5.4,9.2,17.,29.,49.,90.,155.,9*230./
C
      DO 10 I = 1,41
   10 EK(I) = CK(I)
      RETURN
      END
      SUBROUTINE RCONST
C.......................................................................
C
C.....CMS04 - CHLORINE MODEL STUDY PROGRAM
C
C.....SUBROUTINE RCONST - CALCULATES REACTION RATES FOR PROGRAM
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C                                                                       004030
C.....VERSION 4.0        LEVEL 770214                                   004040
C.....E.R.T.,INC.        N.D.SZE, N.TRIPP                               004050
C                                                                       004060
C.......................................................................004070
C                                                                       004080
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)                  004090
      REAL JNO3                                                         004100
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3                004110
      DIMENSION REACT1(7,9),REACT2(7,9),REACT3(7,9),                    004120
     1          REACT4(7,9),REACT5(7,9),REACT6(7,9),REACTS(7,63)        004130
      EQUIVALENCE (REACTS(1, 1),REACT1(1,1)),                           004140
     1            (REACTS(1,10),REACT2(1,1)),                           004150
     2            (REACTS(1,19),REACT3(1,1)),                           004160
     3            (REACTS(1,28),REACT4(1,1)),                           004170
     4            (REACTS(1,37),REACT5(1,1)),                           004180
     5            (REACTS(1,46),REACT6(1,1))                            004190
      DATA REACT1/4HOH +,4H CH3,4HCL  ,4H   =,4H CH2,4HCL +,4H H2O,    004200
     2            4HH2O ,4H+ O(,4H*D) ,4H   =,4H 2OH,4H    ,4H    ,     004210
     3            4HCH4 ,4H+ O(,4H*D) ,4H   =,4H CH3,4H + O,4HH   ,     004220
     4            4HH2 +,4H O(*,4HO)  ,4H   =,4H OH ,4H+ H ,4H    ,     004230
     5            4HH + ,4HO2 +,4H M  ,4H   =,4H HO2,4H + M,4H    ,     004240
     6            4HH + ,4HO3   ,4H   ,4H   =,4H OH ,4H+ O2,4H    ,     004250
     7            4HOH +,4H O3 ,4H    ,4H   =,4H HO2,4H + O,4H2   ,     004260
     8            4HOH +,4H H2O,4H2   ,4H   =,4H H2O,4H + H,4HO2  ,     004270
     9            4HHO2 ,4H+ O3,4H    ,4H   =,4H OH ,4H+ 2O,4H2   /     004280
      DATA REACT2/4HHO2 ,4H+ O ,4H    ,4H   =,4H OH ,4H+ O2,4H    ,     004290
     2            4HHO2 ,4H+ NO,4H    ,4H   =,4H OH ,4H+ NO,4H2   ,     004300
     3            4HHO2 ,4H+ CL,4HO   ,4H   =,4H HCL,4HO + ,4HO2  ,     004310
     4            4HHO2 ,4H+ HO,4H2   ,4H   =,4H H2O,4H2 + ,4HO2  ,     004320
     5            4HHO2 ,4H+ OH,4H    ,4H   =,4H H2O,4H + O,4H2   ,     004330
     6            4HHO2 ,4H+ CL,4H    ,4H   =,4H HCL,4H + O,4H2   ,     004340
     7            4HH + ,4HHO2 ,4H    ,4H   =,4H H2 ,4H+ O2,4H    ,     004350
     8            4HH + ,4HHO2 ,4H    ,4H   =,4H 2OH,4H    ,4H    ,     004360
     9            4HOH +,4H CO ,4H    ,4H   =,4H H +,4H CO2,4H    /     004370
      DATA REACT3/4HOH +,4H O  ,4H    ,4H   =,4H H +,4H O2 ,4H    ,     004380
     2            4HOH +,4H HCL,4H    ,4H   =,4H H2O,4H + C,4HL   ,     004390
     3            4HOH +,4H CH4,4H    ,4H   =,4H H2O,4H + C,4HH3  ,     004400
     4            4HOH +,4H NO2,4H + M,4H   =,4H HNO,4H3 + ,4HM   ,     004410
     5            4HOH +,4H HNO,4H3   ,4H   =,4H H2O,4H + N,4HO3  ,     004420
     6            4HOH +,4H OH ,4H    ,4H   =,4H H2O,4H + O,4H    ,     004430
     7            4HOH +,4H H2 ,4H    ,4H   =,4H H2O,4H + H,4H    ,     004440
     8            4HCL +,4H H2 ,4H    ,4H   =,4H HCL,4H + H,4H    ,     004450
     9            4HCL +,4H H2O,4H2   ,4H   =,4H HCL,4H + H,4HO2  /     004460
      DATA REACT4/4HCLO ,4H+ NO,4H2 + ,4HM  =,4H CLN,4HO3 +,4H M  ,     004470
     2            4HCL +,4H O3 ,4H    ,4H   =,4H CLO,4H + O,4H2   ,     004480
     3            4HCL +,4H CH4,4H    ,4H   =,4H HCL,4H + C,4HH3  ,     004490
     4            4HCLO ,4H+ O ,4H    ,4H   =,4H CL ,4H+ O2,4H    ,     004500
     5            4HCLO ,4H+ NO,4H    ,4H   =,4H CL ,4H+ NO,4H2   ,     004510
     6            4HO + ,4HHCL ,4H    ,4H   =,4H OH ,4H+ CL,4H    ,     004520
     7            4HO + ,4HO2 +,4H M  ,4H   =,4H O3 ,4H+ M ,4H    ,     004530
     8            4HO + ,4HO3   ,4H   ,4H   =,4H 2O2,4H    ,4H    ,     004540
     9            4HNO2 ,4H+ NO,4H3   ,4H   =,4H N2O,4H5*  ,4H    /     004550
      DATA REACT5/4HN2O5,4H*    ,4H   ,4H   =,4H NO2,4H + N,4HO3  ,     004560
     2            4HN2O5,4H* + ,4HM   ,4H   =,4H N2O,4H5 + ,4HM   ,     004570
     3            4HN2O5,4H + M,4H    ,4H   =,4H N2O,4H5* +,4H M  ,     004580
     4            4HNO +,4H O3 ,4H    ,4H   =,4H NO2,4H + O,4H2   ,     004590
     5            4HNO2 ,4H+ O3,4H    ,4H   =,4H NO3,4H + O,4H2   ,     004600
     6            4HNO2 ,4H+ O ,4H    ,4H   =,4H NO ,4H+ O2,4H    ,     004610
     7            4HN2O ,4H+ O(,4H*D) ,4H   =,4H N2 ,4H+ O2,4H    ,     004620
     8            4HN2O ,4H+ O(,4H*D) ,4H   =,4H 2NO,4H    ,4H    ,     004630
     9            4HN + ,4HNO   ,4H   ,4H   =,4H N2 ,4H+ O ,4H    /     004640
      DATA REACT6/4HN + ,4HO2   ,4H   ,4H   =,4H NO ,4H+ O ,4H    ,     004650
     2            4HO(*D,4H) + ,4HCFC.,4H3  =,4H PRO,4HDUCT,4HS   ,     004660
     3            4HO(*D,4H) + ,4HCF2C,4HL3 =,4H PRO,4HDUCT,4HS   ,     004670
     4            4HO(*D,4H) + ,4HCH3C,4HL  =,4H OH ,4H+ C4,4H2C. ,     004680
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     5            4HO(*O,4H) + ,4HCCL4,4H   =,4H PRO,4HDUCT,4HS   ,
     6            4HO(*O,4H) + ,4HM   ,4H   =,4H ) +,4H M  ,4H    ,
     A   21*1H /
C
C  SET UP RATES ARRAY FOR 65 REACTIONS
      DO 10 I = 1,65
      DO 10 J = 1,81
   10 RATE (I,J) = RA(I) * EXP(RB(I)/CTEMP(J))
C
C  RE-CALCULATE RATE CONSTANTS THAT DO NOT FIT ABOVE FORMULA
      DO 20 J = 1,81
      RATE(22,J) = 2.3E-13*EXP(880./CTEMP(J))/(2.6E16+CDM(J))
      RATE(37,J) = 1.0E+08*CDM(J)/(2.6E19+CDM(J)) + 1.0E7
   20 CONTINUE
C
C  PRINT OUT ALL REACTIONS AND RATE CONSTANTS A & B
      CALL PAGE
      WRITE (6,600)
  600 FORMAT (1H0,3X,*REACTION RATE (AS A FUNCTION OF ALTITUDE,Z) = A *
     1,1H*,* EXP(B/TEMP(Z))*//4X,*NO.*,15X,*REACTION*,17X,*A*,11X,*B*/)
C
      DO 30 I = 1,21
   30 WRITE (6,601) I,(REACTS(N,I),N=1,7),RA(I),RB(I)
  601 FORMAT (1H ,I5,4X,7A4,1PE13.2,0PF11.0)
      DO 40 I = 23,36
   40 WRITE (6,601) I,(REACTS(N,I),N=1,7),RA(I),RB(I)
      DO 50 I = 38,51
   50 WRITE (6,601) I,(REACTS(N,I),N=1,7),RA(I),RB(I)
C
C  PRINT EXCEPTIONAL CASES
      WRITE (6,602) (REACTS(N,22),N=1,7)
     1,             (REACTS(N,37),N=1,7)
  602 FORMAT (1H0,3X,*REACTIONS WHOSE RATES ARE CALCULATED BY DIFFERENT
     1FORMULAE ARE:*//
     2 4X,*22*,4X,7A4,5X,*R = 2.3E-13*,1H*,
     3 *EXP(880./TEMP(Z)/(2.6E18 + M(Z))*/
     4 4X,*37*,4X,7A4,5X,*R = 1.0E+8*,1H*,
     5 *M(Z)/(2.6E19+M(Z)) + 1.0E7*)
      RETURN
      END
      SUBROUTINE PHOCHM
C.......................................................................
C
C.............CHLORINE MODEL STUDY PROGRAM    VERSION 4
C
C.....SUBROUTINE PHOCHM
C
C.....VERSION 4.0       LEVEL 770214
C.....E.R.T.,INC.       N. D. SZE, N.TRIPP
C
C.......................................................................
C
      DIMENSION Y(10)
      COMMON /INTDEN/DO3INT(41),OMINT(41),DAINT(41)
      COMMON /JVAL/ CJO2(50),CJO3(50),CJCF2(50),CJCF3(50),CJCCL4(50),
     1              CJCH3C(50),CJCLO3(50),CJN2O(50),CJHNO3(50)
     2, CJH2O2(50),CJO31(50),CJN2O5(50)
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      COMMON /NETPRO/ PP(4),SS(4)
      COMMON /OLD/ OJO2(41),OJO3(41),OJCF2(41),OJCF3(41),OJCCL4(41),
     1 OJCH3C(41),OJCLO3(41),OJN2O(41),OJHNO3(41),OJH2O2(41),OJO31(41),
     2 OJN2O5(41),OLDOH(41),OO3INT(41),OO3(41)
      COMMON /PARA1/ STEP,QQU,PPL,PPU,N,M
      COMMON /PARM/ ISWIT,TSTEP,TSTOP,TLOOP,ITPRNT,ISIZE,ISCATT
      REAL JO2. JO3. JH2O. JNO2. JN2O. JN2O5. JHNO3. JCH4. JCF2.
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     X                    JCF3, JHCL, JH2O2,JHOCL
      COMMON /PHRATE/ JO2(41),JO3(41),JH2O(41),JNO2(41),JN2O(41),
     X JN2O5(41),JHNO3(41),JCH4(41),JCF2(41),JCF3(41),JHCL(41),JH2O2(41)
     Y ,JHOCL(41)
      COMMON /PRORATE/ AA(10),BB(10),CC(10),DD(11),EE(10),GG(10),HH(10)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SOLCON/WL(100),FL(100),IO2(100),QO3(100)
      REAL NO,NO2,NOX,NO3,N2O5
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),OCLX(41),NO3(41),N2O5(41),
     3 CLNO3(41)
      COMMON /PRODS/       POODH(7,41),SOODH(3,41),O3INT(41),CLCH4(41),
     1 YY(9),HHH(9,41)
      DIMENSION OOO3(41)
C
      COMMON /TFCTR/ FT,FA,FB,FM
C  S.S. FT=0, FA=2, FB=0, FM=0;  T.D. FT=1, FA=1, FB=1, FM=1
C
      LOGICAL NEXT
      DATA NEXT/.FALSE./
      FT = 0.
      FA = 2.
      FB = 0.
      FM = 0.
      N1 = 31
      LL. = 1
      LLJ = 41
      N = 81
      STEP = 1.
      M = 1
      HX = 6.0E+5
      EPS = .001
      EPS1 = .01
      CALL SETUP2 (STEP,N)
      QQJ =HX/(CEK(N)*CDM(N))
      PPL = -CEK(1)*CDM(1)
      PPJ = -CEK(N)*CDM(N)
      CALL RJITER (ISWIT,ISCATT)
C
      I = 0
   10 I = I + 1
      IF (I.GT.50) GO TO 501
      IF (I.EQ.1) GO TO 30
      DO 12 J = LLL,LLU
      OLDOH(J) = OH(J)
      OO3(J) = O3(J)
   12 CONTINUE
   30 DO 40 J = LLL,LLU
      L = 2*J - 1
      JO2(J) = CJO2(J)
      JO3(J) = CJO3(J)
      JHNO3(J) = CJHNO3(J)
      JH2O2(J) = CJH2O2(J)
      JN2O5(J) = CJN2O5(J)
      DIO(J) = CJO31(J)*O3(J)/(RATE(51,L)*DM(J))
   40 CONTINUE
   60 DO 100 K = LLL,LLU
      L = 2*K - 1
      CALL INITAL(K,Y,I,NEXT)
      CALL SOLVE (K,ALP,Y,N1)
      DO 300 J = 1,9
  300 HHH(J,K) = HH(J)
      HHH(9,K) = PP(4)
      POODH(1,K) = AA(1)*2.
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      POODH(2,K) = CC(1)
      POODH(3,K) = CC(2)
      POODH(4,K) = CC(8)
      POODH(5,K) = AA(3)
      POODH(6,K) = CC(5)
      POODH(7,K) = CC(6)
      CLCH4(K) = RATE(30,L) * CL(K) * CH4(K)
      SOODH(1,K) = DD(2) * 2.
      SOODH(2,K) = DD(3)*2.
      DO 305 J = 3,7
  305 SOODH(J,K) = DD(J+3)
      SOODH(8,K) = 2.0 * RATE(16,L) * H(K) * HO2(K)
      SOODH(9,K) = GG(7)
  100 CONTINUE
C
      DO 108 K = LLL,LLU
  108 ODO3(K) = O3(K)
      CALL CFLOW (N1,I)
      DO 110 K = LLL,LLU
  110 O3(K) = (O3(K) + ODO3(K))/2.
C
      DO 20 J = LLL,LLU
      OJO2(J) = CJO2(J)
      OJO3(J) = CJO3(J)
      OJCF2(J) = CJCF2(J)
      OJCF3(J) = CJCF3(J)
      OJCCL4(J) = CJCCL4(J)
      OJCH3C(J) = CJCH3C(J)
      OJCLO3(J) = CJCLO3(J)
      OJN2O(J) = CJN2O(J)
      OJHNO3(J) = CJHNO3(J)
      OJH2O2(J) = CJH2O2(J)
      OJO31(J) = CJO31(J)
      OJN2O5(J) = CJN2O5(J)
      OO3INT(J) = DO3INT(J)
   20 CONTINUE
      CALL RJITER (ISWIT,ISCATT)
      IF (I.EQ.1) GO TO 10
C
      DO 50 J = LLL,LLU
      E = ABS((CJO3(J) - OJO3(J))/CJO3(J))
      IF (E.GE.EPS) GO TO 10
      E1 = ABS((OH(J) - OLDOH(J))/OH(J))
      IF (E1.GE.EPS1) GO TO 10
   50 CONTINUE
  502 CONTINUE
      CALL O3LINT (HHH,YY,9,36)
      O3INT(LLU) = O3(LLU)*5.0E5
      LLUML = LLU - LLL
      DO 310 K = 1,LLUML
      J = LLU - K
      JP1 = J + 1
  310 O3INT(J) = O3INT(JP1) + (O3(JP1) + O3(J))*1.E5
      CALL PRINTX (I,LLL,LLU)
      NEXT=.TRUE.
      RETURN
C
  501 I = I - 1
      WRITE (6,601) I
  601 FORMAT (1H0/10X,*DID NOT CONVERGE IN*,I4,*  ITERATIONS*)
      GO TO 502
C
      END
      SUBROUTINE RJITER (ISWIT,ISCATT)
C.....................................................................
C
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C.....CMS03 - CHLORINE MODEL STUDY PROGRAM
C
C.....VERSION 3.3        LEVEL 770201
C.....E.R.T.,INC.        N.D.SZE, N.TRIPP
C
C.......................................................................
      COMMON /RATES/RATE(65,81),RA(65),RB(65),JNO3,PJO3
C
      NT = 41
      HAV = 5.0E05
      IL = 1
      IU = 72
      IF(ISCATT.EQ.1)IU=99
      IF(ISCATT.EQ.1)PJO3=0.0
      RDF = 1.0
      IF (ISWIT.EQ.0) RDF = 0.5
      GMJ = .707
      CALL COLDEN (NT,HAV)
      CALL COMPJ (IL,IU,GMU,RDF,NT,ISWIT,ISCATT)
      RETURN
      END
      SUBROUTINE COLDEN(NT,HAV)
C
C     THIS ROUTINE COMPUTES COLUMN DENSITIES OF OZONE
C
C     NT   IS THE INDEX NUMBER OF THE TOP LAYER
C     HAV  IS THE AVERAGE SCALE HEIGHT OF TOP LAYER
C
      REAL NO,NO2,NOX,NO3,N2O5
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),OCLX(41),NO3(41),N2O5(41),
     3 CLNO3(41)
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
      COMMON /INTDEN/DO3INT(41),DMINT(41),DAINT(41)
C
      NTM1 = NT - 1
      DELZ = 2.0E05
      DO3INT(NT) =  O3(NT) * HAV
      DO 10 J = 1,NTM1
      I = NT - J
      IP1 = I + 1
   10 DO3INT(I) = DO3INT(IP1) + ( O3(IP1) +  O3(I)) * DELZ*.5
      RETURN
      END
      SUBROUTINE COMPJ (IL,IU,GMU,RDF,NT,ISWIT,ISCATT)
C.......................................................................
C
C.....CMS03 - CHLORINE MODEL STUDY PROGRAM
C
C.....VERSION 3.3        LEVEL 770201
C.....E.R.T.,INC.        N.D.SZE, N.TRIPP
C
C.......................................................................
C
C     THIS ROUTINE COMPUTES J-VALUES, IL = LOWER LIMIT, IU = UPPER LIMIT
C     GMJ = SOLAR ZENITH ANGLE
C     RDF = FLUX REDUCTION FACTOR
C     NT = INDEX NUMBER OF TOP LAYER
C     ISWIT = SWITCH USED IN COMPUTING TRAN FROM TAU
C     ISCATT = SWITCH FOR ABSORBING OR SCATTERING MODEL
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
      COMMON /INTDEN/ DO3INT(41),DMINT(41),DAINT(41)
      COMMON /JVAL/ CJO2(50),CJO3(50),CJCF2(50),CJCF3(50),CJCCL4(50),
     1              CJCH3C(50),CJCLO3(50),CJN2O(50),CJHNO3(50)
     2, CJH2O2(50),CJO31(50),CJN2O5(50)
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      COMMON /MSCAT/ SCNO2,SCCLO3,SCH2O2,SCN2O5                         007330
      COMMON /PHIS/ PHI1(100)                                           007340
      REAL JO2,JO3,JH2O,JNO2,JN2O,JN2O5,JHNO3,JCH4,JCF2,                007350
     X JCF3,JHCL,JH2O2,JHOCL                                            007360
      COMMON /PHRATE/ JO2(41),JO3(41),JH2O(41),JNO2(41),JN2O(41),       007370
     X JN2O5(41),JHNO3(41),JCH4(41),JCF2(41),JCF3(41),JHCL(41),         007380
     Y JH2O2(41),JHOCL(41)                                              007390
      COMMON /SOLCON/ WL(100),FL(100),QO2(100),QO3(100)                 007400
      COMMON /SOLCN1/ QCF2(100),QCF3(100),QCCL4(100),QCH3C(100),        007410
     X QCLNO3(100),QN2O(100),QHNO3(100),QH2O2(100),QN2O5(100),          007420
     Y QHCL(100),QHOCL(100),QNO2(100),QH2O(100)                         007430
      REAL LAT                                                          007440
      COMMON /WT/ A(6),DL,LAT,DEL                                       007450
      COMMON/SCA/TAUINT(100),F(41,100),FAV(41,100),FLUX(41)             007460
      DIMENSION PHI(100)                                                007470
C                                                                       007480
C     COMPUTE COLUMN DENSITIES, STORED IN DO3INT,DMINT,                 007490
C        COMPUTED IN SUBROUTINE COLDEN                                  007500
C     IF ISWITCH THEN FIX GMU FOR INTEGRAL ELSE CALL COMPTAU            007510
C     IF ISCATT DO MULTIPLE SCATTERING CALCULATION AND                  007520
C     WEIGHT FLUX FACTORS IF ISWIT                                      007530
      PO2 = 0.21                                                        007540
      IF(ISCATT.EQ.0)GO TO 50                                           007550
      IF(ISWIT.EQ.0)GO TO 60                                            007560
      DO 65 I=1,NT                                                      007570
      DO 66 J=IL,IU                                                     007580
      FAV(I,J)=0.0                                                      007590
      F(I,J)=0.0                                                        007600
66    CONTINUE                                                          007610
65    CONTINUE                                                          007620
      DO 70 KK=1,5                                                      007630
      GMU=1./A(KK)                                                      007640
      CALL OMEGA(NT,IL,IU,GMU)                                          007650
      DO 80 I=1,NT                                                      007660
      DO 90 J=IL,IU                                                     007670
      FAV(I,J)=FAV(I,J)+F(I,J)                                          007680
90    CONTINUE                                                          007690
80    CONTINUE                                                          007700
70    CONTINUE                                                          007710
      DO 75 I=1,NT                                                      007720
      DO 76 J=IL,IU                                                     007730
      F(I,J)=FAV(I,J)*DL*2./1036800.                                    007740
76    CONTINUE                                                          007750
75    CONTINUE                                                          007760
      GO TO 50                                                          007770
60    CALL OMEGA(NT,IL,IU,GMU)                                          007780
50    CONTINUE                                                          007790
      DO 10 I=1,NT                                                      007800
      TEMP2 = 0.0                                                       007810
      TEMP3 = 0.0                                                       007820
      TEMP4 = 0.0                                                       007830
      TEMP5 = 0.0                                                       007840
      TEMP6 = 0.0                                                       007850
      TEMP7 = 0.0                                                       007860
      TEMP8 = 0.                                                        007870
      TEMP9 = 0.                                                        007880
      TEMP10 = 0.                                                       007890
      TEMP11 = 0.                                                       007900
      TEMP12 = 0.                                                       007910
      TEMP13=0.                                                         007920
      TEMP14=0.                                                         007930
      TEMP15=0.                                                         007940
      TEMP16=0.                                                         007950
      DO 20 J = IL,IU                                                   007960
      IF(ISCATT.EQ.1)GO TO 7                                            007970
      TAJ = QO3(J)*DO3INT(I) + QO2(J)*DMINT(I)*PO2                      007980
```

```
      IF (ISMIT.GT.0) GO TO 100                                         007790
      TAU = -TAU/SMU                                                    008800
      IF (TAU.GE.-150.) GO TO 5                                         008010
      TRAN = 0.                                                         008020
      GO TO 6                                                           008030
    5 TRAN = EXP(TAU)                                                   008040
      GO TO 6                                                           008050
100   CALL COMTAU (TAU,TRAN)                                            008060
      TRAN = TRAN*(DL/1036800.)                                         008070
      GO TO 6                                                           008080
7     TRAN=F(I,J)                                                       008090
    6 TEMP2 = TEMP2 + FL(J)*QO2(J)*TRAN                                 008100
      TEMP3 = TEMP3 + FL(J)*QO3(J)*TRAN                                 008110
      TEMP4 = TEMP4 + FL(J)*QCF2(J) * TRAN                              008120
      TEMP5 = TEMP5 + FL(J)*QCF3(J) * TRAN                              008130
      TEMP6 = TEMP6 + FL(J)*QCCL4(J)* TRAN                              008140
      TEMP7 = TEMP7 + FL(J)*QCH3C(J)* TRAN                              008150
      TEMP8 = TEMP8 + FL(J)*QCLNO3(J)*TRAN*PHI1(J)                      008160
      TEMP9 = TEMP9 + FL(J)*QN2O(J)*TRAN                                008170
      TEMP10=TEMP10 + FL(J)*QHNO3(J)*TRAN                               008180
      TEMP11 = TEMP11 + FL(J)*QH2O2(J)*TRAN                             008190
      TEMP12 = TEMP12 + FL(J)*QN2O5(J)*TRAN                             008200
      TEMP13=TEMP13 + FL(J)*QHCL(J)*TRAN                                008210
      TEMP14=TEMP14 + FL(J)*QHOCL(J)*TRAN                               008220
      TEMP15=TEMP15 + FL(J)*QNO2(J)*TRAN                                008230
      TEMP16=TEMP16 + FL(J)*QH2O(J)*TRAN                                008240
   20 CONTINUE                                                          008250
      CJO2(I) = TEMP2*RDF                                               008260
      CJO3(I) = TEMP3*RDF                                               008270
      CJCF2(I)  = TEMP4*RDF                                             008280
      CJCF3(I)  = TEMP5*RDF                                             008290
      CJCCL4(I) = TEMP6*RDF                                             008300
      CJCH3C(I) = TEMP7*RDF                                             008310
      CJCLO3(I) = TEMP8*RDF*SCCLO3                                      008320
      CJN2O(I) = TEMP9*RDF                                              008330
      CJHNO3(I) = TEMP10*RDF                                            008340
      CJH2O2(I) = TEMP11*RDF*SCH2O2                                     008350
      CJN2O5(I) = TEMP12*RDF*SCN2O5                                     008360
      JHCL(I)=TEMP13*RDF                                                008370
      JHOCL(I)=TEMP14*RDF                                               008380
      JNO2(I)=TEMP15*RDF                                                008390
      JH2O(I)=TEMP16*RDF                                                008400
   10 CONTINUE                                                          008410
      PHI(53) = .7                                                      008420
      PHI(54) = .05                                                     008430
      DO 30 I = 1,NT                                                    008440
      TEMP31 = 0.                                                       008450
      DO 40 J = IL,54                                                   008460
      IF (ISCATT.EQ.1) GO TO 110                                        008470
      TAJ = QO3(J)*DO3INT(I) + QO2(J)*DMINT(I)*PO2                      008480
      IF (ISMIT .GT. 0) GO TO 25                                        008490
      TAU=-TAU/GMJ                                                      008500
      IF (TAU .GE. -150.) GO TO 24                                      008510
      TRAN=0.                                                           008520
      GO TO 27                                                          008530
   24 TRAN=EXP(TAU)                                                     008540
      GO TO 27                                                          008550
   25 CALL COMTAU (TAU,TRAN)                                            008560
      TRAN = TRAN*(DL/1036800.)                                         008570
      GO TO 27                                                          008580
  110 TRAN=F(I,J)                                                       008590
   27 IF (J.GT.52) GO TO 40                                             008600
      PHI(J) = 1.0                                                      008610
   40 TEMP31 = TEMP31 + FL(J)*PHI(J)*QO3(J)*TRAN                        008620
   30 CJO31(I) = TEMP31*RDF                                             008630
      LLL=1                                                             008640
```

```
      LLJ=NT
      WRITE (6,1601)
      WRITE (6,602) (ALT(J),CJO2(J),CJO3(J),CJCF2(J),CJCF3(J),CJO31(J),
     1              JHCL(J), JHOCL(J),JNO2(J),JH2O(J),  J=LLL,LLU)
      WRITE (6,1603)
      WRITE (6,604) (ALT(J),CJCLO3(J),CJN2O(J),CJHNO3(J),CJH2O2(J),
     1 CJN2O5(J),CJCCL4(J),CJCH3C(J),J=LLL,LLU)
 1601 FORMAT (1H0,5X,*LAST ITERATION  +  1*    // 5X,*ALT*,6X,*CJO2*, 7X,
     1 *CJO3*, 6X,*CJCF2*, 6X,*CJCF3*,6X,*CJO 31*,5X,*  JHCL*,5X,
     2 * JHOCL*,5X,* JNO2*,6X,*  JH2O*//)
  602 FORMAT (1H ,0PF9.0, 1P09E11.3)
 1603 FORMAT (1H0,5X,*LAST ITERATION  +  1*//
     A                                  6X,*ALT*,5X,*CJCLO3*,5X,*CJN2O*,
     1 6X,*CJHNO3*,5X,*CJH2O2*,5X,*CJN2O5*,5X,*CJCCL4*,4X,*CJCH3CL*//)
  604 FORMAT (1H ,0PF9.0, 1P07E11.3)
      RETURN
      END
      SUBROUTINE COMTAU (TAU,TRAN)
C.....................................................................
C
C.....CMS03 - CHLORINE MODEL STUDY PROGRAM
C
C.....VERSION 3.3        LEVEL 770201
C.....F.R.T.,INC.        N.D.SZE, N.TRIPP
C
C.....................................................................
C
      REAL LAT
      COMMON /WT/ A(6),DL,LAT,DEL
      IF (TAU.GT.1.E-3) GO TO 10
      TRAN = DL/3600.
      RETURN
C
   10 TRAN = 0.0
      IF (TAU.GT.50.0) RETURN
      T = -TAU * A(1)
C     TEST FOR UNDERFLOW
      IF (T.LT.-100.0) RETURN
      TRAN = EXP(T) * 2.0
      T = -TAU * A(2)
      IF (T.LT.-100.0) RETURN
      TRAN = TRAN + 2.0 * EXP(T)
      T = -TAU * A(3)
      IF (T.LT.-100.) RETURN
      TRAN = TRAN + 2.0 * EXP(T)
      T = -TAU * A(4)
      IF (T.LT.-100.) RETURN
      TRAN = TRAN + 2.0 * EXP(T)
      T = -TAU * A(5)
      IF (T.LT.-100.) RETURN
      TRAN = TRAN + 2.0 * EXP(T)
      T = -TAU * A(6)
      IF (T.LT.-100.) RETURN
      TRAN = TRAN + 2.0 * EXP(T)
      RETURN
      END
      SUBROUTINE INITAL (K,Y,II,NEXT)
C
      DIMENSION Y(10),RR(3)
      REAL NO,NO2,NOX,NO3,N2O5
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),OCLX(41),NO3(41),N2O5(41),
     3 C.NO3(41)
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DIO(41),DA23(41)
      COMMON /SFACT/ FCL,FH2O,FCLNO3,FNO
```

```
      LOGICAL NEXT
C
      IF(NEXT) GO TO 10
      IF (II.GT.1) GO TO 10
      FCO = 1.0
      CO(K) =  CO(K) * DM(K) * FCO
      O2(K) = 0.2 * DM(K)
      H2(K) = 0.5E-6 * DM(K)
      CH4(K) =  CH4(K) * DM(K)
      DCLX(K) = CLX(K) * FCL
      CLX(K) = CLX(K) *DM(K) * FCL
      H2O(K) =  H2O(K) * DM(K) * FH2O
      NOX(K) =  NOX(K) * DM(K)
      OH(K) =  OH(K) * 1.1
      HO2(K) =  HO2(K) * 1.1
   10 Y(1) = H(K)
      Y(2) = OH(K)
      Y(3) = HO2(K)
      Y(4) = O3(K)
      J=0
   20 J=J+1
      IF(J.GT.10)GO TO 50
      TNO=NO(K)
      TNO2=NO2(K)
      THNO3=HNO3(K)
      CALL PCLOX (K)
      CALL PNOX(K)
      RR(1)=TNO/NO(K)
      RR(2)=TNO2/NO2(K)
      RR(3)=THNO3/HNO3(K)
      DO 25 M=1,3
      IF(RR(M).GT.1.005.OR.RR(M).LT.0.995)GO TO 20
   25 CONTINUE
      RETURN
   50 J=J-1
      WRITE(6,650)J
  650 FORMAT(1H0,5X,*DID NOT CONVERGE IN INITAL IN *,I3,* TIMES*)
      STOP
      END
      SUBROUTINE PCLOX (K)
C
      COMMON /JVA_/ CJO2(50),CJO3(50),CJCF2(50),CJCF3(50),CJCCL4(50),
     1              CJCH3C(50),CJCLO3(50),CJN2O(50),CJHNO3(50)
     2, CJH2O2(50),CJO31(50),CJN2O5(50)
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
      REAL JO2, JO3, JH2O, JNO2, JN2O, JN2O5, JHNO3, JCH4, JCF2,
     X                JCF3, JHCL, JH2O2,JHOCL
      COMMON /PHRATE/ JO2(41),JO3(41),JH2O(41),JNO2(41),JN2O(41),
     X JN2O5(41),JHNO3(41),JCH4(41),JCF2(41),JCF3(41),JHCL(41),JH2O2(41)
     Y ,JHOCL(41)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SFACT/ FCL,FH2O,FCLNO3,FNO
      REAL NO,NO2,NOX,NO3,N2O5
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),DCLX(41),NO3(41),N2O5(41),
     3 CLNO3(41)
C
      L = 2*K - 1
C     RRC1 = (CLO)/(CL)
      RRC1 = RATE(29,L)*O3(K)/(RATE(31,L)*O(K) + RATE(32,L)*NO(K))
C     RRC2 = (HCL)/(CL)
      RRC2 =(RATE(30,L)*CH4(K) + RATE(26,L)*H2(K) + RATE(15,L)*HO2(K) +
     1 RATE(27,L)*H2O2(K))/(RATE(20,L)*OH(K) + RATE(33,L)*O(K) +JHCL(K))
C     RRC3A = (CLNO3)/(CLO)
```

```
C     RRC3B = (CLNO3)/(CL)
      RRC3A= RATE(25,L)*NO2(K)*FCLNO3*DM(K)/CJCLO3(K)
      RRC3B = RRC3A * RRC1
C     CLX = CL + CLO + HCL
      CL(K) = CLX(K)/(1. + RRC1 + RRC2 + RRC3B)
      CLO(K) =RRC1*CL(K)
      HCL(K) =RRC2*CL(K)
      RETURN
      END
      SUBROUTINE PNOX (K)
C
      COMMON /JVAL/ CJO2(50),CJO3(50),CJCF2(50),CJCF3(50),CJCCL4(50),
     1              CJCH3C(50),CJCLO3(50),CJN2O(50),CJHNO3(50)
     2, CJH2O2(50),CJO31(50),CJN2O5(50)
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
      COMMON /MSCAT/ SCNO2,SCCLO3,SCH2O2,SCN2O5
      REAL JO2, JO3, JH2O, JNO2, JN2O, JN2O5, JHNO3, JCH4, JCF2,
     X                JCF3, JHCL, JH2O2,JHOCL
      COMMON /PHRATE/ JO2(41),JO3(41),JH2O(41),JNO2(41),JN2O(41),
     X JN2O5(41),JHNO3(41),JCH4(41),JCF2(41),JCF3(41),JHCL(41),JH2O2(41)
     Y ,JHOCL(41)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SFACT/ FCL,FH2O,FCLNO3,FNO
      REAL NO,NO2,NOX,NO3,N2O5
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),DCLX(41),NO3(41),N2O5(41),
     3 CLNO3(41)
C
      L = 2*K - 1
C     RR1 = (NO)/(NO2)
      CJNO2 = JNO2(K) * SCNO2
      RR1 = (CJNO2+RATE(42,L)*O(K))/(RATE(32,L)*CLO(K)+RATE(40,L)*O3(K))
C     RR2 = (HNO3)/(NO2)
      RR2 = RATE(22,L)*OH(K)*DM(K)/(JHNO3(K)+RATE(23,L)*OH(K))
C     RR3 = (NO3)/(NO2)
      RR3 = RATE(41,L)*O3(K)/JNO3
C     RR4 = (N2O5)/(NO2)**2
      RR6 = RATE(38,L)*DM(K)/(RATE(37,L)+RATE(38,L)*DM(K))
      RR7 = RATE(37,L)/(RATE(37,L)+RATE(38,L)*DM(K))
      RR4 = RATE (36,L)*RR6/(RR7*RATE(39,L)+JN2O5(K))
      RR4 = RR3*RR4
C     RR9 = (CLNO3)/(NO2)
      RR9 = RATE(28,L)*CLO(K)*FCLNO3*DM(K)/CJCLO3(K)
      A = 2.0*RR4
      B = 1. + RR1 + RR2 + RR3 + RR9
      C = NOX(K)
      CALL QUAD (A,B,C,X)
      NO2(K) = X
      NO(K) = X * RR1
      HNO3(K) = X * RR2
      NO3(K) = X * RR3
      N2O5(K) = X*X * RR4
      CLNO3(K) = X * RR9
   10 RETURN
      END
      SUBROUTINE QUAD(A,B,C,X)
C     SOLVE EQ. A*X*X+B*X = C
      DD=4.*A*C/(B*B)
      IF (DD .GT. .01) GO TO 10
      X= B*(.5*DD-.125*DD*DD)
      X=X/(2.*A)
      RETURN
   10 X= -B+SQRT(B*B+4.*A*C)
      X=X/(2.*A)
```

```
      RETURN
      END
      SUBROUTINE SOLVE (K,ALP,Y,N1)
C.......................................................................
C
C.....CMS04 - CHLORINE MODEL STUDY PROGRAM
C
C.....SUBROUTINE SOLVE - ORGANIZES SOLUTION OF CHEMICAL SYSTEM
C
C.....VERSION 4.0        LEVEL 770214
C.....E.R.T.,INC.        N. D. SZE , N. TRIPP
C
C.......................................................................
C
      REAL B
      COMMON /MATRIX/ B(20,21)
      COMMON /NETPRO/ PP(4),SS(4)
      REAL JO2, JO3, JH2O, JNO2, JN2O, JN2O5, JHNO3, JCH4, JCF2,
     X                JCF3, JHCL, JH2O2,JHOCL
      COMMON /PHRATE/ JO2(41),JO3(41),JH2O(41),JNO2(41),JN2O(41),
     X JN2O5(41),JHNO3(41),JCH4(41),JCF2(41),JCF3(41),JHCL(41),JH2O2(41)
     Y ,JHOCL(41)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      REAL NO,NO2,NOX,NO3,N2O5
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),OCLX(41),NO3(41),N2O5(41),
     3 CLNO3(41)
      DIMENSION Y(10), YO(10)
      LOGICAL LINEQN
C
      L = 2*K - 1
      WASH = 1.65E-6
      IF (K.GE.9) WASH = 0.0
      KKK = 0
      KK = 1
      N = 3
      NP1 = N + 1
    5 DO 10 J = 1,NP1
   10 YO(J) = Y(J)
      I = 1
C
    1 CALL JACOB (K,ALP,Y,N1)
      ERR = 0.
      DO 20 J = 1,N
      B(J,NP1) = PP(J) - SS(J)
      ERR = ERR + (B(J,NP1)/SS(J))**2
   20 CONTINUE
C
      IF (LINEQN(N)) GO TO 50
      IF (ABS(ERR).LE.1.E-05) GO TO 100
      DO 55 J = 1,N
   55 Y(J) = Y(J) - B(J,NP1)
      I = I + 1
      IF (I.GT.20) GO TO 101
      GO TO 1
C
  100 CONTINUE
      KK = KK + 1
      H(K) = Y(1)
      OH(K) = Y(2)
      HO2(K) = Y(3)
      O3(K) = Y(4)
      O(K) = ALP*Y(4)
      H2O2(K) = RATE(13,L)*Y(3)*Y(3)/(RATE(8,L)*Y(2)+JH2O2(K)+WASH)
```

```
      CALL PCLOX (K)
      CALL PNOX(K)
      IF (KK.GE.50) GO TO 145
      DO 75 II = 1,4
      IF ((YO(II)/Y(II)).LT.0.995) GO TO 5
      IF ((YO(II)/Y(II)).GT.1.005) GO TO 5
   75 CONTINUE
      CALL JACOB (K,ALP,Y,N1)
      RETURN
C
  145 WRITE (6,151)
  151 FORMAT (/,*      KK EQUAL TO 50 - SUBROUTINE SOLVE*/)
      RETURN
   50 WRITE (6,155)  K
  155 FORMAT (/,*      MATRIX SINGULAR   LEVEL = *,I3,/)
      KKK = KKK + 1
      IF (KKK.GE.3) RETURN
      DO 501 J = 1,N
  501 Y(J) = 0.9*Y(J)
      GO TO 1
  101 WRITE (6,152)
  152 FORMAT (/,*      DOES NOT CONVERGE - SUBROUTINE SOLVE*/)
      RETURN
      END
      SUBROUTINE JACOB (K,ALP,Y,N1)
C.......................................................................
C
C.....CMS04 - CHLORINE MODEL STUDY PROGRAM
C
C.....SUBROUTINE JACOB - FORMS JACOBIAN OF CHEMICAL SYSTEM
C
C.....VERSION 4.0       LEVEL 770214
C.....E.R.T.,INC.       N. D. SZE , N. TRIPP
C
C.....................................................................
C
      DIMENSION Y(10)
      REAL A
      COMMON /MATRIX/ A(20,21)
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
      COMMON /NETPRO/ PP(4),SS(4)
      REAL JO2, JO3, JH2O, JNO2, JN2O, JN2O5, JHNO3, JCH4, JCF2,
     X                JCF3, JHCL, JH2O2,JHOCL
      COMMON /PHRATE/ JO2(41),JO3(41),JH2O(41),JNO2(41),JN2O(41),
     X JN2O5(41),JHNO3(41),JCH4(41),JCF2(41),JCF3(41),JHCL(41),JH2O2(41)
     Y ,JHOCL(41)
      COMMON /PRORATE/ AA(10),BB(10),CC(10),DD(11),EE(10),GG(10),HH(10)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      REAL NO,NO2,NOX,NO3,N2O5
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),OCLX(41),NO3(41),N2O5(41),
     3 CLNO3(41)
C
      L = 2*K - 1
      ALP = (JO3(K) + PJO3)/(RATE(34,L)*O2(K)*DM(K))
      AA(1) = RATE(4,L)*DID(K)*H2(K) + JH2O(K)*H2O(K)
      AA(2) = RATE(19,L)*ALP*Y(4)*Y(2)
      AA(3) = RATE(18,L)*Y(2)*CO(K)
      AA(4) = RATE(21,L)*CH4(K)*Y(2)
      AA(5) = RATE(25,L)*Y(2)*H2(K)
    5 PP(1) = AA(1) + AA(2) + AA(3) + AA(4) + AA(5)
      BB(1) = RATE(5,L)*O2(K)*DM(K)*Y(1)
      BB(2) = RATE(6,L)*Y(4)*Y(1)
      BB(3) = (RATE(16,L) + RATE(17,L))*Y(3)*Y(1)
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```
9     SS(1) = BB(1) + BB(2) + BB(3)                                    011950
10    A(1,1)=-SS(1)/Y(1)                                               011960
11    A(1,2) = (AA(2) + AA(3) + AA(4) + AA(5))/Y(2)                     011970
12    A(1,3) = -BB(3)/Y(3)                                             011980
      CC(1) = 2.0*RATE(2,L)*DID(K)*H2D(K)                              011990
      CC(2) = 2.0*RATE(3,L)*DID(K)*CH4(K)                              012000
      CC(3) = RATE(10,L)*Y(4)*ALP*Y(3)                                 012010
      CC(4) = RATE(9,L)*Y(4)*Y(3)                                      012020
      CC(5) = RATE(11,L)*NO(K)*Y(3)                                    012030
19    CC(6) = 2.0*JH2O2(K)*H2O2(K)                                     012040
      CC(7) = RATE(6,L)*Y(1)*Y(4)                                      012050
21    CC(8) = JHNO3(K) * HNO3(K)                                       012060
      CC(9) = 2.0*RATE(17,L)*Y(1)*Y(3)                                 012070
      CC(10) = AA(1)                                                   012080
23    PP(2) = CC(1)+CC(2)+CC(3)+CC(4)+CC(5)+CC(6)+CC(7)+CC(8)+CC(9)    012090
     1 +CC(10)                                                         012100
      DD(1) = RATE(7,L)*Y(4)*Y(2)                                      012110
      DD(2) = RATE(8,L)*H2O2(K)*Y(2)                                   012120
      DD(3) = RATE(14,L)*Y(3)*Y(2)                                     012130
27    DD(4) = AA(3)                                                    012140
28    DD(5) = AA(2)                                                    012150
      DD(6) = RATE(20,L)*HCL(K)*Y(2)                                   012160
      DD(7) = RATE(21,L)*CH4(K)*Y(2)                                   012170
      DD(8) = RATE(22,L)*NO2(K)*DM(K)*Y(2)                             012180
      DD(9) = RATE(23,L)*HNO3(K)*Y(2)                                  012190
      DD(10) = 2.0*RATE(24,L)*Y(2)*Y(2)                                012200
      DD(11) = AA(5)                                                   012210
34    SS(2)=DD(1)+DD(2)+DD(3)+DD(4)+DD(5)+DD(6)+DD(7)+DD(8)+DD(9)+DD(10)012220
     1 +DD(11)                                                         012230
35    A(2,1) = (CC(7) + CC(9))/Y(1)                                    012240
36    A(2,2) =-(SS(2) + DD(10))/Y(2)                                   012250
37    A(2,3) = (CC(3)+CC(4)+CC(5)+CC(9)-DD(3))/Y(3)                    012260
39    EE(1) = BB(1)                                                    012270
40    EE(2) = DD(1)                                                    012280
      EE(3) = RATE(27,L)*CL(K)*H2O2(K)                                 012290
      EE(4) = DD(2)                                                    012300
42    PP(3) = EE(1) + EE(2) + EE(3) + EE(4)                            012310
43    GG(1) = CC(4)                                                    012320
44    GG(2) = CC(3)                                                    012330
45    GG(3) = CC(5)                                                    012340
      GG(4) = RATE(12,L)*CLO(K)*Y(3)                                   012350
      GG(5) = 2.0*RATE(13,L)*Y(3)*Y(3)                                 012360
48    GG(6) = DD(3)                                                    012370
      GG(7) = RATE(15,L)*CL(K)*Y(3)                                    012380
50    GG(8) = BB(3)                                                    012390
51    SS(3) = GG(1)+GG(2)+GG(3)+GG(4)+GG(5)+GG(6)+GG(7)+GG(8)          012400
52    A(3,1) = (EE(1) - GG(8))/Y(1)                                    012410
53    A(3,2) = (EE(2) + EE(4) - GG(6))/Y(2)                            012420
54    A(3,3) = -(SS(3) + GG(5))/Y(3)                                   012430
56    PP(4) = 2.0*JO2(K)*O2(K)                                         012440
57    HH(1) = BB(2)                                                    012450
58    HH(2) = DD(1)                                                    012460
59    HH(3) = CC(4)                                                    012470
60    HH(4) = CC(3)                                                    012480
61    HH(5) = AA(2)                                                    012490
      HH(6) = 2.0*RATE(42,L)*NO2(K)*Y(4)*ALP                           012500
      HH(7) = 2.0*RATE(31,L)*CLO(K)*ALP*Y(4)                           012510
      HH(8) = 2.0*ALP*RATE(35,L)*Y(4)*Y(4)                             012520
65    SS(4) = HH(1)+HH(2)+HH(3)+HH(4)+HH(5)+HH(6)+HH(7)+HH(8)          012530
      N11 = (N1-1)/2                                                   012540
      IF (K.LE.N11) GO TO 80                                           012550
      T1 = 2.0*RATE(42,L)*NO2(K)                                       012560
      T2 = RATE(13,L)*Y(2)                                             012570
      T3 = RATE(10,L)*Y(3)                                             012580
      T4 = 2.0*RATE(31,L)*CLO(K)                                       012590
      TT1=(T1+T2+T3+T4)*ALP                                            012600
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      T5 = RATE(6,L)*Y(1)
      T6 = RATE(7,L)*Y(2)
      T7 = RATE(9,L)*Y(3)
      T8 = 2.0*RATE(41,L)*NO2(K)
      TT2=T5+T6+T7+T8
      B1=TT1+TT2
      A1 = 2.0*RATE(35,L)*ALP
      C1=PP(4)
      CALL QUAD(A1,B1,C1,XX)
      Y(4)=XX
      O(K) = ALP * XX
   70 RETURN
   80 Y(4) = O3(K)
      RETURN
      END
      SUBROUTINE CFLOW(N1,NITER)
C
C  FLOW PROGRAM FOR VARIOUS SPECIES:
C     SP1 = N2O, SP2 = NOX, SP3 = CH4
C     SP4 = FC11, SP5 = FC12
C     SP6 = CH3CL, SP7 = CLX , SP8 = O3, SP9 = CCL4, SP10 = CO
C  TIME-DEPENDENT TERM FOR EACH SPECIES IS DFP.
C     (SHOULD ALL BE SET = 0. FOR STEADY-STATE CASE)
C
      COMMON /CHLOR/ XCL(81)
      COMMON /COEF2/ A(81),B(81),C(81),F(81),X(81)
      COMMON /INT81/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XHO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /ITER/ KKK
      COMMON /JVAL/ CJO2(50),CJO3(50),CJCF2(50),CJCF3(50),CJCCL4(50),
     1              CJCH3C(50),CJCLO3(50),CJN2O(50),CJHNO3(50)
     2, CJH2O2(50),CJO31(50),CJN2O5(50)
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
      COMMON /MOLHYD/ XH(81),XH2O(81),PH2O,RH2,X11(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      COMMON /PARA1/ STEP,QQU,PPL,PPU,N,M
      COMMON /RLOW/ RN2O,RNOX,RCH4,RF11,RF12,RCH3C,RCLX,RCCL4,RO3
      REAL NO,NO2,NOX,NO3,N2O5
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),OCLX(41),NO3(41),N2O5(41),
     3 CLNO3(41)
      COMMON /SPECON/ FJ,FJFC,TL
      COMMON /XLS/ XL1(81),XL2(81),XL3(81),XL4(81),XL5(81),XL6(81),
     1 XL7(81),XL8(81),XL9(81),XL10(81)
      COMMON /XXES/ X1(81),X2(81),X3(81),X4(81),X5(81),X6(81),X7(81),
     1 X8(81),X9(81),X10(81)
      DIMENSION PR1(81),PR2(81),PR3(81),PR4(81),PR5(81),PR6(81),PR7(81),
     1 PR8(81),PR9(81),PR10(81)
      DIMENSION DFP1(81),DFP2(81),DFP3(81),DFP4(81),DFP5(81),DFP6(81),
     1 DFP7(81),DFP8(81),DFP9(81),DFP10(81)
      DIMENSION PR11(81),XL11(81),DFP11(81)
      COMMON /TRAPH2/ XL11
      LOGICAL CONV,OKPO3
      EXTERNAL CXL1,CXL2,CXL3,CXL4,CXL5,CXL6,CXL7,CXL8,CXL9,CXL10,CXL11
      CALL RINTER (DID,XDID)
      CALL RINTER  (OH,XOH)
      CALL RINTER (CJN2O,XJN2O)
      CALL RINTER (CJCF3,XJCF3)
      CALL RINTER (CJCF2,XJCF2)
      CALL RINTER (CJCH3C,XJCH3C)
      CALL RINTER (CJO2,XJO2)
      CALL RINTER (CJO3,XJO3)
      CALL RINTER  (HO2,XHO2)
      CALL RINTER  (NO2,XNO2)
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      CALL RINTER (NO,XNO)
      CALL RINTER  (O3,XO3)
      CALL RINTER (CJCCL4,XJCCL4)
      CALL RINTER (CLO,XCLO)
      CALL RINTER (CL,XCL)
      CALL RINTER (H,XH)
      CALL RINTER (H2O,XH2O)
      IF (RN2O.GT.1.0) QL1 = 0.
      IF (RN2O.LE.1.0) QL1 = 1.
      CALL CSPEC(1.,0.,PPL,QL1,RN2O,PR1,DFP1,XL1,CXL1)
      DO 1 I = 1,N
    1 X1(I) = X(I)
      CONV = .FALSE.
      IF (RNOX.GT.1.0) QL2 = 0.
      IF (RNOX.LE.1.0) QL2 = 1.
      K1 = 1
      IF (NITER.GT.1) K1 = 2
      DO 206 KKK = K1,25
      CALL CSPEC(1.,0.,PPL,QL2,RNOX,PR2,DFP2,XL2,CXL2)
      EMAX = 0.
      DO 202 I = 40,81
      EI =ABS((X2(I)-X(I))/X(I))
      IF (EI.GT.EMAX) EMAX = EI
  202 CONTINUE
      IF (EMAX.LT.0.05)CONV = .TRUE.
      IF (CONV) GO TO 204
      IF (KKK.EQ.1) GO TO 204
      DO 203 I = 1,N
  203 X2(I) = (X2(I) + X(I))/2.
      GO TO 206
  204 DO 205 I = 1,N
  205 X2(I) = X(I)
      IF (CONV) GO TO 2
  206 CONTINUE
      GO TO 500
    2 CONTINUE
      IF (RCH4.GT.1.0) QL3 = 0.
      IF (RCH4.LE.1.0) QL3 = 1.
      CALL CSPEC(1.,0.,PPL,QL3,RCH4,PR3,DFP3,XL3,CXL3)
      DO 3 I = 1,N
    3 X3(I) = X(I)
      IF (RF11.GT.1.0) QL4 = 0.
      IF (RF11.LE.1.0) QL4 = 1.
      CALL CSPEC(1.,0.,PPL,QL4,RF11,PR4,DFP4,XL4,CXL4)
      DO 4 I = 1,N
    4 X4(I) = X(I)
      IF (RF12.GT.1.0) QL5 = 0.
      IF (RF12.LE.1.0) QL5 = 1.
      CALL CSPEC(1.,0.,PPL,QL5,RF12,PR5,DFP5,XL5,CXL5)
      DO 5 I = 1,N
    5 X5(I) = X(I)
      IF (RCH3C.GT.1.) QL6 = 0.
      IF (RCH3C.LE.1.) QL5 = 1.0
      CALL CSPEC(1.,0.,PPL,QL6,RCH3C,PR6,DFP6,XL6,CXL6)
      DO 6 I = 1,N
    6 X6(I) = X(I)
      IF (RCCL4.GT.1.) QL9 = 0.
      IF (RCCL4.LE.1.) QL9 = 1.0
      CALL CSPEC(1.,0.,PPL,QL9,RCCL4,PR9,DFP9,XL9,CXL9)
      DO 9 I = 1,N
    9 X9(I) = X(I)
      IF (RCLX.GT.1.0) QL7 = 0.
      IF (RCLX.LE.1.0) QL7 = 1.0
      CALL CSPEC(1.,0.,PPL,QL7,RCLX,PR7,DFP7,XL7,CXL7)
      DO 7 I = 1,N
    7 X7(I) = X(I)
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      IF (RH2.GT.1.0) QL11 = 0.
      IF (RH2.LE.1.0) QL11 = 1.
      CALL CSPEC(1.,0.,PPL,QL11,RH2,PR11,DFP11,XL11,CXL11)
      DO 11 I = 1,N
   11 X11(I) = X(I)
  800 N = N1
      DO 801 I = 1,N
  801 X8(I) = XO3(I)/COM(I)
      CONV = .FALSE.
      RUO3 = XO3(N1)/COM(N1)
      IF (RO3.GT.1.0) QL8 = 0.
      IF (RO3.LE.1.0) QL8 = 1.
      DO 806 KK = 1,25
      CALL CSPEC (0.,RUO3,PPL,QL8,RO3,        PR8,DFP8,XL8,CXL8)
      EMAX = 0.
      DO 802 I = 1,N
      EI =ABS((X8(I)-X(I))/X(I))
      IF (EI.GT.EMAX) EMAX = EI
  802 CONTINUE
      IF (EMAX.LT.0.01)CONV = .TRUE.
  804 DO 805 I = 1,N
  805 X8(I) = X(I)
      IF (CONV) GO TO 8
  806 CONTINUE
      GO TO 501
    8 CONTINUE
      OKPO3 = .FALSE.
      CALL REPCN (N1,OKPO3)
      IF (OKPO3) GO TO 50
      CALL RINTER (CLO,XCLO)
      CALL RINTER (NO2,XNO2)
      GO TO 800
   50 N = 81
      CALL SETUP2(STEP,N)
C
      N12 = (N1 + 1)/2
      DO 100 J = 1,41
      I = 2*J - 1
      NOX(J) = X2(I) * COM(I)
      CH4(J) = X3(I) * COM(I)
      CLX(J) = X7(I) * COM(I)
      H2(J) = X11(I) * COM(I)
      IF (J.GT.N12) GO TO 100
      O3(J) = X8(I) * COM(I)
  100 CONTINUE
      RETURN
C
  500 WRITE (6,600)
  600 FORMAT (1H0,*  X2 DOES NOT CONVERGE IN 25 ITERATIONS - CFLOW*)
      STOP
  501 WRITE (6,601)
  601 FORMAT (1H0,*  X8 DOES NOT CONVERGE IN 25 ITERATIONS - CFLOW*)
      STOP
      END
      SUBROUTINE RINTER (XX,XXX)
      DIMENSION XX(50),XXX(81)
      DO 10 I = 1,41
      J = 2*I - 1
   10 XXX(J) = XX(I)
C
      DO 20 I = 1,40
      J = 2*I
      IP1 = I + 1
   20 XXX(J) = SQRT(XX(I) * XX(IP1))
      RETURN
      END
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```
      SUBROUTINE CSPEC (UP,UR,P,Q,R,PR,DFP,XL,CXL)
C  FOR FIXED MIXING RATIO AT TOP  -  PU = 0, QU = 1., RU MUST BE SPECIFI
      COMMON /BC/ PJ,QU,RU,PL,QL,RL(1000)
      COMMON /COEF2/ A(81),B(81),C(81),F(81),X(81)
      COMMON /PARA1/ STEP,QQU,PPL,PPU,N,M
      DIMENSION PR(81),DFP(81),XL(81)
      PU = UP
      RU = UR
      PL = P
      QL = Q
      IF (Q.EQ.1.) PL = 0.
      RL(1) = R
      CALL CXL (PR,DFP,XL,N)
      QU = 1.0
      IF (PU.EQ.0.) GO TO 10
      QU = XL(N) * QQU
   10 CALL COEF (PR,XL,DFP)
      CALL TRIDIA (N)
      DO 20 I = 1,N
   20 XL(I) = PR(I) - XL(I)*X(I)
      RETURN
      END
      SUBROUTINE CXL1 (PR1,DFP1,XL1,N)
      COMMON /INT81/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XNO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SPECON/ FJ,FJFC,TL
      COMMON /SPLOSS/ SPL1(81),SPL4(81),SPL5(81),SPL6(81),SPL9(81)
      DIMENSION PR1(81),DFP1(81),XL1(81)
      DO 10 I = 1,N
      PR1(I) = 0.
      DFP1(I) = 0.
      XL1(I) = ((RATE(43,I) + RATE(44,I))*XDID(I) + XJN2O(I)) * CDM(I)
      SP_1(I) = RATE(44,I) * XDID(I) * CDM(I)
   10 CONTINUE
      RETURN
      END
      SUBROUTINE CXL2 (PR2,DFP2,XL2,N)
      COMMON /ITER/ KKK
      COMMON /INT81/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XNO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SPECON/ FJ,FJFC,TL
      COMMON /SPLOSS/ SPL1(81),SPL4(81),SPL5(81),SPL6(81),SPL9(81)
      COMMON /XXES/ X1(81),X2(81),X3(81),X4(81),X5(81),X6(81),X7(81),
     1 X8(81),X9(81),X10(81)
      DIMENSION PR2(81),DFP2(81),XL2(81),XL2T(81)
      IF (KKK.GT.1) GO TO 8
      DO 5 I = 1,7
      XL2T(I) = CDM(I)/(7.*8.64E4)
    5 XL2(I) = XL2T(I)
      DO 6 I = 8,11
      XL2T(I) = CDM(I)/(10.*8.64E4)
    6 XL2(I) = XL2T(I)
      DO 7 I = 12,81
      XL2T(I) = 0.0
    7 XL2(I) = XL2T(I)
    8 DO 10 I = 1,N
      DFP2(I) = 0.
      PR2(I) = 2.0*SPL1(I)*X1(I)
```

```
      IF (KKK.EQ.1) GO TO 10
      XJNO = 4.0E-6*EXP((I-81)/7.0)
      XL2(I)=(2.0*RATE(45,I)*XJNO/(RATE(46,I)*.21))*CDM(I)*X2(I)+XL2T(I)
   10 CONTINUE
      RETURN
      END
      SUBROUTINE CXL3 (PR3,DFP3,XL3,N)
      COMMON /CHLOR/ XCL(81)
      COMMON /INT81/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XHO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SPECON/ FJ,FJFC,TL
      DIMENSION PR3(81),DFP3(81),XL3(81)
      DO 10 I = 1,N
      PR3(I) = 0.
      DFP3(I) = 0.
      XL3(I) = (RATE(3,I)*XDID(I) + RATE(21,I)*XOH(I)) * CDM(I)
      XL3(I) = XL3(I) + RATE(30,I)*XCL(I)*CDM(I)
   10 CONTINUE
      RETURN
      END
      SUBROUTINE CXL4 (PR4,DFP4,XL4,N)
      COMMON /INT81/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XHO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SPECON/ FJ,FJFC,TL
      COMMON /SPLOSS/ SPL1(81),SPL4(81),SPL5(81),SPL6(81),SPL9(81)
      DIMENSION PR4(81),DFP4(81),XL4(81)
      DO 10 I = 1,N
      PR4(I) = 0.
      DFP4(I) = 0.
      XL4(I) = (FJ*XJCF3(I) + 1./TL + RATE(47,I)*XDID(I)) * CDM(I)
      SPL4(I) = XL4(I)
   10 CONTINUE
      RETURN
      END
      SUBROUTINE CXL5 (PR5,DFP5,XL5,N)
      COMMON /INT81/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XHO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SPECON/ FJ,FJFC,TL
      COMMON /SPLOSS/ SPL1(81),SPL4(81),SPL5(81),SPL6(81),SPL9(81)
      DIMENSION PR5(81),DFP5(81),XL5(81)
      DO 10 I = 1,N
      PR5(I) = 0.
      DFP5(I) = 0.
      XL5(I) = (FJ*XJCF2(I) + 1./TL + RATE(48,I)*XDID(I)) * CDM(I)
      SPL5(I) = XL5(I)
   10 CONTINUE
      RETURN
      END
      SUBROUTINE CXL6 (PR6,DFP6,XL6,N)
      COMMON /INT81/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XHO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      REAL JNO3
```

```
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SPECON/ FJ,FJFC,TL
      COMMON /SPLOSS/ SPL1(81),SPL4(81),SPL5(81),SPL6(81),SPL9(81)
      DIMENSION PR6(81),DFP6(81),XL6(81)
      DO 10 I = 1,N
      PR6(I) = 0.
      DFP6(I) = 0.
      XL6(I) = (FJ*XJCH3C(I) + RATE(1,I)*XOH(I)) * CDM(I)
      SPL6(I) = XL6(I)
   10 CONTINUE
      RETURN
      END
      SUBROUTINE DXL7 (PR7,DFP7,XL7,N)
      COMMON /INT81/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XNO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      COMMON /SPECON/ FJ,FJFC,TL
      COMMON /SPLOSS/ SPL1(81),SPL4(81),SPL5(81),SPL6(81),SPL9(81)
      COMMON /XXES/ X1(81),X2(81),X3(81),X4(81),X5(81),X6(81),X7(81),
     1 X8(81),X9(81),X10(81)
      DIMENSION PR7(81),DFP7(81),XL7(81)
      DO 10 I = 1,7
   10 XL7(I) = CDM(I)/(7.*8.64E4)
      DO 20 I = 8,11
   20 XL7(I) = CDM(I)/(10.*8.64E4)
      DO 30 I = 12,81
   30 XL7(I) = 0.0
      DO 40 I = 1,N
      DFP7(I) = 0.0
      PR7(I) = 3.0*SPL4(I)*X4(I) + 2.0*SPL5(I)*X5(I) + SPL6(I)*X6(I)
     1         + 2.0*SPL9(I)*X9(I)
   40 CONTINUE
      RETURN
      END
      SUBROUTINE DXL8(PR8,DFP8,XL8,N)
      COMMON /INT81/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XNO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SFACT/ FCL,FH2O,FCLNO3,FNO
      COMMON /XXES/ X1(81),X2(81),X3(81),X4(81),X5(81),X6(81),X7(81),
     1 X8(81),X9(81),X10(81)
      DIMENSION PR8(81),DFP8(81),XL8(81),XX(81)
      DO 10 I = 1,N
      ALP = (XJO3(I) + PJO3)/(RATE(34,I)*.21*CDM(I)**2)
      XX(I) = XCLO(I)*ALP
      XLA = RATE(9,I)*XNO2(I)
      XLB = RATE(7,I)*XOH(I)
      XLC = 2.0*RATE(42,I)*XNO2(I)*ALP
      XLD = RATE(10,I)*XNO2(I)*ALP
      XLE = RATE(19,I)*XOH(I)*ALP
      XLF = 2.0*RATE(31,I)*XX(I)
      XLG = 2.0*RATE(35,I)*ALP*CDM(I)*X8(I)
      XLH = 2.0*RATE(41,I)*XNO2(I)
      XL8(I) = (XLA+XLB+XLC+XLD+XLE+XLF+XLG)*CDM(I)
      XL8(I)=XL8(I)+XLH*CDM(I)
      PR8(I) = 2.0 * RATE(1,I) * CDM(I) * .21
      DFP8(I) = PR8(I) + RATE(11,I)*XNO2(I)*XNO(I)*FNO
      DFP8(I) = 0.
      RETURN
      END
```

```
      COMMON /INT31/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XHO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      COMMON /SPECON/ FJ,FJFC,TL
      COMMON /SPLOSS/ SPL1(81),SPL4(81),SPL5(81),SPL6(81),SPL9(81)
      DIMENSION PR9(81),DFP9(81),XL9(81)
      DO 10 I = 1,N
      PR9(I) = 0.
      DFP9(I) = 0.
      XL9(I) = FJ*XJCCL4(I)*CDM(I)
      SPL9(I) = XL9(I)
   10 CONTINUE
      RETURN
      END
      SUBROUTINE CXL11 (PR11,DFP11,XL11,N)
      COMMON /CHLOR/ XCL(81)
      COMMON /INT31/ XOH(81),XDID(81),XJN2O(81),XJCF3(81),XJCF2(81),
     1 XJCH3C(81),XJO2(81),XJO3(81),XHO2(81),XNO2(81),XO3(81)
     2,XJCCL4(81),XCLO(81),XNO(81)
      COMMON /MOLHYD/ XH(81),XH2O(81),PH2O,RH2,X11(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /SPECON/ FJ,FJFC,TL
      DIMENSION PR11(81),DFP11(81),XL11(81)
      DO 10 I = 1,N
      PR11(I) = RATE(16,I)*XH(I)*XHO2(I)+RATE(2,I)*XDID(I)*XH2O(I)*PH2O
      XL11(I) = (RATE(26,I)*XCL(I) + RATE(25,I)*XOH(I)
     1          + RATE(4,I)*XDID(I)) * CDM(I)
   10 CONTINUE
      RETURN
      END
      SUBROUTINE COEF (PR,XL,DFP)
C
C SUBROUTINE COEF TO COMPUTE ALL NEEDED VALUES FOR TRIDIA
C S.S. FT=0,FA=2,FB=0,FM=0; T.D. FT=1,FA=1,FB=1,FM=1
C EK=EDDY COEF,DM=AIR DENSITY,DF=INITIAL MIXING RATIO,N=NO.OF LAYERS
C THE VALUES OF B(1) AND C(N) ARE SPECIFIED BUT NOT USED
C
      COMMON /BC/ PJ,QU,RU,PL,QL,RL(1000)
      COMMON /COEF1/AA(81),BB(81),CC(81),DL(81),DJ(81),U(81)
      COMMON /COEF2/ A(81),B(81),C(81),F(81),X(81)
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)
      COMMON /PARA1/ STEP,QQU,PPL,PPU,N,M
      COMMON /TFCTR/ FT,FA,FB,FM
      REAL PR(81),XL(81),DFP(81),T(81),DD(81),DDR(81),S(81)
      IF (FT.EQ.1.)GO TO 5
      DO 2 I = 1,N
    2 DFP(I) = 0.
    5 DZ=1.0E+05
      DT=3.15576E7*STEP
      AA(1) = 2.0*CEK(1)*CDM(1)
      TT = AA(1)*J(1)
      NM1=N-1
      DO 10 I=1,N
   10 T(I)=0.5*XL(I)*DT/CDM(I)
      DO 50 I=2,NM1
      S(I)=PR(I)*DT/CDM(I)
      DD(I)=(-(FT +T(I)+U(I)*AA(I)))*FA
   50 DDR(I)=(-FT+T(I)+U(I)*AA(I))*FB
      IF (ABS(PL).LE.1.E-60)GO TO 60
C FLUXES ARE SPECIFIED BOTH AT TOP AND BOTTOM
      S(1)=2.0*RL(M)*DZ/PL
      DD(1) =-(FT/TT + T(1)/TT + 1.0)*FA
      DU(1)=1.0*FA
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      DDR(1) = (-FT/TT + T(1)/TT + 1.0)*FB
      F(1)=DDR(1)*DFP(1)-DU(1)*DFP(2)+S(1)
      GO TO 70
C FLUX AT TOP,SPECIFIED MIXING RATIO AT BOTTOM
   60 S(1)=RL(1)
      DD(1)=.5*FA
      DU(1)=0.*FA
      DDR(1)=-.5*FB
      F(1)=DDR(1)*DFP(1)+S(1)
   70 IF (ABS(QU).LE.1.E-60)GO TO 71
      IF (ABS(PU).LE.1.E-60)GO TO 72
      S(N)=0.
      DD(N)=(1.+QU*DZ)*FA
      DL(N)=-1.*FA
      DDR(N)=-DD(N)*FB
      GO TO 73
C  FLUX SPECIFIED AT TOP
   71 S(N) = 2.0*RU*DZ/PU
      DD(N) = 1.0*FA
      DL(N) = -1.0*FA
      DDR(N) = -1.0*FB
      GO TO 73
C  MIXING RATIO SPECIFIED AT TOP
   72 S(N) = RU
      DD(N) = 0.5*FA
      DL(N) = 0.
      DDR(N) = -.5*FB
   73 DO 80 I=2,NM1
      IM1=I-1
      IP1=I+1
   80 F(I)=-DL(I)*DFP(IM1)+DDR(I)*DFP(I)-DU(I)*DFP(IP1)-S(I)
      F(N)=-DL(N)*DFP(N-1)+DDR(N)*DFP(N)+S(N)
      DO 90 I=1,N
   90 A(I)=DD(I)
      DO 91 I=2,N
   91 B(I)=DL(I)
      DO 92 I=1,NM1
   92 C(I)=DU(I)
      B(1)=1.0
      C(N)=1.0
      DL(1)=1.
      DU(N)=1.
      RETURN
      END
      SUBROUTINE TRIDIA (N)
C SUBROUTINE TRIDIA TO COMPUTE MIXING RATIO
      COMMON /COEF2/ A(81),B(81),C(81),F(81),X(81)
      REAL ALPHA(81),GAMMA(81),G(81)
      IF (A(1).EQ.0.0) GO TO 100
      ALPHA(1)=A(1)
      GAMMA(1)=C(1)/ALPHA(1)
      NM1=N-1
      DO 10 I=1,NM1
      IF (ALPHA(I).EQ.0.0) GO TO 100
      GAMMA(I)=C(I)/ALPHA(I)
       IP1=I+1
   10 ALPHA(IP1)=A(IP1)-B(IP1)*GAMMA(I)
      G(1)=F(1)/ALPHA(1)
      DO 30 I=2,N
   30 G(I)=(F(I)-B(I)*G(I-1))/ALPHA(I)
      X(N)=G(N)
      DO 40 I=1,NM1
      J=N-I
   40 X(J)=G(J)-GAMMA(J)*X(J+1)
      GO TO 101
  100 WRITE (6,105) I
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  105 FORMAT (/,2X,*SINGULAR MATRIX - I =*,I3/)
  101 RETURN
      END
      SUBROUTINE REPCN (N1,OKPO3)
      LOGICAL OKPO3
      COMMON /JVAL/ CJO2(50),CJO3(50),CJCF2(50),CJCF3(50),CJCCL4(50),
     1              CJCH3C(50),CJCLO3(50),CJN2O(50),CJHNO3(50)
     2, CJH2O2(50),CJO31(50),CJN2O5(50)
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      REAL NO,NO2,NOX,NO3,N2O5
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),DCLX(41),NO3(41),N2O5(41),
     3 CLNO3(41)
      COMMON /XXES/ X1(81),X2(81),X3(81),X4(81),X5(81),X6(81),X7(81),
     1 X8(81),X9(81),X10(81)
      REAL     CLO1(41),NO21(41)
C
      N11 = (N1 - 1)/2
      E1MAX = 0.
      E2MAX = 0.
      DO 10 I = 1,N11
      L = 2*I - 1
      CLO1(I) = CLO(I)
      NO21(I) = NO2(I)
      ALP = (CJO3(I) + PJO3)/(RATE(34,L)*.21*DM(I)**2)
      O3(I) = X8(2*I - 1) * DM(I)
      O(I) = ALP * O3(I)
      CLX(I) = X7(L)*DM(I)
      NOX(I) = X2(L)*DM(I)
      CALL PNOX (I)
      CALL PCLOX(I)
      E1 = ABS((CLO(I) - CLO1(I))/CLO1(I))
      IF (E1.GT.E1MAX) E1MAX = E1
      E2 = ABS((NO2(I) - NO21(I))/NO21(I))
      IF (E2.GT.E2MAX) E2MAX = E2
      CLO(I) = (CLO(I) + CLO1(I))/2.
      NO2(I) = (NO2(I) + NO21(I))/2.
   10 CONTINUE
      IF (E1MAX.LT..010.AND.E2MAX.LT..010) OKPO3 = .TRUE.
      RETURN
      END
      SUBROUTINE O3LINT (X,Y,IL,IU)
      DIMENSION X(9,41),Y(9)
C
      IF (IU.LE.40) GO TO 5
      WRITE (6,600) IU
  600 FORMAT (1H0,* IN SUBROUTINE O3LINT, IU =*,I3,* - TOO HIGH FOR INTE
     1GRAND ARRAY*)
      STOP
C
    5 DO 10 I =1,9
      Y(I) = 0.
      DO 10 J = IL,IU
   10 Y(I) = Y(I) + (X(I,J) + X(I,J+1))*1.E5
C
      RETURN
      END
      SUBROUTINE PRINTX (I,LLL,LLU)
      COMMON /INTDEN/DO3INT(41),DMINT(41),DAINT(41)
      COMMON /JVAL/ CJO2(50),CJO3(50),CJCF2(50),CJCF3(50),CJCCL4(50),
     1              CJCH3C(50),CJCLO3(50),CJN2O(50),CJHNO3(50)
     2, CJH2O2(50),CJO31(50),CJN2O5(50)
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
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      COMMON /MOLHYD/ XH(81),XH2O(81),PH2O,RH2,X11(81)                  018550
      COMMON /NDATA/ CEK(81),CDM(81),CTEMP(81),CDA(81)                  018560
      COMMON /OLD/ OJO2(41),OJO3(41),OJCF2(41),OJCF3(41),OJCCL4(41),    018570
     1 OJCH3C(41),OJCLO3(41),OJN2O(41),OJHNO3(41),OJH2O2(41),OJO31(41), 018580
     2 OJN2O5(41),OLDDH(41),OO3INT(41),OO3(41)                          018590
      COMMON /PRODS/       PODDH(7,41),SODDH(9,41),O3INT(41),CLCH4(41), 018600
     1 YY(9),HHH(9,41)                                                  018610
      REAL NO,NO2,NOX,NO3,N2O5                                          018620
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),018630
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),   018640
     2 CL(41),CLO(41),HCL(41),CLX(41),DCLX(41),NO3(41),N2O5(41),        018650
     3 CLNO3(41)                                                        018660
      DIMENSION XL11(81)                                                018670
      COMMON /TRAPH2/ XL11                                              018680
      COMMON /XLS/ XL1(81),XL2(81),XL3(81),XL4(81),XL5(81),XL6(81),     018690
     1 XL7(81),XL8(81),XL9(81),XL10(81)                                 018700
      COMMON /XXES/ X1(81),X2(81),X3(81),X4(81),X5(81),X6(81),X7(81),   018710
     1 X8(81),X9(81),X10(81)                                            018720
      DIMENSION C1(41),C4(41),C5(41),C6(41),C9(41)                      018730
      REAL MCL(41),MCLO(41),MHCL(41),MCLNO3(41),M9(41)                  018740
C                                                                       018750
      CALL PAGE                                                         018760
      WRITE (6,601) I                                                   018770
      WRITE (6,602) (ALT(J),OJO2(J),OJO3(J),OJCF2(J),OJCF3(J),OJO31(J), 018780
     1              OO3(J),OO3INT(J),DMINT(J),OLDDH(J),J=LLL,LLU)       018790
      CALL PAGE                                                         018800
      WRITE (6,603) I                                                   018810
      WRITE (6,604) (ALT(J),OJCLO3(J),OJN2O(J),OJHNO3(J),OJH2O2(J),     018820
     1 OJN2O5(J),OJCCL4(J),OJCH3C(J),J=LLL,LLU)                         018830
C                                                                       018840
      CALL PAGE                                                         018850
      WRITE (6,1601)                                                    018860
      WRITE (6,602) (ALT(J),CJO2(J),CJO3(J),CJCF2(J),CJCF3(J),CJO31(J), 018870
     1              O3(J),DO3INT(J),DMINT(J),    DH(J),J=LLL,LLU)       018880
      CALL PAGE                                                         018890
      WRITE (6,1603)                                                    018900
      WRITE (6,604) (ALT(J),CJCLO3(J),CJN2O(J),CJHNO3(J),CJH2O2(J),     018910
     1 CJN2O5(J),CJCCL4(J),CJCH3C(J),J=LLL,LLU)                         018920
C                                                                       018930
      DO 10 J = LLL,LLU                                                 018940
      MCL(J) = CL(J)/DM(J)                                              018950
      MCLO(J) = CLO(J)/DM(J)                                            018960
      MHCL(J) = HCL(J)/DM(J)                                            018970
      MCLNO3(J) = CLNO3(J)/DM(J)                                        018980
   10 CONTINUE                                                          018990
      NLINE = LLU - LLL + 1                                             019000
      CALL PAGE                                                         019010
      CALL LINES (3+NLINE),RETURNS(315)                                 019020
  315 WRITE (6,605)                                                     019030
      WRITE (6,606)(K,ALT(K),H(K),OH(K),HO2(K),H2O2(K),O(K),O3(K),      019040
     1 O3INT(K),DID(K),K=LLL,LLU)                                       019050
      CALL LINES (3+NLINE),RETURNS(320)                                 019060
  320 WRITE (6,607)                                                     019070
      WRITE (6,608)(K,ALT(K),NO(K),NO2(K),HNO3(K),NO3(K),N2O5(K),NOX(K),019080
     1 K=LLL,LLU)                                                       019090
      CALL LINES (3+NLINE),RETURNS(325)                                 019100
  325 WRITE (6,609)                                                     019110
      WRITE (6,615) (K,ALT(K),CL(K),HCL(K),CLO(K),MCLO(K),MCL(K),       019120
     1 MHCL(K),CLNO3(K),MCLNO3(K),DCLX(K),K=LLL,LLU)                    019130
C                                                                       019140
      CALL LINES (7+NLINE),RETURNS(330)                                 019150
  330 WRITE (6,614)                                                     019160
      WRITE (6,615) (K,ALT(K),(HHH(J,K),J=1,9),K=LLL,LLU)               019170
      WRITE (6,714)                                                     019180
      WRITE (6,715) (YY(J),J=1,9)                                       019190
      CALL LINES (3+NLINE),RETURNS(335)                                 019200
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  335 WRITE (6,615)
      WRITE (6,606) (K,ALT(K),(PODOH(J,K),J=1,7),CLCH4(K),K=LLL,LLU)
      CALL LINES (3+NLINE),RETURNS(340)
  340 WRITE (6,618)
      WRITE (6,615) (K,ALT(K),(SOODH(J,K),J=1,9),K=LLL,LLU)
C
      CALL PRINT9 (X1,X2,X3,X4,X5,X6,X7,X9,X11,4HN2O ,4HNOX ,4HCH4 ,
     1 4HFC11,4HFC12,4HCH3C,4HCLX ,4HCCL4,4H H2 )
C  COMPUTE FLUX AT BOTTOM
      CALL TRAP (XL1,FN2O,1,81)
      CALL TRAP (XL2,FNOX,1,81)
      CALL TRAP (XL3,FCH4,1,81)
      CALL TRAP (XL4,FF11,1,81)
      CALL TRAP (XL5,FF12,1,81)
      CALL TRAP (XL6,FCH3C,1,81)
      CALL TRAP (XL7,FCLX,1,81)
      CALL TRAP (XL9,FCCL4,1,81)
      CALL TRAP (XL11,FH2,1,81)
      WRITE (6,70) FN2O,FNOX,FCH4,FF11,FF12,FCH3C,FCLX,FCCL4,FH2
C
      DO 100 J = LLL,LLU
      K = 2*J - 1
      C4(J) = X4(K) * CDM(K)
      C5(J) = X5(K) * CDM(K)
      C6(J) = X6(K) * CDM(K)
      C9(J) = X9(K) * CDM(K)
      C1(J) = X1(K) * CDM(K)
      M8(J) = O3(J)/DM(J)
  100 CONTINUE
      CALL PAGE
      WRITE (6,611)
      WRITE (6,608) (K,ALT(K),M8(K),C4(K),C5(K),C6(K),C9(K),
     1 CLX(K),K=LLL,LLU)
      CALL PAGE
      WRITE (6,612)
      WRITE (6,613) (K,ALT(K), C1(K),NOX(K),CH4(K),K=LLL,..U)
      RETURN
C
   70 FORMAT (1H0,3X,*FN2O =*,1PE13.5,4X,*FNOX =*,E13.5,4X,
     1 *FCH4 =*,E13.5,4X,*FF11 =*,E13.5,4X,*FF12 =*,E13.5//
     2 4X,*FCH3C =*,E13.5,4X,*FCLX =*,E13.5,4X,*FCCL4 =*,E13.5,
     3 4X,*FH2 =*,E13.5)
  601 FORMAT (1H0,5X,*LAST ITERATION =*,I3     // 5X,*ALT*,6X,*CJO2*, 7X,
     1 *CJO3*, 6X,*CJCF2*, 6X,*CJCF3*,6X,*CJO31*,5X,*PREVO3*,5X,
     2 *DO3INT*,5X,*DMINT*,6X,*PREVOH*//)
  602 FORMAT (1H ,0PF9.0, 1P09E11.3)
  603 FORMAT (1H0,5X,*LAST ITERATION =*,I3     //
     A                                  6X,*ALT*,5X,*CJCLO3*,5X,*CJN2O*,
     1 6X,*CJHNO3*,5X,*CJH2O2*,5X,*CJN2O5*,5X,*CJCCL4*,4X,*CJCH3CL*//)
  604 FORMAT (1H ,0PF9.0, 1P07E11.3)
  605 FORMAT (1H0,2X,*K*,7X,*ALT*, 9X,*H*,12X,*OH*,12X,*HO2*,11X,*H2O2*,
     1 11X,*O*,13X,*O3*,10X,*O3INT*,9X,*O(**D)*/)
  606 FORMAT (1H , I3,0PF11.0,1P8E14.4)
  607 FORMAT (1H0,2X,*K*,7X,*ALT*, 9X,*NO*,13X,*NO2*,12X,*HNO3*,11X,
     1 *NO3*,12X,*N2O5*,10X,* NOX*/)
  608 FORMAT (1H , I3,0PF11.0,1P6E15.4)
  609 FORMAT (1H0,1X,*K*,7X,*ALT*,15X,*CL*,23X,*CLO*,23X,*HCL*,22X,
     1 *CLNO3*,15X,*OCLX*/)
  610 FORMAT (1H , I3,0PF11.0,1P5E15.4)
  611 FORMAT (1H0,2X,*K*,7X,*ALT*,8X,*MR O3*,11X,*FC11*,11X,*FC12*,10X,
     1 *CH3CL*,11X,*CCL4*,11X,*CLX*/)
  612 FORMAT (1H0,2X,*K*,7X,*ALT*, 9X,*N2O*,12X,*NOX*,12X,*CH4*/)
  613 FORMAT (1H ,I3,0PF11.0,1P3E15.4)
  614 FORMAT (1H0,1X,*K*,7X,*ALT*,6X,*H + O3*,7X,*OH + O3*,5X,
     1 *HO2 + O3*,6X,*HO2 + O*,6X,*OH + O*,7X,*NO2 + O*,6X,*CLO + O*,
     2 6X,*O + O3*, 7X,*O2 + HV*/)
```

```
  615 FORMAT (1H ,I2,0PF11.0,1P9E13.4)
  616 FORMAT (1H0,2X,*K*,7X,*ALT*,6X,*H2O + HV*,6X,*H2O + O1D*,5X,
     1 *CH4 + O1D*,5X,*HNO3 + HV*,5X,*CO + OH*,7X,*NO + HO2*,5X,
     2 *JH2O2+H2O2*,5X,*CL + CH4*/)
  617 FORMAT (1H , I3,0PF11.0,1P7E15.4)
  618 FORMAT (1H0,2X,*K*,7X,*ALT*,5X,*H2O2 + OH*,4X,*HO2 + OH*,5X,
     1 *HCL + OH*,5X,*CH4 + OH*,5X,*OH + HO2*,5X,*OH + HNO3*,5X,
     2 *OH + OH*,5X,*H + HO2*,5X,*CL + HO2*/)
  714 FORMAT (1H0,* INTEGRATED LOSS FOR OZONE*/)
  715 FORMAT (1H ,13X,1P9E13.4)
 1601 FORMAT (1H0,5X,*LAST ITERATION  +  1*    // 5X,*ALT*,6X,*CJO2*, 7X,
     1 *CJO3*, 6X,*CJCF2*, 6X,*CJCF3*,6X,*CJO31*,5X,*PREVO3*,5X,
     2 *DO3INT*,5X,*DMINT*,6X,*PREVOH*//)
 1603 FORMAT (1H0,5X,*LAST ITERATION  +  1*//
     A                                  6X,*ALT*,5X,*CJCLO3*,5X,*CJN2O*,
     1 6X,*CJHNO3*,5X,*CJH2O2*,5X,*CJN2O5*,5X,*CJCCL4*,4X,*CJCH3CL*//)
C
      END
      SUBROUTINE TRAP (XX,XXX,N1,N2)
      DIMENSION XX(81)
      XXX = (XX(N1) + XX(N2))*.5
      N1P1 = N1 + 1
      N2M1 = N2 - 1
      DO 10 I = N1P1,N2M1
   10 XXX = XXX + XX(I)
      XXX = XXX*1.0E5
      RETURN
      END
      SUBROUTINE PRINT9 (X1,X2,X3,X4,X5,X6,X7,X8,X9,HD1,HD2,HD3,HD4,HD5,
     1                   HD6,HD7,HD8,HD9)
      DIMENSION X1(81),X2(81),X3(81),X4(81),X5(81),X6(81),X7(81),X8(81),
     1 X9(81)
      COMMON /MODEL/ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
  600 FORMAT (1H0,6X,*ALT*,2X,9(6X,A4,3X)/)
  601 FORMAT (1X,0PF11.0,1P9E13.4)
  603 FORMAT (1H0,5X,*MIXING RATIOS:*/)
C
      CALL PAGE
      WRITE (6,603)
      WRITE (6,600) HD1,HD2,HD3,HD4,HD5,HD6,HD7,HD8,HD9
      DO 60 I = 1,41
   60 WRITE (6,601)  ALT(I),X1(2*I-1),X2(2*I-1),X3(2*I-1),X4(2*I-1),
     1  X5(2*I-1),X6(2*I-1),X7(2*I-1),X8(2*I-1),X9(2*I-1)
      RETURN
      END
      SUBROUTINE INPUT(KEYS,N,IC,IFORM,TITLE,K),RETURNS(A)
C
      REAL NAME
      INTEGER KEYS(N),TITLE(13),KEYW(5),KEY(3),BLANK
      DATA KEYW/4HPARA,4HCOMM,4HCOMP,4HENDJ,4H9999/,BLANK/1H /,
     X NAME/5HINPJT/
C
   10 READ(5,5010)KEY,IC,IFORM,TITLE,JF
 5010 FORMAT(3A4,I3,I3,2X,12A4,2A2)
      IF(EOF(5))800,15
   15 IF(IC)20,49,22
   20 IC=-IC
      REWIND IC
   22 CALL PAGE
      CALL LINES(4),RETURNS(25)
   25 WRITE(6,6025)IC,TITLE
 6025 FORMAT(/T21,*TAPE*,I2,T31,*LABEL=*,12A4,A2//)
      IF(JF.NE.BLANK)CALL INE(IC,.TRUE.)
      READ(IC,5010)KEY,K,IFORM,TITLE,JF
      IF(EOF(IC))800,50
   49 IC=5
```

```
   50 DO 60 K=1,5
      IF(KEY(1).EQ.KEYW(K))GO TO (100,200,10,400,10),K
   60 CONTINUE
      DO 80 K=1,N
      IF(KEY(1).EQ.KEYS(K))GO TO 90
   80 CONTINUE
      CALL ERRX(80,NAME)
   90 IF(IC.EQ.5)CALL PAGE
      WRITE(6,6090)KEY,TITLE,IC
 6090 FORMAT(/T2,3A4,T21,12A4,A2,T81,*(UNIT *,I2,*)*/)
      CALL LINES(3),RETURNS(95)
   95 RETURN
  100 CALL INPARM
      GO TO 10
  200 CALL INE(IC,.TRUE.)
      GO TO 10
  800 CALL ERRM(800,NAME),RETURNS(400)
  400 RETURN A
      END
      SUBROUTINE PAGE
C     ******************************************************************
C     PRINTS PAGE HEADER AND KEEPS TRACK OF LINE COUNT
C     VERSION 1.0  LEVEL 711122
C     ******************************************************************
      INTEGER ICODE,IRUN,NPAGE
      REAL TITLE(6)
      COMMON /HEAD/ TITLE,ICODE,VERS,LEVEL,DAT, IRUN,NPAGE,NLOG
      COMMON/LINUM/LINE
C     ------------------------------------------------------------------
      LINE=4
      NPAGE=NPAGE+1
      WRITE (6,2030) ICODE,IRUN,TITLE,VERS,LEVEL,DAT, NPAGE
 2030 FORMAT(*1*,I3,I6,5X,6A8,* VERSION *,F5.1,*  (*,I6,*)*,11X,
     X   A10,10X,*PAGE *,I3/1X,127(*-*))
      RETURN
      END
      SUBROUTINE LINES(N),RETURNS(A)
C     ******************************************************************
C     VERSION 1.0   LEVEL 760921
C     ******************************************************************
      REAL TITLE(6)
      INTEGER ICODE,IRUN,NPAGE,LCT
      COMMON /HEAD/ TITLE,ICODE,VERS,LEVEL,DATE,IRUN,NPAGE,NLOG
      COMMON/LINUM/LINE
      DATA LCT/61/
C     ------------------------------------------------------------------
      LINE=LINE+N
      IF(LINE.LT.LCT) RETURN
      LINE=N+4
   30 NPAGE=NPAGE+1
      WRITE(6,2030) ICODE,IRUN,TITLE,VERS,LEVEL,DATE,NPAGE
 2030 FORMAT(*1*,I3,I6,5X,6A8,* VERSION *,F5.1,*  (*,I6,*)*,11X,
     X   A10,10X,*PAGE *,I3/1X,127(*-*))
      RETURN A
      END
      SUBROUTINE INE(IC,PRINT)
C     ******************************************************************
C     VERSION 1        LEVEL 720602
C     READS AND PRINTS COMMENTS CARDS
C     ******************************************************************
      REAL NAME
      LOGICAL PRINT
      INTEGER IFORM,IF(3),COM(13),BLANK
      DATA IF/1H ,1H0,1H1/,NAME/3HINE/,BLANK/1H /
C     ------------------------------------------------------------------
   10 READ(IC,5010)    IFORM,COM,JF
```

```
 5010 FORMAT(14X,A1,5X,12A4,A2,A2)
      IF(.NOT.PRINT)    GO TO 50
      DO 20    I=1,3
      IF(IFORM.EQ.IF(I))    GO TO (30,30,40),I
   20 CONTINUE
      CALL ERRX(20,NAME)
   30 CALL LINES(I),RETURNS(32)
   32 WRITE(6,6032)    IF(I),COM
 6032 FORMAT(A1,T21,12A4,A2)
      GO TO 50
   40 CALL PAGE
      I=2
      GO TO 30
   50 IF(JF.NE.BLANK)    GO TO 10
      RETURN
      END
      SUBROUTINE DAY
C     ******************************************************************
C     VERSION 1.0    LEVEL 760921
C     ******************************************************************
      REAL TITLE(5)
      COMMON /HEAD/ TITLE,ICODE,VERS,LEVEL,DAT,IRUN,NPAGE,NLOG
C     ------------------------------------------------------------------
      DAT = DATE(D)
      RETURN
      END
      SUBROUTINE ERRX(N,NAME)
C     ******************************************************************
C     VERSION 2    LEVEL 720421
C     ******************************************************************
      INTEGER N
      REAL NAME
C     ------------------------------------------------------------------
      WRITE(6,6000) N,NAME
 6000 FORMAT(*0EXECUTION TERMINATED DUE TO ERROR NO. *,I4,* IN *,A8)
      STOP
      END
      SUBROUTINE ERRM(N,NAME)
C     ******************************************************************
C     VERSION 1.0    LEVEL 760921
C     ******************************************************************
      INTEGER N
      REAL NAME
C     ------------------------------------------------------------------
      WRITE(6,6100)    N,NAME
 6100 FORMAT(*0ERROR NO. *,I4,* IN *,A8/)
      RETURN
      END
      SUBROUTINE QSCATT
C.....................................................................
C
C        CHLORINE MODEL STUDY PROGRAM
C
C
C        SUBROUTINE QSCATT COMPUTES AEROSOL AND MOLECULAR EXTINCTION
C        COEFFICIENTS
C        QRAY(J)= RAYLEIGH SCATTERING COEFFICIENT
C        QAE(J)= AEROSOL EXTINCTION COEFFICIENT
C        QAA(J)= AEROSOL ABSORBTION COEFFICINT
C
C        SIZE DISTRIBUTION PARAMETER ISIZE= 1 (RURAL) FROM SELBY ET AL
C                                           2 (MARITIME)        (1976)
C                                           3 (URBAN)
C                                           4 (TROPOSPHERE)
C                                           5 (SPECIAL)
C        TO INPUT SPECIAL MODEL DIMENSION ALAM(8) AND QE(5).QA(5)
```

```
C       N= # OF WAVELENGTH INTERVALS AEROSOL DATA DIGITIZED
C       ALAM= ARRAY OF WAVELENGTH VALUES CORRESPONDING TO DIGITIZATION
C.......................................................................
      COMMON /SCAPAR/QRAY(100),QAE(100),QAA(100)
      COMMON /SOLCON/WL(100),FL(100),QO2(100),QO3(100)
      COMMON /PARM/ ISWIT,TSTEP,TSTOP,TLOOP,ITPRNT,ISIZE,ISCATT
      DIMENSION ALAM(8),QE(5,8),QA(5,5)
      DATA ALAM/.200,.250,.300,.400,.488,.550,.694,.860/
      DATA  IL,IU,N/1,99,7/
C
C       SPECIFY AEROSOL MODEL
      GO TO (1,2,3,4,5)ISIZE
C       RURAL
1     QE(1,1)=.38223
      QE(1,2)=.32979
      QE(1,3)=.28540
      QE(1,4)=.22026
      QE(1,5)=.17989
      QE(1,6)=.15800
      QE(1,7)=.12064
      QE(1,8)=.09151
      QA(1,1)=.07945
      QA(1,2)=.03661
      QA(1,3)=.02110
      QA(1,4)=.01317
      QA(1,5)=.01114
      QA(1,6)=.01095
      QA(1,7)=.00968
      QA(1,8)=.01058
      GO TO 20
C       MARITIME
2     QE(2,1)=.20932
      QE(2,2)=.19518
      QE(2,3)=.18479
      QE(2,4)=.17032
      QE(2,5)=.16213
      QE(2,6)=.15800
      QE(2,7)=.15001
      QE(2,8)=.14412
      QA(2,1)=.02054
      QA(2,2)=.00864
      QA(2,3)=.00442
      QA(2,4)=.00243
      QA(2,5)=.00193
      QA(2,6)=.00186
      QA(2,7)=.00155
      QA(2,8)=.00171
      GO TO 20
C       URBAN
3     QE(3,1)=.31030
      QE(3,2)=.28416
      QE(3,3)=.25805
      QE(3,4)=.20867
      QE(3,5)=.17631
      QE(3,6)=.15900
      QE(3,7)=.12601
      QE(3,8)=.10071
      QA(3,1)=.10692
      QA(3,2)=.08649
      QA(3,3)=.07571
      QA(3,4)=.06376
      QA(3,5)=.05674
      QA(3,6)=.05282
      QA(3,7)=.04528
      QA(3,8)=.04022
      GO TO 20
```

```
C       TROPOSHERE
4     QE(4,1)=.40212
      QE(4,2)=.34505
      QE(4,3)=.29674
      QE(4,4)=.22585
      QE(4,5)=.18187
      QE(4,6)=.15800
      QE(4,7)=.11722
      QE(4,8)=.08537
      QA(4,1)=.08042
      QA(4,2)=.03451
      QA(4,3)=.01767
      QA(4,4)=.00371
      QA(4,5)=.00772
      QA(4,6)=.00745
      QA(4,7)=.00619
      QA(4,8)=.00683
      GO TO 20
5     CONTINUE
C       INPUT SPECIAL MODEL
20    DO 40 J=IL,IU
      WLM1C=WL(J)/1.0E4
      QRAY(J)=(9.507E-20)*(1.0E4/WLM1C)**4.0117
      QRAY(J)=QRAY(J)*1.E-5
      IF(WLM1C.LT.0.2)GO TO 35
      DO 30 K=1,N
      KP1=K+1
      IF(WLM1C.GE.ALAM(K).AND.WLM1C.LE.ALAM(KP1))GO TO 31
30    CONTINUE
31    XD=WLM1C-ALAM(K)
      QAE(J)=(QE(ISIZE,KP1)-QE(ISIZE,K))*XD/(ALAM(KP1)-ALAM(K))+
     1 QE(ISIZE,K)
      QAE(J)=QAE(J)*1.E-5
      QAA(J)=(QA(ISIZE,KP1)-QA(ISIZE,K))*XD/(ALAM(KP1)-ALAM(K))+
     1 QA(ISIZE,K)
      QAA(J)=QAA(J)*1.E-5
      GO TO 40
35    QAE(J)=0.0
      QAA(J)=0.0
40    CONTINUE
      WRITE(6,101)ISIZE
101   FORMAT(* AEROSOL MODEL =*,I4)
      WRITE(6,105)
105   FORMAT(3X,*J*,11X,*WL(J)*,8X,*QRAY(J)*,9X,*QAE(J)*,9X,*QAA(J)*)
      DO 50 J=IL,IU
      WRITE(6,102)J,WL(J),QRAY(J),QAE(J),QAA(J)
102   FORMAT(I4,4E15.4)
50    CONTINUE
      RETURN
      END
      SUBROUTINE OMEGA(NT,IL,IU,GMU)
C.....................................................................
C     SUBROUTINE OMEGA COMPUTES SINGLE SCATTERING ALBEDO PROFILE AND
C     OPTICAL DEPTH AS A FUNCTION OF ALTITUDE
C     SINGLE SCATTERING ALBEDO PROFILE AS A FUNCTION OF TAU COMPUTED
C     FOR INPUT TO VIM
C
C     MEAN INTENSITY RETURNED AS A FUNCTION OF TAU REINTERPOLATED
C     FOR ALTITUDE LEVELS
C
C     RETURN TO COMPJ
C.....................................................................
      COMMON /SCAPAR/QRAY(100),QAE(100),QAA(100)
      COMMON /SOLCON/WL(100),FL(100),QO2(100),QO3(100)
      COMMON /INTDEN/DO3INT(41),DMINT(41),DAINT(41)
      COMMON /MODEL/ALT(41).TEMP(41).DM(41).DID(41).DA23(41)
```

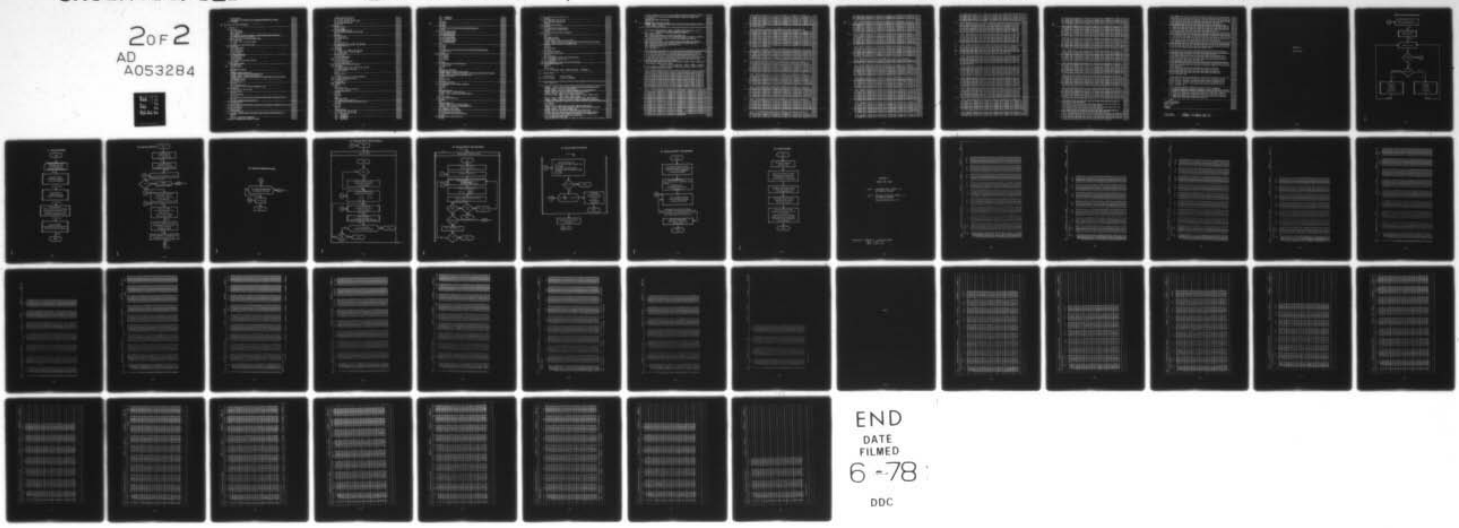
```
      COMMON /SPECIE/H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),OCLX(41),NO3(41),N2O5(41),
     3 CLNO3(41)
      COMMON /VRP/TAUZ(41,100),OMEGAZ(41,100),TAU(41),OMEGAT(41)
      COMMON/SCA/TAUINT(100),F(41,100),FAV(41,100),FLUX(41)
      COMMON /PARA/ U0,N,N1,N2,NN,NNP1,REF
      DIMENSION IN(100),INN(100),II(41)
C
C     COMPUTE OPTICAL DEPTH AND ALBEDO AS A FUNCTION OF
C     WAVELENGTH FOR EACH LEVEL
      PO2=0.21
      U0=GMU
      DO 20 I=1,NT
      DO 10 J=IL,IU
      TAUZ(I,J)=QO3(J)*DO3INT(I)+QO2(J)*PO2*DMINT(I)+QRAY(J)*DMINT(I)
     1 /DM(1)+QAE(J)*DAINT(I)/DA23(1)
      GAMSCA=QRAY(J)*DM(I)/DM(1)+(QAE(J)-QAA(J))*DA23(I)/DA23(1)
      GAMEXT=QAE(J)*DA23(I)/DA23(1)+QRAY(J)*DM(I)/DM(1)+QO3(J)*
     1 O3(I)+QO2(J)*PO2*DM(I)
      OMEGAZ(I,J)=GAMSCA/GAMEXT
      IF(I.NE.NT)GO TO 10
      TZ=TAUZ(1,J)
      N=TZ/.5+1.6
      IF(N.LT.3)N=3
      IF(N.GT.21)N=21
      IN(J)=N
      NN=(N-1)*2
      IF(TZ.LE.1.)NN=10
      IF(TZ.GT.1..AND.TZ.LE.3.)NN=(N-1)*5
      IF(TZ.GT.3..AND.TZ.LE.5.)NN=(N-1)*3
      INN(J)=NN
      TAUINT(J)=TZ/NN
10    CONTINUE
20    CONTINUE
C     COMPUTE SINGLE SCATTERING ALBEDO VS TAU AT EQUAL TAU INTERVALS
      DO 50 J=IL,IU
      NN=INN(J)
      NNP1=NN+1
      II(1)=1
      II(NNP1)=NT
      TAU(1)=TAUZ(1,J)
      TAU(NNP1)=0.0
      OMEGAT(1)=OMEGAZ(1,J)
      OMEGAT(NNP1)=OMEGAZ(NT,J)
      DO 40 K=2,NN
      KK=NNP1-K
      TAU(K)=TAUINT(J)*KK
      DO 30 I=1,NT
      IM1=I-1
      DELTAU=TAU(K)-TAUZ(I,J)
      IF(DELTAU)30,35,35
30    CONTINUE
      GO TO 40
35    OMEGAT(K  )=(OMEGAZ(IM1,J)-OMEGAZ(I,J))*DELTAU/(TAUZ(IM1,J)
     1 -TAUZ(I,J))+OMEGAZ(I,J)
      II(K)=I
40    CONTINUE
      NN=INN(J)
      NNP1=NN+1
      N=IN(J)
      N1=N-1
      N2=N-2
      DO 85 I=1,NT
      IF(OMEGAZ(I,J).GT..05)GO TO 88
85    CONTINUE
```

```
      DO 86 I=1,NT
      FR=0.
      IF(-TAUZ(1,J)/GMU.LT.-70.)GO TO 87
      FR=GMU*2.*REF*E2(TAUZ(1,J)-TAUZ(I,J))*EXP(-TAUZ(1,J)/GMU)
87    F(I,J)=FR
      IF(-TAUZ(I,J)/GMU.LT.-70.)GO TO 86
      F(I,J)=EXP(-TAUZ(I,J)/GMU)+FR
86    CONTINUE
      GO TO 50
88    CALL VIM
C     CONVERT FLUX FROM TAU TO Z LEVELS FOR COMPJ
      F(1,J)=FLUX(1)
      F(NT,J)=FLUX(NNP1)
      DO 70 K=2,NN
      IKL=II(K)
      IKU=II(K+1)
      IF(IKL.EQ.IKU)GO TO 70
      IKU=IKU-1
      DO 60 I=IKL,IKU
      KP1=K+1
      TAUEXP=TAU(K)-TAUZ(I,J)
      TAUEXP=TAUEXP/TAUINT(J)
      F(I,J)=(FLUX(KP1)**TAUEXP)*(FLUX(K)**(1.-TAJEXP))
60    CONTINUE
70    CONTINUE
50    CONTINUE
      RETURN
      END
      SUBROUTINE VIM
C.....................................................................
C     VARIATIONAL ITERATIVE METHOD CALCULATES ATMOSPHERIC MULTIPLE
C     SCATTERING AND SURFACE REFLECTION EFFECTS WHICH AFFECT PHOTO-
C     DISSOCIATION RATES
C
C     INPUT INFORMATION INCLUDES SURFACE REFLECTION COEFFICIENT,
C     SINGLE SCATTERING ALBEDO AND OPTICAL DEPTH PROFILES
C     RESULTANT FLUX ADJUSTMENT PROFILE RETURNS TO OMEGA
C
C     ADAPTED FROM H. K. BURKE, E.R.T.,INC. 1977
C.....................................................................
      LOGICAL LINEQN
      REAL M,MIN,INT
      COMMON /PARA/U0,N,N1,N2,NN,NNP1,REF
      COMMON/SCA/TAUINT(100),Q(41,100),FAV(41,100),FLUX(41)
      COMMON /VRP/TAUZ(41,100),OMEGAZ(41,100),TAU(41),OMEGAT(41)
      COMMON /MATRIX/M(20,21)
      COMMON /MESH/ T(21),G(101),W(21)
      COMMON /EFUN/ E3T(21),E2T(101),E3TT(101),E3T1(101),E2TT(101)
      COMMON /COEFF/ A(20),AA(20)
      DIMENSION S1(101),T1(101),S0(101)
      DIMENSION SS2(101),F(101),F0(101),F1(101),F2(101)
      DIMENSION GG(101),FF(21),WW(101)
      DIMENSION U(50),INT(50),GA(101)
      DIMENSION E3(101),EX(101)
    4 FORMAT(/*1*,6X,*MATRIX ELEMENTS, WL=*,I4)
    5 FORMAT(    4X,1P11E11.3)
    6 FORMAT(//,9X,*TA*,8X,*A(J)*,10X,*AA(J)*)
    7 FORMAT(   6X,E9.3,2E16.6)
    9 FORMAT(  * SINGULAR MATRIX*)
   11 FORMAT(*1*,9X,*T1*,9X,*1ST ITERATION*,5X,*OMEGA*)
   12 FORMAT(   6X,E9.3,5X,E14.6,5X,E14.6)
   13 FORMAT(///,6X,*ITERATION= *,I5,/,9X,*T1*,9X,*NEW ITERA*,9X,*LAST
     1ITERA*,9X,*DEL*)
   14 FORMAT(   6X,E9.3,3(5X,E14.6))
   16 FORMAT(//,5X,*NOT CONVERGE*)
   17 FORMAT(4X,F7.3,5(5X,E14.6))
```

```
   18 FORMAT(///,7X,*T*,10X,*F*,19X,*=0*,18X,*F1*,18X,*F2*,18X,*F3*)
C
C     DEFINE T1 AND WW SUCH THAT K=1 CORRESPONDS TO TOP OF ATMOSPHERE,
C     K=NNP1 IS BOTTOM OF ATMOSPHERE
C
      DO 111 K=1,NNP1
      NK=NNP1-K+1
      T1(K)=TAU(NK)
111   WW(K)=OMEGAT(NK)
      DO 45 K=1,NNP1
      E2T(K)=E2(T1(K))
      E3T1(K)=E3(T1(K))
      E2TT(K)=E2(T1(NNP1)-T1(K))
      E3TT(K)=E3(T1(NNP1)-T1(K))
      EX(K)=EXP(-T1(K)/U0)
45    CONTINUE
      DT=T1(NNP1)/N1
      K=0
      L=NN/N1+.1
C
C     COMPUTE T AND W PROFILES
C
      T(N)=DT*N1
      E3T(N)=E3(T(N))
      DO 10 J=1,N1
      T(J)=DT*(J-1)
      E3T(J)=E3(T(J))
      SUM=0.
      DO 15 KK=1,L
      K=K+1
      SUM=SUM+WW(K)
15     W(J)=SUM/L
10     CONTINUE
      DO 46 K=1,NNP1
      S0(K)=.5*WW(K)*(E2TT(K)*U0*REF+.5)*EX(K)
46    CONTINUE
      CALL RMATRI
      DO 20 J=1,N1
      FF(J)=M(J,N)
   20 CONTINUE
      IF (LINEQN(N-1)) GO TO 100
      DO 25 J=1,N1
      TA    =(T(J)+T(J+1))*0.5
C
C THIS IS T AVERAGE FOR EACH LAYER
C
      A(J)=M(J,N)
C
C THIS IS SOLUTION TO MATRIX EQN
C
      AA(J)=SQRT(W(J))*A(J)
C
C THIS IS AVERAGE SOURCE IN THE INTERVAL
C
   25 CONTINUE
      GO TO 200
  100 WRITE(6,9)
      GO TO 400
  200 S2=0.
      DO 40 J=1,N1
      JP1=J+1
      SS2(J)=AA(J)*(E3(T(N)-T(JP1))-E3(T(N)-T(J)))
      S2=S2+SS2(J)
   40 CONTINUE
      DO 30 K=1,NNP1
      K=T1(K)
```

AD-A053 284 ENVIRONMENTAL RESEARCH AND TECHNOLOGY INC CONCORD MASS F/G 4/1
DEVELOPMENT OF THE RADIATIVE TRANSFER PORTION OF A 1-D PHOTOCHE--ETC(U)
MAR 78 R G ISAACS, H K BURKE, N TRIPP F19628-77-C-0078
UNCLASSIFIED ERT-P-2994F AFGL-TR-77-0293 NL

2 OF 2
AD
A053284



END
DATE
FILMED
6-78
DDC

```
      S1(K)=S11(X)
      G(K)=S0(K)+.5*WW(K)*S1(K)+.5*WW(K)*REF*E2TT(K)*S2*2.
   30 CONTINUE
C
C RESULT OF 1ST ITERATION
C
      II=2
  300 DIFF=0.
      CALL COMP(SG)
      DO 35 K=1,NNP1
      GG(K)=G(K)
      G(K)=S0(K)+.5*WW(K)*S1NT(K)+.5*WW(K)*REF*E2TT(K)*SG*2.
      DEL=ABS((GG(K)-G(K))/G(K))
C     WRITE (6,14) T1(K),G(K),GG(K),DEL
   35 DIFF=DIFF+DEL
      IF (DIFF .LE. .1) GO TO 400
      II=II+1.
      IF (II .LT. 10.) GO TO 300
  400 CONTINUE
      Y=EXP(-T(N)/U0)
      CALL COMP(SG)
      DO 50 K=1,NNP1
      F0(K)=EX(K)
      F1(K)=2.*S1NT(K)
      X=2.*REF*E2TT(K)
      F2(K)=X*SG*2.
      F3(K)=X*U0*Y
      F(K)=F0(K)+F1(K)+F2(K)+F3(K)
   50 CONTINUE
      DO 333 K=1,NNP1
      NK=NNP1-K+1
333   FLJX(K)=F(NK)
      END
      SUBROUTINE RMATRI
      REAL M
      COMMON /MATRIX/M(20,21)
      COMMON /PARA/U0,N,N1,N2,NN,NNP1,REF
      COMMON /MESH/ T(21),G(101),W(21)
      COMMON /EFUN/ E3T(21),E2T(101),E3TT(101),E3T1(101),E2TT(101)
      DIMENSION DH(21)
      DIMENSION TJ(21)
      DO 10 J=1,N1
      JP1=J+1
      DH(J)=T(JP1)-T(J)
      M(J,J)=DH(J)-W(J)*(DH(J)+E3(DH(J))-.5)
   10 CONTINUE
      IF (N .EQ. 3) GO TO 100
      DO 20 I=1,N2
      IP1=I+1
      DO 20 J=IP1,N1
      JP1=J+1
      EE=  E3(T(J)-T(I))-E3(T(J)-T(IP1))-E3(T(JP1)-T(I))+E3(T(JP1)-
     1T(IP1))
      M(I,J)=.5*SQRT(W(I)*W(J))*EE
   20 M(J,I)=M(I,J)
      GO TO 200
  100 M(1,2)=.5*SQRT(W(1)*W(2))*(E3(DH(1))+E3(DH(2))-E3(DH(1)+DH(2))-.5)
      M(2,1)=M(1,2)
  200 DO 30 J=1,N1
      TU(J)=T(J)
      TU(J+1)=T(J+1)
   30 M(J,N)= .25*U0*(EXP(-TU(J)/U0)-EXP(-TU(J+1)/U0))*(W(J))**.5
      RETURN
      END
      LOGICAL FUNCTION LINEQN(N)
C GAUSSIAN ELIMINATION METHOD IS USED
```

```
      COMMON/MATRIX/A(20,21)
      IF (N .GT. 1) GO TO 10
      IF (A(1,1).EQ.0.) GO TO 500
      A(1,2)=A(1,2)/A(1,1)
      GO TO 420
   10 SUM=0.
      DO 20 I=1,N
      DO 20 J=1,N
   20 SUM=SUM+ABS(A(I,J))
      TOLER=(SUM/FLOAT(N)**2)*1.E-10
      N1=N-1
      NP1=N+1
      DO 300 K=1,N1
      TEMP=ABS(A(K,K))
      ITEMP=K
      KP1=K+1
      DO 100 I=KP1,N
      IF(ABS(A(I,K)).LE.TEMP) GO TO 100
      TEMP=ABS(A(I,K))
      ITEMP=I
  100 CONTINUE
      IF (TEMP .LE. TOLER) GO TO 500
      IF (ITEMP .EQ. K) GO TO 200
      DO 110 I=K,NP1
      TEMP=A(K,I)
      A(K,I)=A(ITEMP,I)
  110 A(ITEMP,I)=TEMP
  200 DO 210 I=KP1,N
      A(I,K)=A(I,K)/A(K,K)
      DO 210 J=KP1,NP1
  210 A(I,J)=A(I,J)-A(I,K)*A(K,J)
  300 CONTINUE
      IF (ABS(A(N,N)) .LE. TOLER) GO TO 500
      A(N,NP1)=A(N,NP1)/A(N,N)
      DO 410 I=1,N1
      K=N-I
      DO 400 J=1,I
      L=NP1-J
  400 A(K,NP1)=A(K,NP1)-A(K,L)*A(L,NP1)
  410 A(K,NP1)=A(K,NP1)/A(K,K)
  420 LINEQN=.FALSE.
      GO TO 600
  500 LINEQN=.TRUE.
  600 RETURN
      END
      FUNCTION E2(X)
      IF (X .LE. 1.0E-6) GO TO 1
      E2=EXP(-X)-X*E(X)
      RETURN
    1 E2=1.0
      RETURN
      END
      FUNCTION E3(X)
      IF (X.LE.1.0E-6) GO TO 1
      E3=(EXP(-X)-X*(EXP(-X)-X*E(X)))*0.5
      RETURN
    1 E3= .5
      RETURN
      END
      FUNCTION E(X)
      IF (X.GE.10.) GO TO 200
      IF (X.GE.1.0) GO TO 100
      A0=- .57721566
      A1=  .99999193
      A2=- .24991055
      A3=  .05519968
```

```
      A4=- .00976004
      A5=  .00107857
      X1=X
      X2=X*X1
      X3=X*X2
      X4=X*X3
      X5=X*X4
      E=A0+A1*X1+A2*X2+A3*X3+A4*X4+A5*X5-ALOG(X)
      RETURN
  100 A1=8.573328740100
      A2=18.0590169730D0
      A3=8.6347608925D0
      A4= .2677737343D0
      B1=9.5733223454D0
      B2=25.6329561486D0
      B3=21.0996503827D0
      B4=3.9584969228D0
      X1=X
      X2=X*X1
      X3=X*X2
      X4=X*X3
      F=(X4+A1*X3+A2*X2+A3*X1+A4)/(X4+B1*X3+B2*X2+B3*X1+B4)
      E=F*EXP(-X)/X
      RETURN
  200 A1=4.03640
      A2=1.15198
      B1=5.03637
      B2=4.19160
      X1=X
      X2=X*X1
      F=(X2+A1*X1+A2)/(X2+B1*X1+B2)
      E=F*EXP(-X)/X
      RETURN
      END
      SUBROUTINE COMP(SG)
      COMMON /MESH/ T(21),G(101),W(21)
      COMMON /EFUN/ E3T(21),E2T(101),E3TT(101),E3T1(101),E2TT(101)
      COMMON /PARA/J0,N,N1,N2,NN,NNP1,REF
      DIMENSION GM(101)
      SUM=0.
      DO 10 K=1,NN
      KP1=K+1
      GM(K)=G(K)+G(KP1)
   10 SUM=SUM+GM(K)*(E3TT(KP1)-E3TT(K))
      SG=SUM*.5
      RETURN
      END
      FUNCTION S11(X)
      COMMON /COEFF/ A(20),AA(20)
      COMMON /PARA/J0,N,N1,N2,NN,NNP1,REF
      S11=0.
      DO 10 J=1,N1
   10 S11=S11+AA(J)*SE(J,X)
      RETURN
      END
      FUNCTION SE(J,X)
      COMMON /MESH/ T(21),G(101),W(21)
      COMMON /PARA/J0,N,N1,N2,NN,NNP1,REF
      IF(J.EQ.1) GO TO 100
      IF(J.EQ.N-1) GO TO 200
      IF(X.LE.T(J)) GO TO 300
      IF(X.GE.T(J+1)) GO TO 400
      SE=2.0-E2(X-T(J))-E2(T(J+1)-X)
      RETURN
  300 SE=E2(T(J)-X)-E2(T(J+1)-X)
      RETURN
```

```
  400 SE=E2(X-T(J+1))-E2(X-T(J))
      RETURN
  100 IF(X.GE.T(2)) GO TO 500
      SE=2.-E2(X)-E2(T(2)-X)
      RETURN
  500 SE=E2(X-T(2))-E2(X)
      RETURN
  200 IF(X.GE.T(N-1)) GO TO 600
      SE=E2(T(N-1)-X)-E2(T(N)-X)
      RETURN
  600 SE=2.0-E2(X-T(N-1))-E2(T(N)-X)
      RETURN
      END
      FUNCTION SINT(I)
      DIMENSION GM(101)
      COMMON /MESH/ T(21),G(101),W(21)
      COMMON /EFUN/ E3T(21),E2T(101),E3TT(101),E3T1(101),E2TT(101)
      COMMON /PARA/U0,N,N1,N2,NN,NNP1,REF
      SUM1=0.
      SUM2=0.
      DO 10 K=1,NN
      KP1=K+1
   10 GM(K)=G(K)+G(KP1)
      IF(I.EQ.1) GO TO 100
      I1=I-1
      DO 20 K=1,I1
   20 SUM1=SUM1+GM(K)*(E2T(I-K)-E2T(I-K+1))
      IF (I.EQ.NNP1) GO TO 200
  100 DO 30 K=I,NN
   30 SUM2=SUM2+GM(K)*(E2T(K-I+2)-E2T(K-I+1))
  200 SINT=(SUM1-SUM2)*.5
      RETURN
      END
      BLOCK DATA
C............ CHLORINE MODEL STUDY PROGRAM - VERSION 4
C
C.....BLOCK DATA
C
C.....VERSION 4.0        LEVEL 770214
C.....E.R.T.,INC.        L.PERRY, N.TRIPP
C
C.......................................................................
      REAL TITLE(6)
C
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      COMMON   /HEAD/ TITLE,ICODE,VERS,LEVEL,DATE,IRUN,NPAGE,NLOG
      COMMON /EDDY/ FKK,I1,P11,P22,NEDDY
      COMMON /MODEL/ ALT(41),TEMP(41),DM(41),DID(41),DA23(41)
      COMMON /MOLHYD/ XH(81),XH2O(81),PH2O,R42,X11(81)
      COMMON /MSCAT/ SCNO2,SCCLO3,SCH2O2,SCN2O5
      REAL JO2, JO3, JH2O, JNO2, JN2O, JN2O5, JHNO3, JCH4, JCF2,
     X                JCF3, JHCL, JH2O2,JHOCL
      COMMON /PARM/ ISWIT,TSTEP,TSTOP,TLOOP,ITPRNT,ISIZE,ISCATT
      COMMON /PHRATE/ JO2(41),JO3(41),JH2O(41),JNO2(41),JN2O(41),
     X JN2O5(41),JHNO3(41),JCH4(41),JCF2(41),JCF3(41),JHCL(41),JH2O2(41)
     Y ,JHOCL(41)
      REAL JNO3
      COMMON /RATES/ RATE(65,81),RA(65),RB(65),JNO3,PJO3
      COMMON /RLOW/ RN2O,RNOX,RCH4,RF11,RF12,RCH3C,RCLX,RCCL4,RO3
      COMMON /SFACT/ FCL,FH2O,FCLNO3,FNO
      COMMON /SOLCON/ WL(100),FL(100),QO2(100),QO3(100)
      COMMON /SOLCN1/ QCF2(100),QCF3(100),QCCL4(100),QCH3C(100),
     X QCLNO3(100),QN2O(100),QHNO3(100),QH2O2(100),QN2O5(100),
     Y QHCL(100),QHOCL(100),QNO2(100),QH2O(100)
      REAL NO,NO2,NOX,NO3,N2O5
      COMMON /SPECIE/ H(41),OH(41),HO2(41),H2O2(41),O3(41),O(41),NO(41),
```

```
     1 NO2(41),HNO3(41),NOX(41),CO(41),O2(41),CH4(41),H2O(41),H2(41),
     2 CL(41),CLO(41),HCL(41),CLX(41),OCLX(41),NO3(41),N2O5(41),
     3 CLNO3(41)
      COMMON /SPECON/ FJ,FJFC,TL
      REAL LAT
      COMMON /WT/ A(6),DL,LAT,DEL
      COMMON /XXES/ X1(81),X2(81),X3(81),X4(81),X5(81),X6(81),X7(81),
     1 X8(81),X9(81),X10(81)
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C
      DATA TITLE/5HCHLORINE,8H MODEL S,8HTUDY PRO,4HGRAM,14 ,1H /,
     X            DATE/1H /,NLOG/9/,IRUN/0/,NPAGE/0/
      DATA JNO3/1.3E-2/
      DATA FCL,FCLNO3,FH2O/1.0,1.00,1.0/,FNO/1.0/
      DATA RN2O,RNOX,RCH4,RF11,RF12,RCH3C,RCLX,RCCL4/2.50E-7,2.00E10,
     1 1.50E-06,9.30E+06,1.30E+07,1.50E-09,1.00E+10,1.30E-10/
      DATA RO3/3.00E-08/
      DATA FJ,FJFC,TL/1.0,1.0,3.15E13/,FKK/1.0/,ISWIT/1/,NEDDY/0/
      DATA I1,P11,P22/59,1.0,1.0/,PJO3/1.8E-4/,LAT,DEL/30.,0./
      DATA SCNO2,SCCLO3,SCH2O2,SCN2O5/4*1.0/
      DATA RH2,PH2O/5.E-7,0./
      DATA X2/81*0./
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA RA/1.66E-12,2.35E-10,1.4E-10,1.0E-10,1.8E-32,2.6E-11,2.3E-12,
     A 1.0E-11,1.0E-13,1.0E-10,1.1E-11,0.,5.0E-12,2.0E-11,3.0E-11,
     B 1.0E-11,4.2E-10,2.1E-13,1.0E-10,2.0E-12,2.36E-12,0.,1.0E-12,
     C 1.7E-12,6.7E-12,5.7E-11,6.0E-13,3.8E-33,2.7E-11,7.23E-12,
     D 1.07E-10,2.0E-11,0.,1.05E-34,1.3E-11,1.0E-12,0.,3.7E-11,9.0E-6,
     E 2.30E-12,1.2E-13,9.12E-12,5.0E-11,7.0E-11,2.0E-11,5.5E-12,
     F 3.0E-10,3.0E-10,2*0.,2.0E-11,14*0./
      DATA RB/-1070.,3*0.,340.,0.,-1125.,-750.,-1525.,-250.,-1000.,0.,
     X -500.,3*0.,-350.,-115.,-250.,
     A                -313.,-1710.,0.,-600.,0.,-2010.,-2400.,0.,1055.,
     B -257.,-1260.,-224.,2*0.,520.,-2140.,3*0.,-3700.,-1450.,-2450.,
     C 4*0.,-3200.,4*0.,107.,14*0./
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA WL/937.8,949.7,970.0,972.5,977.0,1008.0,991.5,1026.0,1035.0,
     210 50.0,1110.0,1155.0,1190.0,1210.0,1215.7,1250.0,1300.0,1350.0,
     31400.0,1450.0,1500.0,1550.0,1600.0,1650.0,1700.0,1750.0,1800.0,
     41850.0,1900.0,1950.0,2000.0,2050.0,2100.0,2150.0,2200.0,2250.0,
     52300.0,2350.0,2400.0,2450.0,2500.0,2550.0,2575.0,2625.0,2675.0,
     62725.0,2775.0,2825.0,2875.0,2925.0,2975.0,3025.0,3075.0,3125.0,
     73175.0,3225.0,3275.0,3325.0,3375.0,3425.0,3475.0,3525.0,3575.0,
     83625.0,3675.0,3725.0,3775.0,3825.0,3875.0,3925.0,3975.0,4025.0,
     94100.0,4200.0,4300.0,4400.0,4500.0,4600.0,4700.0,4800.0,4900.0,
     A5000.0,5100.0,5200.0,5300.0,5400.0,5500.0,5600.0,5700.0,5800.0,
     B5900.0,6000.0,6200.0,6400.0,6600.0,6800.0,7000.0,7200.0,7300.0/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA   FL/2.2000E+08,3.9000E+08,6.1000E+08,9.0000E+08,4.4000E+09,
     25.5000E+08,4.0000E+07,3.5000E+03,3.9100E+09,4.6800E+09,4.4000E+09,
     33.3000E+09,5.5000E+09,1.1700E+10,2.7000E+11,2.6000E+10,1.1500E+10,
     41.7700E+10,1.9300E+10,3.7000E+10,7.3000E+10,1.3300E+11,2.1600E+11,
     52.0600E+11,2.5800E+11,4.3000E+11,9.1000E+11,1.3100E+12,2.2500E+12,
     63.9000E+12,5.9000E+12,8.7000E+12,1.4400E+13,2.3800E+13,3.1600E+13,
     73.8300E+13,3.8300E+13,3.5400E+13,3.6800E+13,4.6300E+13,4.5000E+13,
     87.1600E+13,4.0800E+13,1.1200E+14,1.5100E+14,1.6200E+14,1.6100E+14,
     92.0600E+14,3.1100E+14,4.2400E+14,4.6400E+14,4.8700E+14,5.5400E+14,
     A6.2200E+14,6.5200E+14,6.9500E+14,9.3300E+14,9.5900E+14,9.3300E+14,
     B9.9000E+14,9.3100E+14,1.1000E+15,1.0200E+15,1.1100E+15,1.3100E+15,
     C1.1700E+15,1.3300E+15,1.1400E+15,1.1600E+15,1.1600E+15,1.2700E+15,
     D1.3800E+15,2.3900E+15,4.0100E+15,3.9500E+15,4.2300E+15,4.8700E+15,
     E4.9700E+15,5.0500E+15,5.2000E+15,4.9000E+ ,5.0100E+15,4.9900E+15,
     F4.8600E+15,5.1000E+15,5.3100E+15,5.3800E+15,5.3200E+15,5.3400E+15,
     G5.4000E+15,5.4200E+15,5.4400E+15,1.0800E+16,1.0700E+16,1.1500E+16,
     H1.0300E+16,1.0100E+16,9.9300E+15,4.9000E+15/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

```
      DATA QO2/5.2000E-18,5.9000E-18,5.5000E-18,4.0000E-17,2.0000E-18,   028450
     21.9000E-18,1.9000E-18,1.6000E-18,1.2000E-18,1.0000E-18,1.0000E-19,028460
     34.0000E-19,3.6000E-19,4.6000E-18,1.0000E-20,1.0000E-18,5.5000E-19,028470
     44.0000E-18,1.0000E-17,1.0000E-17,1.0000E-17,8.4000E-18,4.3000E-18,028480
     54.3000E-18,8.8000E-19,2.7000E-19,6.0000E-21,5.5000E-22,1.0000E-21,028490
     62.0000E-23,1.3000E-23,1.0000E-23,8.5000E-24,6.5000E-24,5.0000E-24,028500
     74.0000E-24,3.0000E-24,1.6000E-24,1.0000E-24,7.0000E-25,3.0000E-25,028510
     81.2000E-25,30*0./                                                 028520
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 028530
      DATA QO3/24*0.,8.3500E-19,8.3500E-19,7.4190E-19,6.6670E-19,        028540
     24.7000E-19,4.0740E-19,2.9630E-19,3.3330E-19,5.9260E-19,1.0500E-18,028550
     31.8600E-18,2.9000E-18,4.4000E-18,6.2000E-18,8.1000E-18,9.9000E-18,028560
     41.1000E-17,1.1300E-17,1.1000E-17,1.0000E-17,8.6000E-18,6.4000E-18,028570
     54.5000E-18,2.7000E-18,1.6000E-19,1.0000E-18,4.7000E-19,2.6000E-19,028580
     61.4000E-19,6.3000E-20,3.6000E-20,1.8000E-20,7.7000E-21,4.1000E-21,028590
     72.0000E-21,6.9000E-22,4.0000E-22,2.5000E-22,10*0.00000,2.9000E-23,028600
     84.0000E-23,6.8000E-23,1.2500E-22,1.7100E-22,3.5700E-22,4.0600E-22,028610
     97.1000E-22,9.3000E-22,1.2000E-21,1.6000E-21,1.8800E-21,2.5000E-21,028620
     A2.9000E-21,3.2000E-21,3.9000E-21,4.7000E-21,4.6000E-21,4.4000E-21,028630
     84.9000E-21,3.9000E-21,2.7000E-21,2.1000E-21,1.4000E-21,9.1000E-22,028640
     C6.4000E-22,5.1000E-22/                                            028650
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 028660
      DATA TEMP/3.0458E+02,2.8956E+02,2.7787E+02,2.6652E+02,2.5241E+02,  028670
     22.3839E+02,2.2442E+02,2.1050E+02,2.0315E+02,2.0738E+02,2.1175E+02,028680
     32.1594E+02,2.1920E+02,2.2384E+02,2.2783E+02,2.3179E+02,2.3574E+02,028690
     42.4040E+02,2.4514E+02,2.4988E+02,2.5462E+02,2.5935E+02,2.6408E+02,028700
     52.6880E+02,2.7215E+02,2.7215E+02,2.7114E+02,2.6721E+02,2.6328E+02,028710
     62.5936E+02,2.5479E+02,2.4735E+02,2.3991E+02,2.3247E+02,2.2504E+02,028720
     72.1761E+02,2.1019E+02,2.0277E+02,1.9536E+02,1.8795E+02,1.8054E+02/028730
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 028740
      DATA DM/2.4110E+19,2.1050E+19,1.6510E+19,1.3400E+19,1.0880E+19,    028750
     28.7330E+18,6.9130E+18,5.9310E+18,4.1030E+18,2.8240E+18,2.0000E+18,028760
     31.4290E+18,1.0320E+18,7.4450E+17,5.4230E+17,3.9700E+17,2.9240E+17,028770
     42.1590E+17,1.6040E+17,1.1980E+17,8.9990E+16,6.7980E+16,5.1610E+16,028780
     53.9390E+16,3.0350E+16,2.3720E+16,1.8600E+16,1.4710E+16,1.1590E+16,028790
     69.1050E+15,7.1440E+15,5.6360E+15,4.4160E+15,3.4350E+15,2.6620E+15,028800
     72.0260E+15,1.5350E+15,1.1520E+15,8.5540E+14,6.2810E+14,4.5560E+14/028810
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 028820
      DATA  O3/6.2500E+11,6.1300E+11,5.3100E+11,4.7800E+11,4.4900E+11,   028830
     24.1800E+11,5.2500E+11,6.5200E+11,2.6700E+12,3.7400E+12,4.4700E+12,028840
     34.8000E+12,4.8700E+12,4.4700E+12,3.9100E+12,3.2500E+12,2.5700E+12,028850
     41.9200E+12,1.3800E+12,9.6600E+11,6.6200E+11,4.4300E+11,2.8300E+11,028860
     51.8100E+11,1.1400E+11,7.4600E+10,4.9300E+10,3.4000E+10,2.3200E+10,028870
     61.5700E+10,1.0600E+10,7.5400E+09,5.2900E+09,3.5200E+09,2.2600E+09,028880
     71.3700E+09,9.5600E+08,5.0700E+08,3.1700E+08,2.0300E+08,1.3200E+08/028890
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 028900
      DATA  OH/1.6100E+06,1.2400E+06,1.0600E+06,1.0100E+06,7.3200E+05,   028910
     24.9600E+05,3.4100E+05,1.9400E+05,2.0000E+05,2.7000E+05,3.4400E+05,028920
     34.3300E+05,5.5400E+05,7.1200E+05,9.3200E+05,1.2600E+06,1.7300E+06,028930
     42.4300E+06,3.3800E+06,4.5900E+06,5.9800E+06,7.2600E+06,8.0000E+06,028940
     57.9600E+06,7.4000E+06,6.7300E+06,6.0100E+06,5.3800E+06,4.7600E+06,028950
     64.1800E+06,3.6700E+06,3.1600E+06,2.6700E+06,2.3400E+06,2.1000E+06,028960
     71.9200E+06,1.7000E+06,1.5500E+05,1.2800E+06,9.8900E+05,7.0500E+05/028970
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 028980
      DATA  O/2.8900E+03,2.8900E+03,3.4800E+03,3.6300E+03,4.6100E+03,    028990
     25.9800E+03,1.0400E+04,1.5000E+04,1.1500E+05,3.6400E+05,9.2900E+05,029000
     32.1100E+06,4.4200E+06,8.6700E+06,1.6000E+07,2.8400E+07,4.8600E+07,029010
     43.1700E+07,1.3500E+08,2.2100E+08,3.6500E+08,6.0800E+08,9.8300E+08,029020
     51.4700E+09,2.0000E+09,2.5500E+09,3.1200E+09,3.6900E+09,4.2500E+09,029030
     64.8100E+09,5.3300E+09,5.9200E+09,6.5100E+09,6.8300E+09,6.9100E+09,029040
     76.8300E+09,6.9400E+09,6.8400E+09,7.2800E+09,8.0900E+09,9.4000E+09/029050
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 029060
      DATA  H/1.2100E-01,8.8000E-02,8.1500E-02,8.0000E-02,5.9100E-02,    029070
     24.1500E-02,2.8700E-02,1.5400E-02,1.4000E-02,2.1000E-02,3.2700E-02,029080
     35.7700E-02,1.1500E-01,2.5800E-01,6.2700E-01,1.6800E+00,5.1030E+00,029090
     41.7000E+01,5.1100E+01,2.2700E+02,8.3300E+02,2.9000E+03,8.1900E+03,029100
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52.2700E+04,4.8500E+04,9.0900E+04,1.5800E+05,2.5800E+05,4.0900E+05,029110
66.3200E+05,9.5800E+05,1.3800E+06,1.9500E+06,2.7800E+06,3.9900E+06,029120
75.9900E+06,8.6900E+06,1.3100E+07,1.9200E+07,2.7500E+07,3.8100E+07/029130
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 029140
 DATA  HO2/2.4200E+08,1.7600E+08,1.3100E+08,1.2500E+08,8.1500E+07, 029150
25.0400E+07,3.1500E+07,1.8100E+07,1.5800E+07,1.7900E+07,2.0400E+07,029160
32.2900E+07,2.5400E+07,2.6700E+07,2.7000E+07,2.5800E+07,2.3000E+07,029170
41.9200E+07,1.5100E+07,1.1700E+07,9.2300E+06,7.6900E+06,6.7200E+06,029180
55.9200E+06,5.1800E+06,4.5500E+06,3.9600E+06,3.4600E+06,3.0000E+06,029190
62.5900E+06,2.2300E+06,1.8700E+05,1.5400E+06,1.3300E+06,1.1900E+06,029200
71.0800E+06,9.5200E+05,8.6700E+05,7.0500E+05,5.2500E+05,3.5500E+05/029210
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 029220
 DATA  H2O2/2.1000E+10,2.5000E+10,1.8000E+10,1.2000E+10,1.3000E+10,029230
25.3000E+09,4.5000E+09,1.4000E+09,9.9400E+07,2.4100E+07,3.9400E+07,029240
34.4200E+07,4.1500E+07,3.5500E+07,3.0100E+07,2.4800E+07,2.2700E+07,029250
42.0800E+07,1.8600E+07,1.6100E+07,1.3300E+07,1.0700E+07,8.4500E+06,029260
56.3800E+06,4.5800E+06,3.2000E+06,2.2400E+06,1.6000E+06,1.1300E+06,029270
67.9800E+05,5.7400E+05,3.8600E+05,2.4600E+05,1.7100E+05,1.2300E+05,029280
79.5900E+04,7.2300E+04,5.9300E+04,3.8300E+04,2.0500E+04,9.0200E+03/029290
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 029300
 DATA JHCL/1.3476E-29,1.7155E-26,1.0596E-23,3.5073E-21,6.9259E-19, 029310
26.7111E-17,3.1183E-15,8.7227E-14,1.5159E-12,1.4303E-11,8.4891E-11,029320
33.6315E-10,1.2327E-09,3.4042E-09,7.9316E-09,1.5998E-08,2.8437E-08,029330
44.5049E-08,6.4398E-08,8.4481E-09,1.0523E-07,1.2410E-07,1.4043E-07,029340
51.5440E-07,1.6726E-07,1.7994E-07,1.9339E-07,2.0849E-07,2.2585E-07,029350
62.4560E-07,2.6740E-07,2.9069E-07,3.1487E-07,3.4177E-07,3.6896E-07,029360
74.0039E-07,4.3648E-07,4.7911E-07,5.2843E-07,5.8180E-07,6.3504E-07/029370
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 029380
 DATA JCH4/25*0.,1.0289E-27,3.2369E-23,1.1507E-19,7.5248E-17,       029390
21.2647E-14,7.2754E-13,1.8015E-11,2.3133E-10,1.7445E-09,8.5503E-09,029400
33.0106E-08,7.9105E-08,1.6859E-07,3.0472E-07,4.8102E-07,6.7959E-07/029410
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 029420
 DATA DID/2.9228E-03,3.3919E-03,3.8611E-03,4.3988E-03,5.1697E-03,  029430
26.1919E-03,1.0078E-02,1.5063E-02,9.7719E-02,2.3901E-01,5.1692E-01,029440
31.0496E+00,2.0826E+00,3.8613E+00,6.8855E+00,1.1820E+01,1.9289E+01,029450
42.9819E+01,4.3466E+01,6.1222E+01,8.4508E+01,1.1458E+02,1.4672E+02,029460
51.6955E+02,1.7919E+02,1.8142E+02,1.7690E+02,1.7115E+02,1.6057E+02,029470
61.4725E+02,1.3288E+02,1.2417E+02,1.1422E+02,9.9626E+01,8.3651E+01,029480
76.7259E+01,5.5916E+01,4.4580E+01,3.8082E+01,3.3875E+01,3.1108E+01/029490
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 029500
 DATA JN2O/3.3115E-10,3.3776E-10,3.4402E-10,3.4968E-10,3.5496E-10, 029510
23.5999E-10,3.6561E-10,3.7298E-10,3.9724E-10,4.6762E-10,6.6381E-10,029520
31.2383E-09,2.5256E-09,6.5720E-09,1.4198E-08,2.7762E-08,4.8867E-08,029530
47.7590E-08,1.1187E-07,1.4846E-07,1.8706E-07,2.2282E-07,2.5396E-07,029540
52.8033E-07,3.0302E-07,3.2303E-07,3.4130E-07,3.5868E-07,3.7595E-07,029550
63.9349E-07,4.1144E-07,4.2975E-07,4.4813E-07,4.6727E-07,4.8608E-07,029560
75.0774E-07,5.3259E-07,5.6308E-07,6.0045E-07,6.4319E-07,6.8785E-07/029570
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 029580
 DATA JN2O5/1.2807E-05,1.2864E-05,1.2918E-05,1.2965E-05,1.3010E-05,029590
21.3052E-05,1.3098E-05,1.3157E-05,1.3330E-05,1.3694E-05,1.4245E-05,029600
31.5057E-05,1.6326E-05,1.8306E-05,2.1404E-05,2.6320E-05,3.3719E-05,029610
44.4228E-05,5.7854E-05,7.4327E-05,9.3804E-05,1.1526E-04,1.3777E-04,029620
51.5999E-04,1.8017E-04,1.9764E-04,2.1265E-04,2.2476E-04,2.3475E-04,029630
62.4284E-04,2.4919E-04,2.5410E-04,2.5789E-04,2.6070E-04,2.6267E-04,029640
72.6400E-04,2.6488E-04,2.6546E-04,2.6584E-04,2.6610E-04,2.6627E-04/029650
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 029660
 DATA JHNO3/1.7653E-07,1.7967E-07,1.8265E-07,1.8533E-07,1.8783E-07,029670
21.9022E-07,1.9287E-07,1.9629E-07,2.0680E-07,2.3252E-07,2.8660E-07,029680
34.1257E-07,7.1813E-07,1.3894E-06,2.7000E-06,4.9742E-06,8.4498E-06,029690
41.3130E-05,1.8690E-05,2.4671E-05,3.1130E-05,3.7342E-05,4.3095E-05,029700
54.9260E-05,5.2789E-05,5.6697E-05,6.0084E-05,6.2996E-05,6.5600E-05,029710
66.7984E-05,7.0208E-05,7.2324E-05,7.4349E-05,7.6237E-05,7.7946E-05,029720
77.9638E-05,8.1042E-05,8.2214E-05,8.3244E-05,8.4143E-05,8.4903E-05/029730
C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 029740
 DATA JH2O2/1.3571E-06,1.3663E-06,1.3750E-06,1.3828E-06,1.3900E-06,029750
21.3968E-06,1.4044E-06,1.4140E-06,1.4421E-06,1.5017E-06,1.5916E-06,029760
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31.7219E-06,1.3206E-06,2.2204E-06,2.6755E-06,3.3861E-06,4.4527E-06,
46.0019E-06,5.1055E-06,1.0840E-05,1.4314E-05,1.8545E-05,2.3397E-05,
52.3488E-05,3.3262E-05,3.7486E-05,4.1182E-05,4.4205E-05,4.6749E-05,
64.3867E-05,5.0575E-05,5.1938E-05,5.3028E-05,5.3880E-05,5.4513E-05,
75.4992E-05,5.5353E-05,5.5639E-05,5.5874E-05,5.6073E-05,5.6238E-05/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA  HNO3/4.74E+10,2.13E+10,1.09E+10,1.58E+10,1.22E+10,8.84E+09,
26.56E+09,4.63E+09,8.86E+09,1.03E+10,9.90E+09,8.16E+09,5.73E+09,
33.31E+09,1.75E+09,9.13E+08,4.84E+08,2.55E+08,1.33E+08,6.72E+07,
43.07E+07,1.18E+07,3.67E+06,9.55E+05,2.35E+05,6.09E+04,1.60E+04,
54.52E+03,1.26E+03,3.30E+02,8.95E+01,2.48E+01,6.86E+00,2.06E+00,
66.94E-01,7.66E-01,3.00E-01,1.37E-01,6.29E-02,2.99E-02,1.39E-02/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA  NOX/2.99E-09,1.76E-09,1.33E-09,1.35E-09,1.36E-09,1.33E-09,
21.48E-09,1.60E-09,3.41E-09,5.45E-09,7.69E-09,1.00E-08,1.23E-08,
31.44E-08,1.62E-08,1.77E-08,1.87E-08,1.92E-08,1.93E-08,1.90E-08,
41.85E-08,1.77E-08,1.67E-08,1.55E-08,1.42E-08,1.29E-08,1.15E-08,
53.98E-09,8.50E-09,7.10E-09,5.83E-09,4.75E-09,3.89E-09,3.26E-09,
62.85E-09,7.91E-09,7.64E-09,7.84E-09,8.58E-09,1.02E-08,1.28E-08/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     DATA  N2O/2.6E-07,2.6E-07,2.6E-07,2.6E-07,2.6E-07,2.6E-07,2.6E-07,
C     22.6E-07,2.57E-07,2.27E-07,1.87E-07,1.52E-07,1.29E-07,1.09E-07,
C     39.20E-08,7.63E-08,6.23E-08,5.03E-08,4.03E-08,3.21E-08,2.56E-08,
C     42.06E-08,1.66E-08,1.36E-08,1.12E-08,9.35E-09,7.89E-09,6.73E-09,
C     55.80E-09,5.06E-09,4.46E-09,3.98E-09,3.58E-09,3.26E-09,3.01E-09,
C     62.80E-09,2.64E-09,2.51E-09,2.42E-09,2.33E-09,2.3E-09/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA  CH4/1.50E-06,1.49E-06,1.48E-06,1.48E-06,1.48E-06,1.47E-06,
21.47E-06,1.47E-06,1.40E-06,1.33E-06,1.25E-06,1.16E-06,1.06E-06,
39.68E-07,8.68E-07,7.69E-07,6.71E-07,5.79E-07,4.93E-07,4.17E-07,
43.52E-07,2.98E-07,2.55E-07,2.23E-07,2.00E-07,1.83E-07,1.71E-07,
51.62E-07,1.56E-07,1.51E-07,1.47E-07,1.45E-07,1.43E-07,1.41E-07,
61.40E-07,6*0./
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA  CO/9.97E-08,9.53E-08,9.05E-08,8.60E-08,8.24E-08,7.98E-08,
27.42E-08,7.08E-08,4.60E-08,3.15E-08,2.39E-08,2.07E-08,2.02E-08,
32.14E-08,2.34E-08,2.56E-08,2.72E-08,2.80E-08,2.77E-08,2.68E-08,
42.57E-08,2.51E-08,2.54E-08,2.66E-08,2.90E-08,3.25E-08,3.75E-08,
54.41E-08,5.21E-08,6.14E-08,7.13E-08,8.11E-08,8.98E-08,9.63E-08,
69.33E-08,5.74E-07,1.10E-06,1.99E-06,3.59E-06,6.45E-06,1.17E-05/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA  NO/6.61E+09,5.03E+09,4.40E+09,1.07E+09,1.48E+09,2.13E+09,
22.50E+09,3.46E+09,2.20E+09,1.60E+09,1.34E+09,1.26E+09,1.29E+09,
31.34E+09,1.35E+09,1.33E+09,1.28E+09,1.22E+09,1.15E+09,1.07E+09,
49.76E+08,8.58E+08,7.10E+08,5.51E+08,4.09E+08,2.97E+08,2.10E+08,
51.45E+08,9.50E+07,6.44E+07,4.16E+07,2.68E+07,1.72E+07,1.12E+07,
67.59E+06,1.60E+07,1.17E+07,9.03E+06,7.34E+06,6.41E+06,5.83E+06/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA  NO2/1.81E+10,1.07E+10,6.70E+09,1.20E+09,1.16E+09,1.15E+09,
21.19E+09,1.39E+09,2.86E+09,3.32E+09,3.78E+09,4.29E+09,4.85E+09,
35.16E+09,4.97E+09,4.34E+09,3.49E+09,2.59E+09,1.79E+09,1.14E+09,
46.53E+08,3.30E+08,1.46E+08,5.88E+07,2.30E+07,9.03E+06,3.52E+06,
51.37E+06,5.22E+05,1.96E+05,7.29E+04,2.71E+04,1.02E+04,3.98E+03,
61.59E+03,2.36E+03,1.22E+03,7.09E+02,4.66E+02,3.46E+02,2.79E+02/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA  H2/5.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,
25.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,
35.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,
45.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,
55.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,5.0000E-07,
65.0000E-07,5.0000E-07,1.0000E-06,1.6000E-06,2.2000E-06,2.9000E-06,
73.3000E-06,4.4000E-06,4.5000E-06,4.3000E-06,4.2000E-06,4.1000E-06/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA JNO2/4.3974E-03,4.3992E-03,4.4009E-03,4.4024E-03,4.4038E-03,
24.4051E-03,4.4065E-03,4.4083E-03,4.4134E-03,4.4238E-03,4.4381E-03,
34.4558E-03,4.4775E-03,4.5019E-03,4.5277E-03,4.5553E-03,4.5829E-03,
```

```
     44.5104E-03,4.6360E-03,4.6598E-03,4.6810E-03,4.6999E-03,4.7159E-03,030430
     54.7291E-03,4.7394E-03,4.7474E-03,4.7536E-03,4.7583E-03,4.7619E-03,030440
     64.7646E-03,4.7667E-03,4.7687E-03,4.7702E-03,4.7710E-03,4.7720E-03,030450
     74.7723E-03,4.7728E-03,4.7733E-03,4.7733E-03,4.7737E-03,4.7737E-03/030460
C    - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 030470
      DATA JCF2/4.0383E-29,6.7920E-26,4.6511E-23,1.6649E-20,3.4437E-18, 030480
     23.3930E-16,1.5605E-14,4.1950E-13,6.8864E-12,6.2006E-11,3.5744E-10,030490
     31.5095E-09,5.1218E-09,1.4246E-08,3.3557E-08,6.8392E-08,1.2268E-07,030500
     41.9576E-07,2.8127E-07,3.7010E-07,4.6109E-07,5.4441E-07,6.1635E-07,030510
     56.7728E-07,7.3306E-07,7.8765E-07,8.4524E-07,9.0972E-07,9.8409E-07,030520
     61.0693E-06,1.1642E-06,1.2662E-06,1.3715E-06,1.4831E-06,1.5852E-06,030530
     71.6855E-06,1.7735E-06,1.8506E-06,1.9193E-06,1.9193E-06,2.0290E-06/030540
C    - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 030550
      DATA JCF3/2.4654E-27,3.0229E-24,1.5298E-21,3.4449E-19,5.0888E-17, 030560
     24.3030E-15,1.8292E-13,4.6028E-12,7.0755E-11,6.0305E-10,3.3214E-09,030570
     31.3478E-08,4.4144E-08,1.1916E-07,2.7409E-07,5.5114E-07,9.8385E-07,030580
     41.5742E-06,2.2816E-06,3.0398E-06,3.8463E-06,4.5932E-06,5.2451E-06,030590
     55.7977E-06,6.2725E-06,6.6895E-06,7.0691E-06,7.4289E-06,7.7537E-06,030600
     68.1405E-06,8.5016E-06,8.8656E-06,9.2254E-06,9.5906E-06,9.9197E-06,030610
     71.0238E-05,1.0514E-05,1.0752E-05,1.0962E-05,1.1145E-05,1.1297E-05/030620
C    - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 030630
      DATA  H2O/2.2717E-02,1.1092E-02,6.7620E-03,3.5483E-03,1.2747E-03, 030640
     24.0172E-04,1.0814E-04,2.1832E-05,4.2000E-06,4.2000E-06,4.2000E-06,030650
     34.2000E-06,4.2000E-06,4.2000E-06,4.2000E-06,4.2000E-06,4.2000E-06,030660
     44.2000E-06,4.2000E-06,4.2000E-06,4.2000E-06,4.2000E-06,4.2000E-06,030670
     54.2000E-06,4.2000E-06,4.2000E-06,4.2000E-06,4.2000E-06,4.2000E-06,030680
     64.2000E-06,4.2000E-06,3.6000E-06,2.9000E-06,2.6000E-06,2.3000E-06,030690
     71.3000E-06,1.3000E-06,1.0000E-06,6.7000E-07,4.4000E-07,2.9000E-07/030700
C    - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 030710
      DATA JH2O/8.1806E-67,8.1806E-67,2.2712E-31,3.1934E-27,7.6346E-24, 030720
     24.2150E-21,6.6966E-19,4.4976E-17,1.3713E-15,1.8280E-14,1.4238E-13,030730
     37.8392E-13,3.3426E-12,1.1276E-11,3.0938E-11,7.0234E-11,1.3649E-10,030740
     42.3139E-10,3.4800E-10,4.7399E-10,5.9999E-10,7.3020E-10,8.7195E-10,030750
     51.0725E-09,1.4382E-09,2.0754E-09,3.0979E-09,4.5909E-09,6.5824E-09,030760
     69.0177E-09,1.1798E-08,1.4922E-08,1.8869E-08,2.6066E-08,4.1000E-08,030770
     77.4037E-08,1.3761E-07,2.4305E-07,3.8386E-07,5.8138E-07,7.8685E-07/030780
C    - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 030790
      DATA JO3/2.9315E-05,2.9694E-05,3.0051E-05,3.0373E-05,3.0674E-05,  030800
     23.0960E-05,3.1279E-05,3.1686E-05,3.2891E-05,3.5506E-05,3.9544E-05,030810
     34.5423E-05,5.4081E-05,6.6396E-05,8.3774E-05,1.0940E-04,1.4673E-04,030820
     42.0226E-04,2.8193E-04,3.9934E-04,5.7774E-04,8.5549E-04,1.2515E-03,030830
     51.7333E-03,2.2239E-03,2.6768E-03,3.0877E-03,3.4194E-03,3.6993E-03,030840
     63.9344E-03,4.1230E-03,4.2709E-03,4.3859E-03,4.4706E-03,4.5289E-03,030850
     74.5668E-03,4.5906E-03,4.6055E-03,4.6146E-03,4.6204E-03,4.6242E-03/030860
C    - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 030870
      DATA JO2/2.8970E-31,3.1074E-28,1.4126E-25,2.5237E-23,2.6991E-21,  030880
     21.7903E-19,6.5744E-18,1.4959E-16,2.1357E-15,1.7354E-14,9.2769E-14,030890
     33.7073E-13,1.2105E-12,3.3061E-12,7.7843E-12,1.6251E-11,3.0572E-11,030900
     45.2363E-11,8.2376E-11,1.2038E-10,1.6697E-10,2.1867E-10,2.7155E-10,030910
     53.2242E-10,3.6953E-10,4.1477E-10,4.6269E-10,5.1803E-10,5.8584E-10,030920
     66.6887E-10,7.6743E-10,8.8054E-10,1.0076E-09,1.1568E-09,1.3310E-09,030930
     71.5628E-09,1.8491E-09,2.1997E-09,2.6087E-09,3.0475E-09,3.4791E-09/030940
C    - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 030950
      DATA QCF2/ 27*0.,9.12E-19,5.70E-19,2.46E-19,9.02E-20,3.11E-20,    030960
     1 9.76E-21,2.00E-21,38*0./                                         030970
      DATA QCF3/ 27*0.,2.41E-18,1.80E-18,1.13E-18,6.56E-19,3.49E-19,    030980
     1 1.52E-19,6.40E-20,2.47E-20,1.00E-20,36*0./                       030990
      DATA QCCL4 /27*0.,3.36E-18,1.36E-18,7.33E-19,6.92E-19,6.25E-19,   031000
     1  4.54E-19,3.01E-19,1.75E-19,7.00E-20,36*0./                      031010
      DATA QCH3C/25*0.,5.5E-19,3.55E-19,1.80E-19,7.68E-20,3.02E-20,     031020
     2 9.83E-21,3.42E-21,9.10E-22,2.30E-22,5.00E-23,37*0./              031030
      DATA  QCLNO3/28*0.,8.0E-18,5.3E-18,3.5E-18,3.4E-18,3.4E-18,3.3E-18031040
     2,3.2E-18,3.2E-18,2.3E-18,1.6E-18,1.2E-18,8.4E-19,6.3E-19,4.7E-19, 031050
     3 4.2E-19,3.8E-19,2.6E-19,2.2E-19,1.6E-19,1.3E-19,8.5E-20,6.3E-20, 031060
     4 3.8E-20,3.0E-20,2.3E-20,1.6E-20,1.2E-20,8.3E-21,6.4E-21,4.6E-21, 031070
     5 3.1E-21,2.6E-21,2.2E-21,1.7E-21,1.1E-21,7.1E-22,8*0./            031080
```

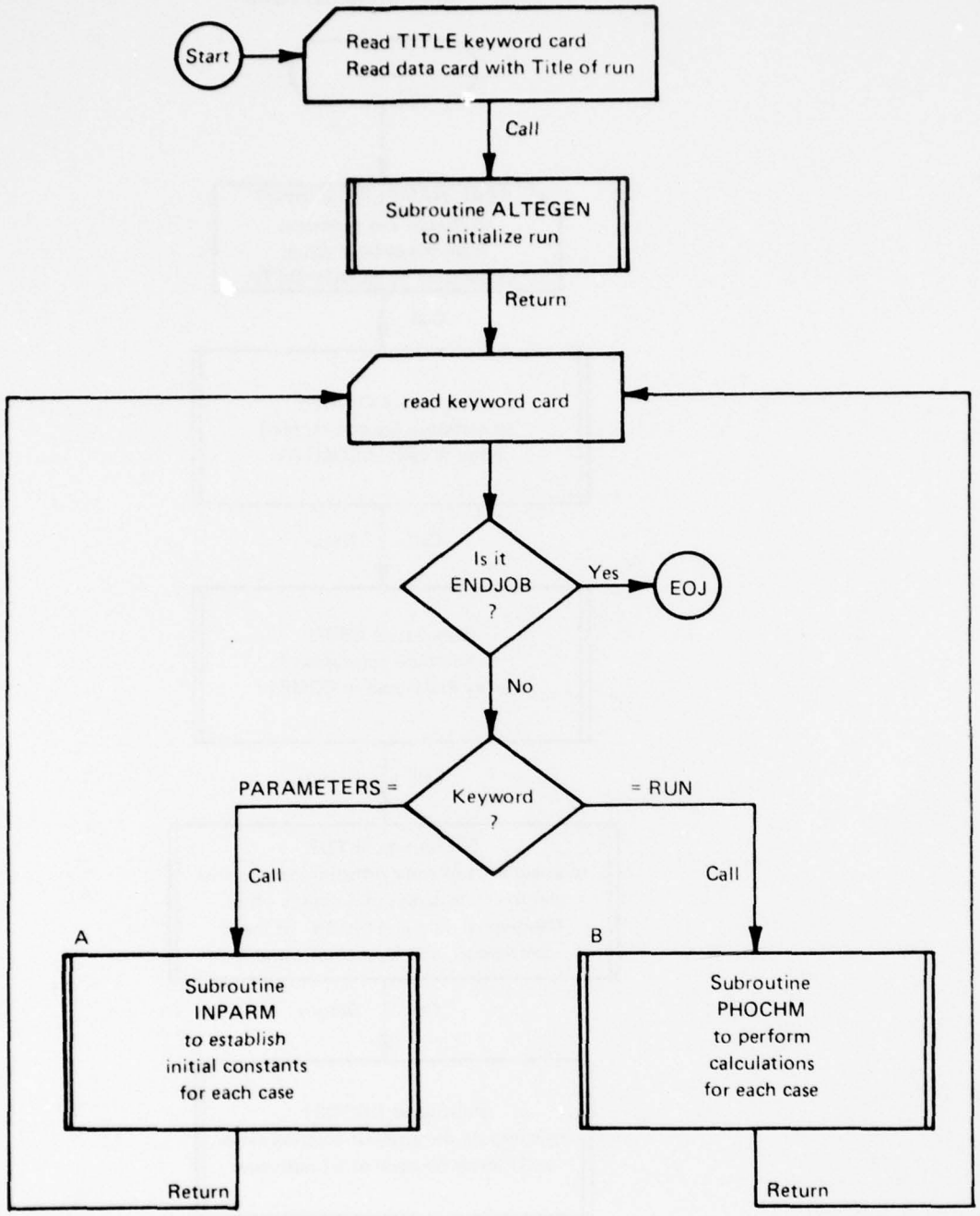
```
      DATA QN2O/ 8*0.,3.7E-17,3.7E-17,3.7E-17,1.5E-17,3.7E-18,2.6E-18,
     2 2.6E-18,1.7E-17,8.9E-17,3.7E-19,5.0E-19,4.0E-18,1.0E-18,1.0E-19,
     3 3.0E-20,4.0E-20,7.0E-20,9.0E-20,1.1E-19,1.1E-19,1.0E-19,6.0E-20,
     4 3.3E-20,1.5E-20,6.0E-21,2.5E-21,1.1E-21,3.0E-22,1.0E-22,3.2E-23,
     5 1.5E-23,7.6E-24,5.0E-24,2.0E-24,6.8E-25,4.0E-25,28*0./
      DATA QHNO3/28*0.,1.32E-17,9.10E-18,5.5E-18,2.55E-18,9.7E-19,
     2 3.28E-19,1.44E-19,8.51E-20,5.63E-20,3.74E-20,2.60E-20,2.10E-20,
     3 1.95E-20,1.94E-20,1.90E-20,1.80E-20,1.63E-20,1.40E-20,1.14E-20,
     4 8.77E-21,6.34E-21,4.26E-21,2.75E-21,1.68E-21,9.50E-22,4.70E-22,
     5 1.80E-22,1.00E-22,1.00E-23,1.00E-24,1.00E-24,13*0./
      DATA QH2O2/26*0.,1.5E-18,1.2E-19,7.5E-19,6.2E-19,4.9E-19,4.3E-19,
     2 3.8E-19,3.4E-19,3.0E-19,2.4E-19,1.9E-19,1.5E-19,1.3E-19,1.1E-19,
     3 8.4E-20,6.5E-20,5.3E-20,3.8E-20,3.0E-20,2.3E-20,1.9E-20,1.4E-20,
     4  1.1E-20,8.1E-21,5.8E-21,3.4E-21,2.7E-21,1.9E-21,1.3E-21,6.5E-22,
     5 5.1E-22,3.9E-22,2.5E-22,1.3E-22,1.0E-22,7.3E-23,5.4E-23,3.4E-23,
     6 2.5E-23,1.6E-23,1.1E-23,6.9E-24,1.1E-24,8.0E-25,0.,0./
      DATA QN2O5/ 32*0.,4.7E-18,3.2E-18,2.0E-18,1.3E-18,9.5E-19,7.8E-19,
     26.0E-19,4.8E-19,3.7E-19,3.1E-19,2.5E-19,2.1E-19,1.7E-19,1.3E-19,
     38.9E-20,5.1E-20,4.2E-20,3.3E-20,2.5E-20,1.9E-20,1.3E-20,1.03E-20,
     47.5E-21,5.8E-21,4.0E-21,3.4E-21,2.7E-21,2.3E-21,1.8E-21,1.4E-21,
     51.0E-21,7.4E-22,4.7E-22,3.0E-22,1.3E-22, 5*0./
C
      DATA QHCL/19*0.,2.11E-18,2.81E-18,3.45E-18,3.82E-18,3.32E-18,
     12.48E-18,1.63E-18,1.09E-18,5.80E-19,3.13E-19,1.45E-19,6.18E-20,
     27.56E-20,9.83E-21,3.95E-21,1.37E-21,4.80E-22,37*0./
      DATA QHOCL/49*0.,6.3E-20,7.9E-20,9.5E-20,1.05E-19,1.15E-19,
     11.25E-19,1.35E-19,1.27E-19,1.19E-19,1.07E-19,9.5E-20,8.8E-20,
     27.30E-20,6.35E-20,4.80E-20,3.80E-20,2.50E-20,2.6E-20,2.4E-20,
     32.00E-20,1.60E-20,1.20E-20,4.80E-20/
      DATA QH2O/8*0.,5.0E-18,4.0E-18,3.0E-18,4.0E-18,5.0E-18,4.0E-18,
     11.4E-17,6.0E-18,7.0E-18,3.2E-18,7.0E-19,5.0E-19,1.0E-18,2.2E-18,
     23.5E-18,4.8E-18,4.3E-18,2.8E-18,7.5E-19,5.0E-20,5.2E-21,6.3E-22,
     36.3E-23,41*0./
      DATA QNO2/48*0.,6.77E-20,8.52E-20,1.09E-19,1.67E-19,
     11.83E-19,2.19E-19,2.35E-19,2.54E-19,2.91E-19,3.14E-19,
     23.23E-19,3.43E-19,3.11E-19,4.37E-19,3.90E-19,5.37E-19,
     34.37E-19,5.00E-19,5.93E-19,5.79E-19,5.49E-19,5.62E-19,
     46.56E-19,8.66E-19/
C
      DATA CLX/1.1E-9,5.7E-10,3.1E-10,1.7E-10,1.2E-10,8.4E-11,1.1E-10,
     11.3E-10,2.4E-10,6.0E-10,9.5E-10,1.3E-9,1.6E-9,1.8E-9,2.0E-9,
     22.2E- 9,2.3E- 9,2.3E- 9,2.4E-9,2.4E-9,2.4E-9,2.4E-9,2.4E-9,
     32.4E- 9,2.4E- 9,2.4E- 9,2.4E-9,2.4E-9,2.4E-9,2.4E-9,2.4E-9,
     42.4E- 9,2.4E- 9,2.4E- 9,2.4E-9,2.4E-9,2.4E-9,2.4E-9,2.4E-9,
     52.4E- 9,2.4E- 9/
C     - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
      DATA DA23/2.828E03,5.371E02,1.192E02,6.337E01,6.069E01,
     1 5.675E01,5.585E01,5.048E01,4.511E01,4.314E01,2.667E01,1.4555E01,
     2 8.826E00,5.706E00,3.574E00,2.238E00,1.148E00,8.223E-01,4.219E-01,
     3 3.022E-01,1.550E-01,7.960E-02,5.704E-02,2.929E-02,2.099E-02,
     4 1.078E-02,5.580E-03,4.014E-03,2.078E-03,1.495E-03,7.735E-04,
     5 4.003E-04,2.880E-04,1.490E-04,1.072E-04,5.550E-05,2.144E-05,
     6 1.332E-05,5.144E-06,3.196E-06,1.234E-06/
C
      END
LIBRARY(LIB,NEW)
ADD(*,MAIN,AL=1)
ADD(*,LGO)
FINISH.
ENDRUN.
```

```
***********          DXDXIDX  //// END OF LIST ////
***********          DXDXIDX  //// END OF LIST ////
```

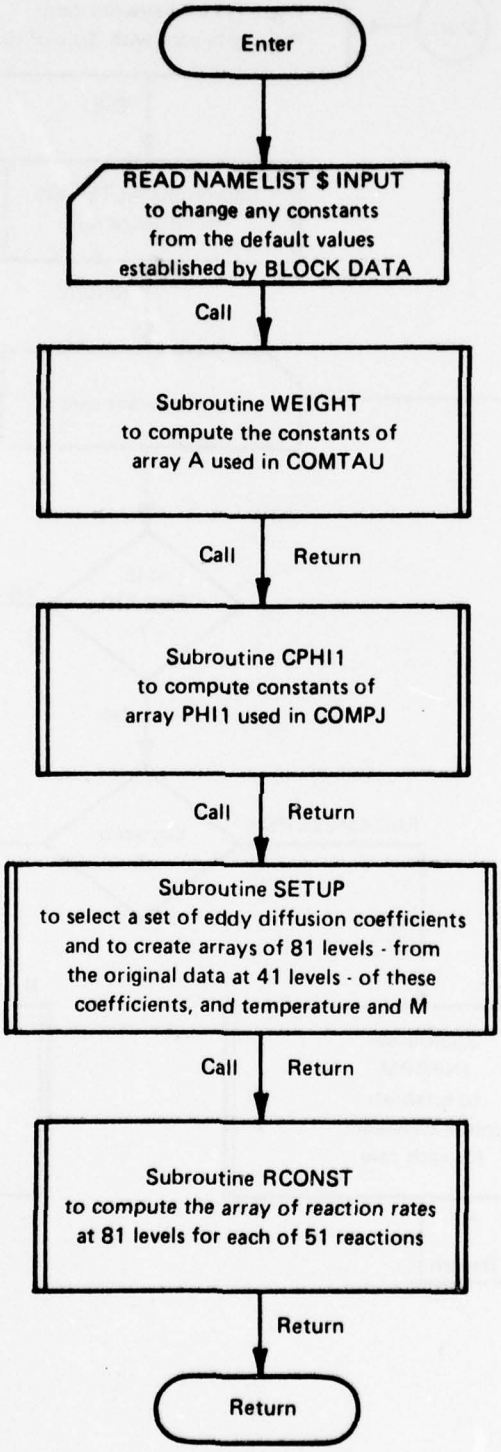
APPENDIX B

FLOW CHARTS

CMSP Chlorine Model Study Program

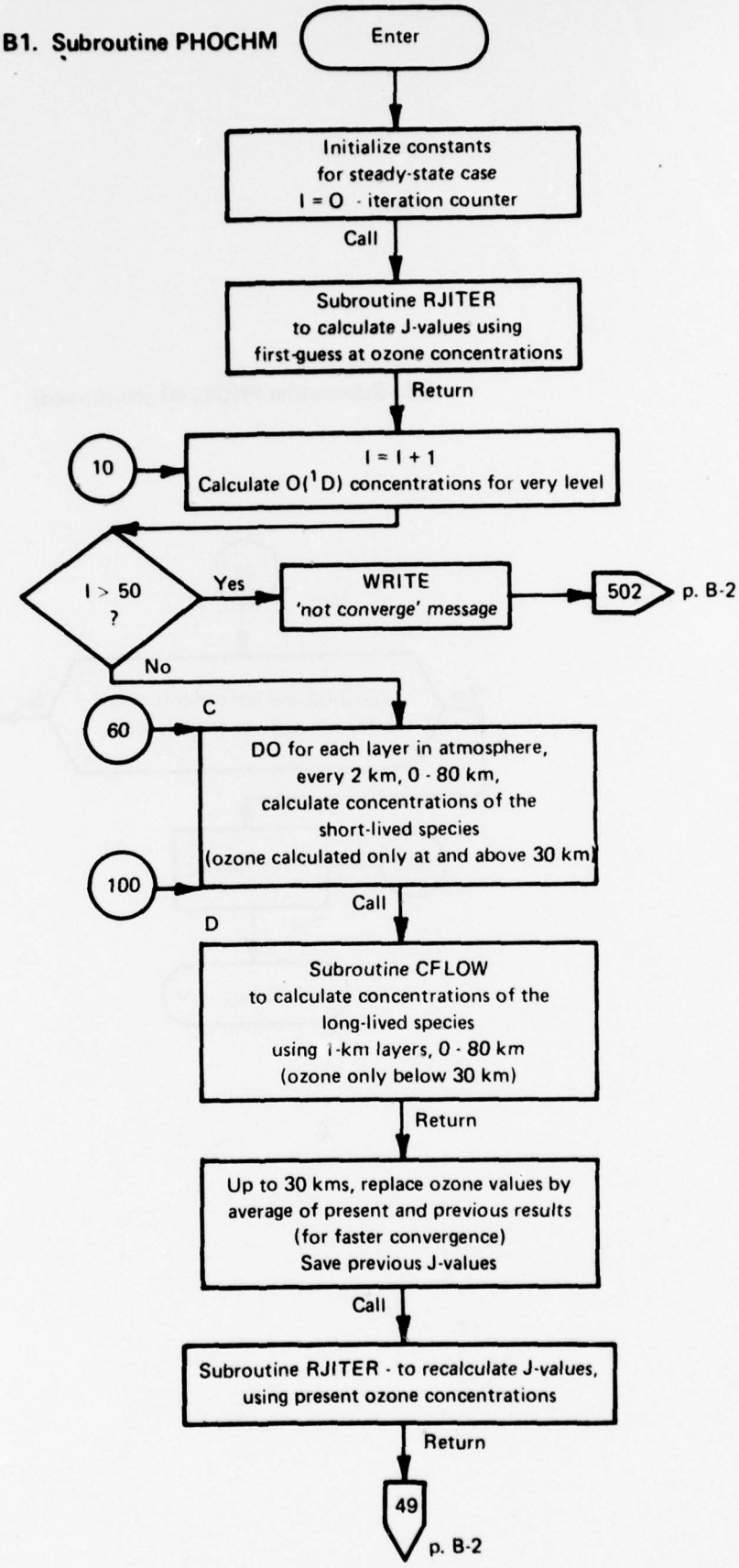


A. Subroutine INPARM



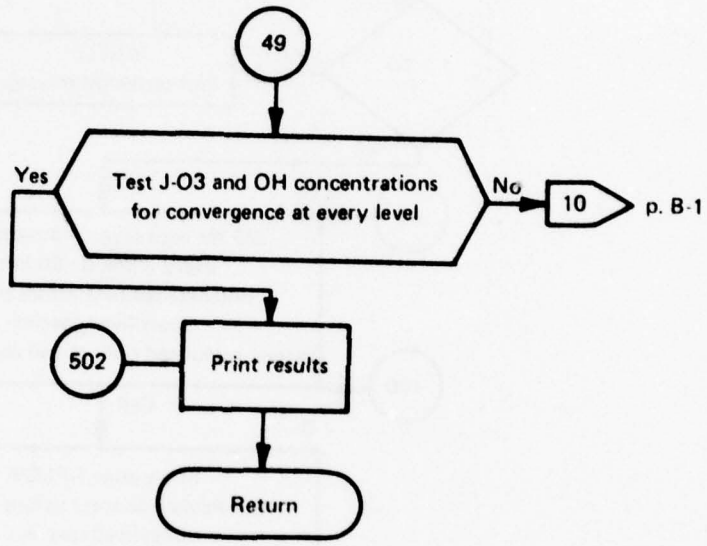
709022

B1. Subroutine PHOCHM

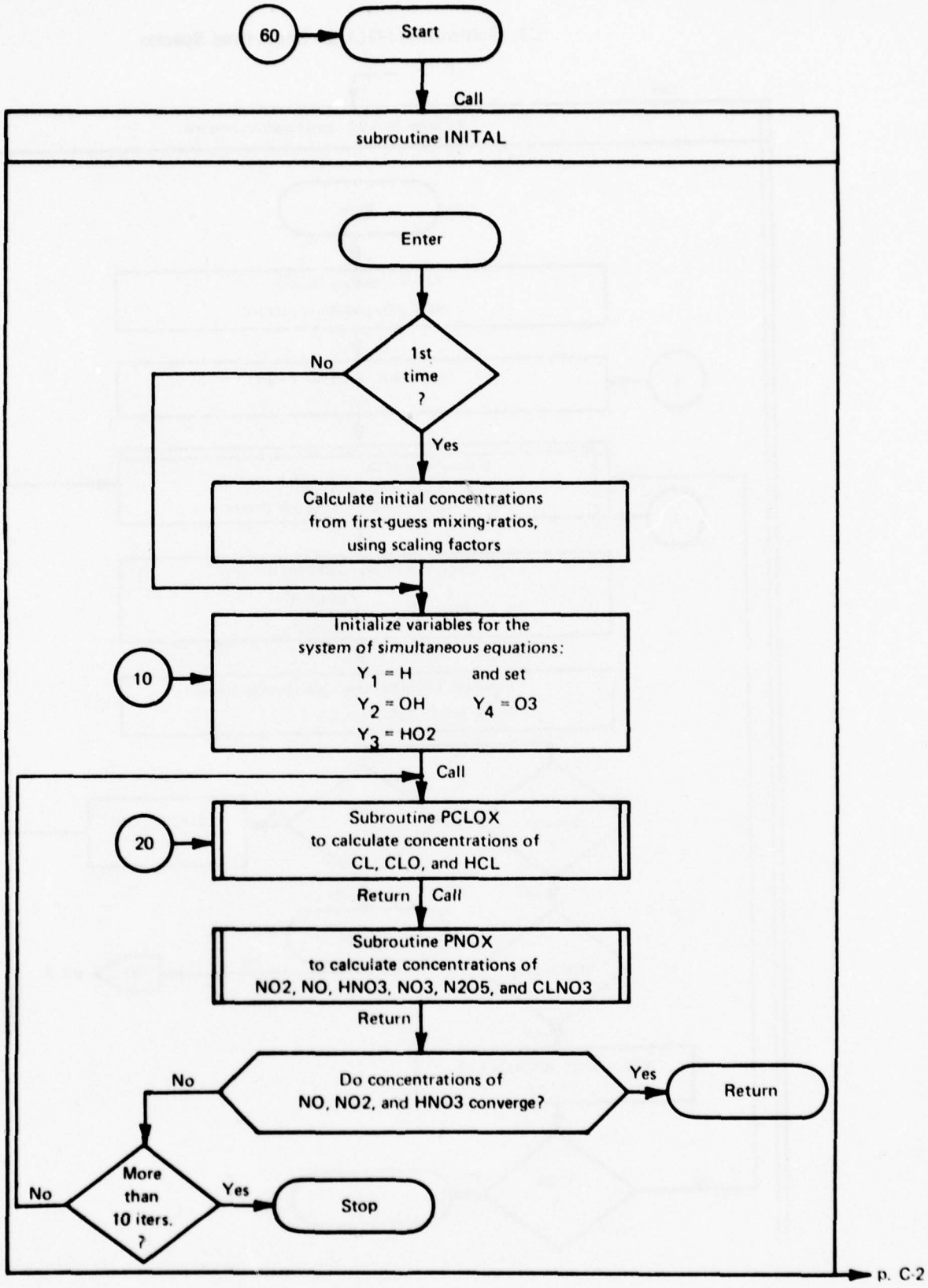


709023

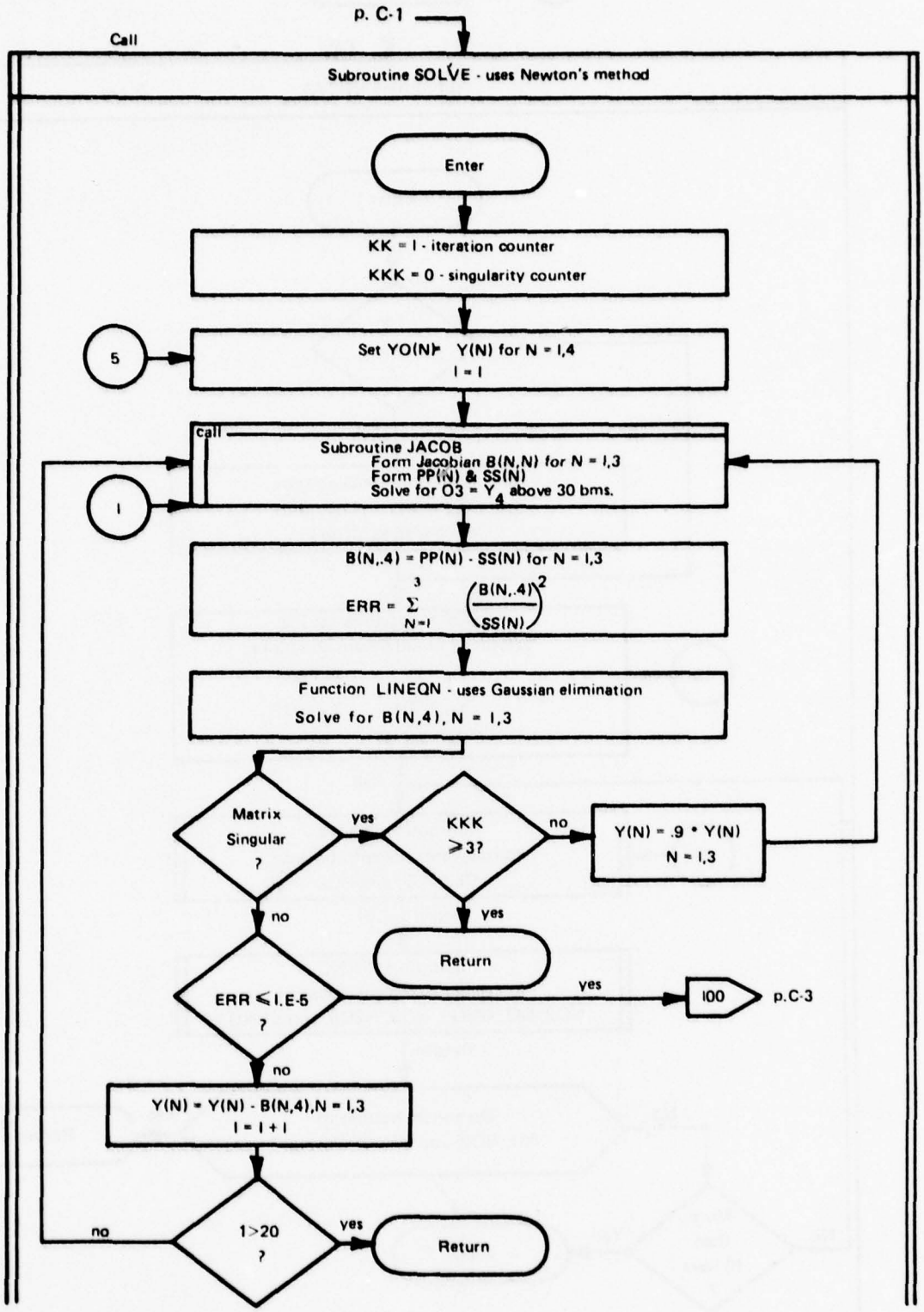
B2. Subroutine PHOCHM (continued)



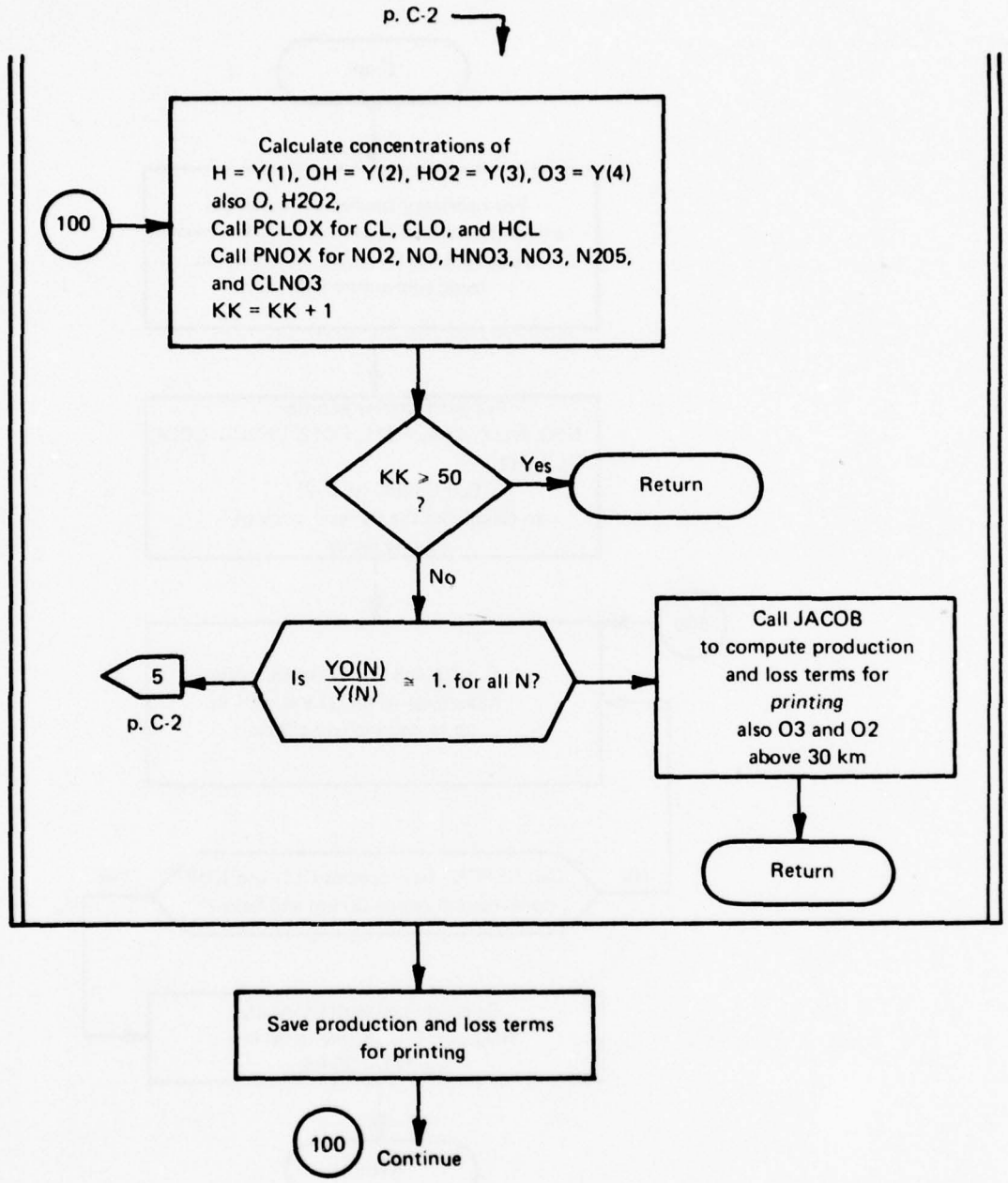
C1. Subroutine INITAL - Short-lived Species



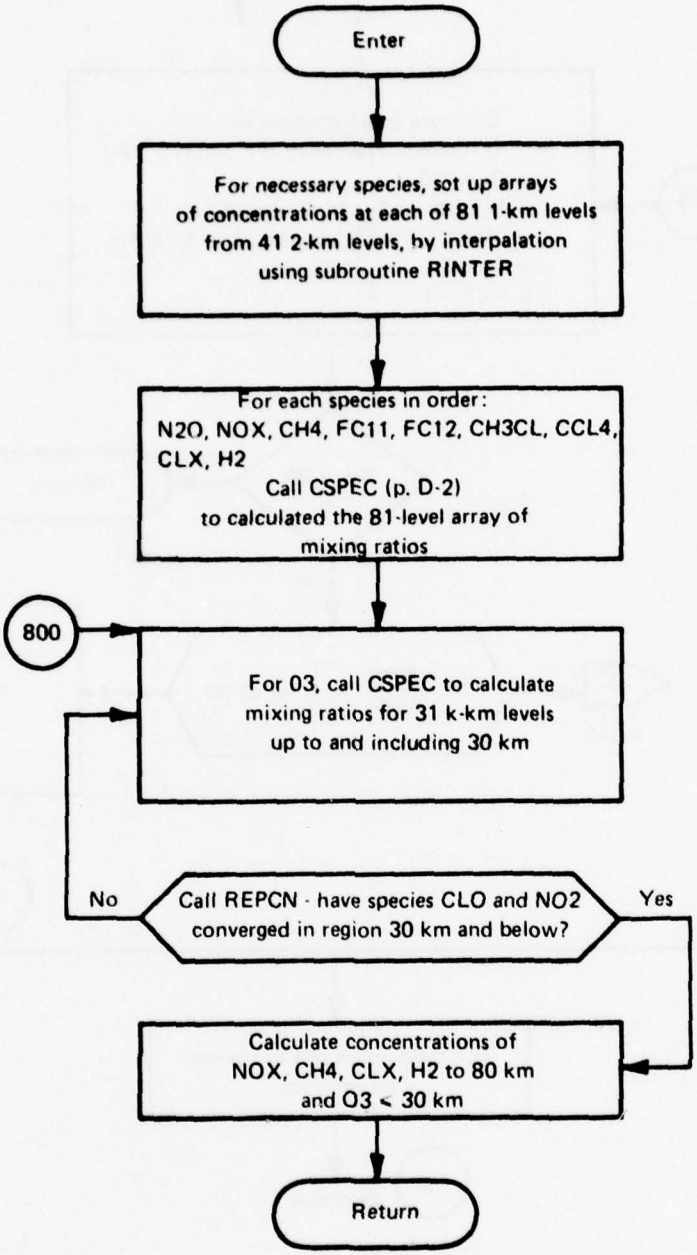
C2. Subroutine SOLVE - Short-lived Species



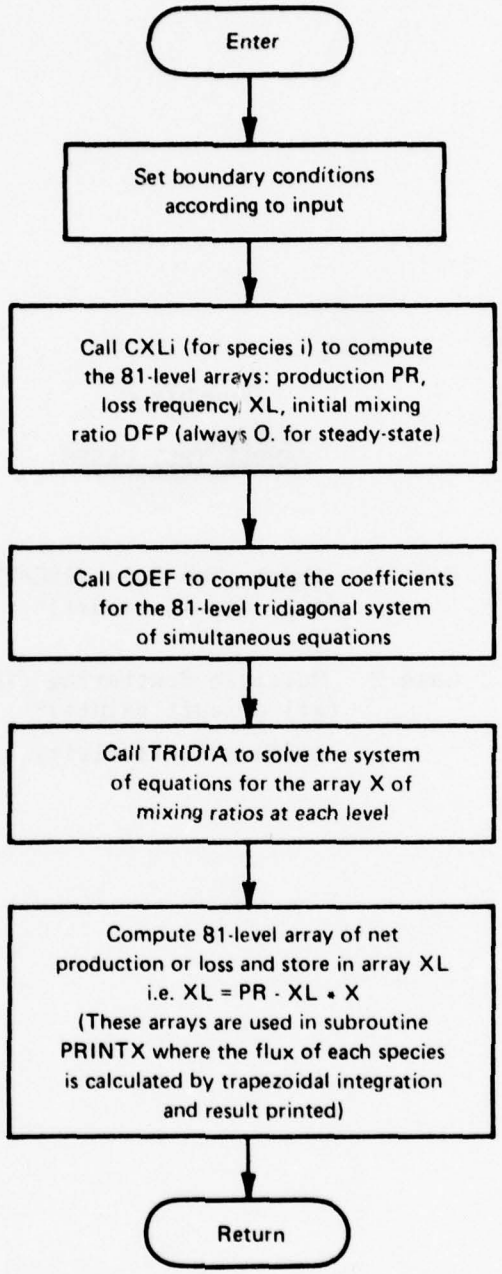
C3. Subroutine SOLVE (continued)



D1. Subroutine CFLOW - Long-lived Species



D2. Subroutine CSPEC



APPENDIX C

SAMPLE TEST CASES

Case 1 Absorption Only (ISCATT = 0)
(all default values)*

Case 2 Multiple Scattering (ISCATT = 1)
(all default values)*

Surface Reflectivity = 0.2

*Exceptions: ISWITCH = 0 (fixed sun angle)
RF11 = 8.30 E + 05
RF12 = 1.13 E + 06

LAST ITERATION = 9

ALT	CJO2	CJO3	CJOF2	CJOF3	CJO31	PREVO3	DOSINT	DMINT	PREVOH
0.	7.677E-30	7.741E-05	1.456E-32	5.171E-31	7.757E-06	7.329E+11	5.922E+18	2.194E+25	3.519E+06
200000.	3.914E-31	3.732E-05	1.135E-28	3.710E-27	6.931E-06	5.953E+11	8.790E+18	1.743E+25	2.321E+06
400000.	5.476E-28	3.854E-05	2.348E-25	6.351E-24	6.257E-06	4.852E+11	9.682E+18	1.367E+25	1.839E+06
600000.	3.169E-25	3.873E-05	1.955E-22	4.347E-21	5.459E-06	4.392E+11	8.590E+18	1.058E+25	1.367E+06
800000.	3.323E-23	3.907E-05	3.501E-20	1.407E-20	8.665E-06	4.170E+11	6.504E+18	8.253E+24	7.978E+05
1000000.	1.231E-20	3.944E-05	6.121E-17	6.709E-19	9.372E-06	4.672E+11	9.416E+18	6.297E+24	4.726E+05
1200000.	3.065E-19	3.990E-05	1.923E-15	2.720E-14	9.179E-06	5.981E+11	8.310E+18	4.727E+24	3.035E+05
1400000.	3.480E-17	4.055E-05	3.024E-14	4.326E-12	9.473E-06	7.080E+11	6.174E+18	3.443E+24	1.626E+05
1500000.	7.231E-16	4.153E-05	2.177E-12	2.316E-11	1.057E-05	1.477E+12	7.950E+18	2.433E+24	2.912E+05
1800000.	7.659E-15	4.395E-05	2.515E-11	2.526E-10	1.153E-05	3.347E+12	7.468E+18	1.747E+24	5.370E+05
2000000.	4.965E-14	4.875E-05	1.555E-10	1.754E-09	1.448E-05	4.437E+12	5.690E+18	1.264E+24	7.570E+05
2200000.	2.418E-13	5.951E-05	9.222E-10	6.543E-09	1.947E-05	5.076E+12	5.739E+18	9.217E+23	1.001E+06
2400000.	9.4[illegible]E-13	8.5[illegible]E-05	3.576E-09	3.237E-08	2.731E-05	5.388E+12	4.692E+18	6.752E+23	1.352E+06
2600000.	3.077E-12	8.417E-05	1.197E-08	1.049E-07	4.185E-05	5.234E+12	3.630E+18	4.975E+23	1.869E+06
2800000.	9.659E-12	1.115E-04	3.243E-08	2.805E-07	6.551E-05	4.606E+12	2.040E+18	3.539E+23	2.690E+06
3000000.	2.[illegible]E-11	[illegible]	7.343E-08	6.319E-07	1.088E-04	3.724E+12	1.801E+18	2.750E+23	4.050E+06
3200000.	4.670E-11	2.[illegible]	1.750E-07	1.199E-06	1.812E-04	2.740E+12	1.150E+18	2.050E+23	6.194E+06
3400000.	8.127E-11	7.535E-04	2.[illegible]E-07	1.976E-06	3.074E-04	1.751E+12	7.129E+17	1.522E+23	9.265E+06
3600000.	1.31[illegible]E-10	[illegible]	3.147E-07	3.117E-06	4.953E-04	[illegible]E+12	[illegible]E+17	1.176E+23	1.322E+07
3800000.	1.892E-10	9.[illegible]E-[illegible]	3.[illegible]E-07	5.435E-06	6.173E-04	5.621E+11	2.597E+17	9.956E+22	1.769E+07
4000000.	2.697E-10	1.[illegible]E-03	[illegible]E-07	8.394E-06	1.242E-03	3.601E+11	1.615E+17	6.858E+22	2.124E+07
4200000.	2.979E-10	1.97[illegible]E-03	[illegible]E-07	4.833E-06	1.876E-03	2.189E+11	1.036E+17	5.278E+22	2.261E+07
4400000.	3.434E-10	2.[illegible]E-03	5.235E-07	4.758E-06	2.468E-03	1.386E+11	5.782E+16	4.033E+22	2.204E+07
4600000.	3.772E-10	3.[illegible]E-03	5.434E-07	5.627E-06	2.924E-03	8.904E+10	4.503E+16	3.170E+22	2.019E+07
4800000.	4.047E-10	3.477E-03	[illegible]E-07	6.237E-06	3.417E-03	5.808E+10	3.035E+16	2.475E+22	1.773E+07
5000000.	4.234E-10	[illegible]E-03	6.[illegible]E-07	5.[illegible]E-06	3.739E-03	7.974E+10	2.060E+16	1.934E+22	1.453E+07
5200000.	4.665E-10	4.[illegible]E-03	1.519E-07	5.[illegible]E-06	3.977E-03	2.602E+10	1.422E+16	1.511E+22	1.345E+07
5400000.	5.098E-10	4.[illegible]E-03	7.[illegible]E-07	6.[illegible]E-06	4.151E-03	1.808E+10	9.985E+15	1.179E+22	1.179E+07
5600000.	5.677E-10	4.736E-03	7.785E-07	6.057E-06	4.275E-03	1.721E+10	6.779E+15	9.156E+21	1.049E+07
5800000.	5.320E-10	4.425E-03	5.[illegible]E-07	5.386E-06	4.353E-03	8.[illegible]E+09	4.732E+15	7.032E+21	9.158E+06
6000000.	7.417E-10	4.[illegible]E-03	9.736E-07	6.[illegible]E-06	4.423E-03	5.576E+09	3.349E+15	5.457E+21	7.389E+06
6200000.	9.[illegible]E-10	4.533E-03	1.024E-06	5.817E-06	4.456E-03	4.[illegible]E+09	2.380E+15	4.179E+21	6.651E+06
6400000.	5.976E-10	4.592E-03	1.142E-06	7.[illegible]E-06	4.493E-03	3.050E+09	1.665E+15	3.174E+21	5.367E+06
6600000.	1.[illegible]E-09	4.779E-03	1.195E-06	7.[illegible]E-06	4.522E-03	2.181E+09	1.146E+15	2.789E+21	4.461E+06
6800000.	1.176E-09	4.792E-03	1.279E-06	7.752E-06	4.538E-03	1.4[illegible]E+09	7.798E+14	1.779E+21	4.093E+06
7000000.	1.417E-09	4.[illegible]E-03	1.334E-06	7.744E-06	4.543E-03	8.672E+08	5.490E+14	1.719E+21	4.078E+06
7200000.	1.762E-09	4.615E-03	1.355E-06	7.935E-06	4.556E-03	6.123E+08	4.011E+14	9.540E+20	3.543E+06
7400000.	2.[illegible]E-09	4.8[illegible]E-03	1.431E-06	8.[illegible]E-06	4.561E-03	4.[illegible]E+08	2.974E+14	6.853E+20	3.103E+06
7600000.	2.[illegible]E-09	4.621E-03	1.456E-06	9.132E-06	4.564E-03	3.347E+08	2.214E+14	4.945E+20	2.365E+06
7800000.	3.298E-09	4.524E-03	1.431E-06	8.709E-06	4.567E-03	2.737E+08	1.606E+14	3.362E+20	1.567E+06
8000000.	3.829E-09	4.62[illegible]E-03	1.511E-06	9.267E-06	4.571E-03	2.226E+08	1.110E+14	2.278E+20	1.012E+06

LAST ITERATION = 9

ALT	CJCL2O	CJN2O	CJHNO3	CJH2O2	CJN2O5	CJCCL4	CJCH3CL
0.	3.669E-05	2.477E-26	1.941E-07	1.502E-06	1.406E-05	3.265E-20	1.979E-33
200000.	3.682E-05	1.459E-26	1.974E-07	1.614E-06	1.413E-05	1.775E-26	1.320E-29
400000.	3.693E-05	2.510E-25	2.001E-07	1.623E-06	1.419E-05	3.000E-23	2.597E-26
500000.	3.702E-05	1.500E-24	2.022E-07	1.631E-06	1.423E-05	1.544E-20	2.022E-23
600000.	3.711E-05	5.945E-20	2.048E-07	1.639E-06	1.427E-05	4.360E-19	9.739E-21
1000000.	3.720E-05	1.157E-17	2.074E-07	1.647E-06	1.432E-05	6.852E-16	2.203E-18
1200000.	3.732E-05	9.868E-15	2.101E-07	1.657E-06	1.437E-05	5.091E-14	2.040E-16
1400000.	3.746E-05	4.424E-12	2.139E-07	1.670E-06	1.444E-05	2.054E-12	9.702E-15
1500000.	3.771E-05	1.013E-12	2.207E-07	1.692E-06	1.457E-05	4.292E-11	2.357E-13
1900000.	3.829E-05	1.131E-11	2.350E-07	1.744E-06	1.483E-05	4.495E-10	2.730E-12
2000000.	3.935E-05	4.873E-11	2.788E-07	1.839E-06	1.537E-05	2.902E-09	1.964E-11
2200000.	4.095E-05	3.314E-10	3.712E-07	1.985E-06	1.624E-05	1.395E-08	1.006E-10
2400000.	4.333E-05	1.613E-09	6.347E-07	2.211E-06	1.728E-05	5.579E-08	4.021E-10
2600000.	4.704E-05	4.847E-09	1.290E-06	2.570E-06	1.911E-05	1.714E-07	1.319E-09
2800000.	5.315E-05	1.296E-08	2.777E-06	3.000E-06	2.236E-05	4.749E-07	3.602E-09
3000000.	6.359E-05	2.913E-08	5.535E-06	4.298E-06	2.848E-05	1.118E-06	8.184E-09
3200000.	8.137E-05	5.507E-08	1.014E-05	5.124E-06	3.945E-05	2.268E-06	1.546E-08
3400000.	1.097E-04	8.575E-08	1.550E-05	6.924E-06	5.509E-05	3.946E-06	2.465E-08
3600000.	1.563E-04	1.241E-07	2.223E-05	1.277E-05	7.999E-05	5.895E-06	3.412E-08
3800000.	2.624E-04	1.561E-07	2.877E-05	2.708E-05	1.079E-04	7.765E-06	4.259E-08
4000000.	2.614E-04	1.823E-07	3.353E-05	2.914E-05	1.385E-04	9.390E-06	4.951E-08
4200000.	3.204E-04	2.027E-07	3.852E-05	2.979E-05	1.689E-04	1.047E-05	5.490E-08
4400000.	3.437E-04	2.183E-07	4.240E-05	3.400E-05	1.953E-04	1.134E-05	5.937E-08
4600000.	4.180E-04	2.305E-07	4.549E-05	3.836E-05	2.192E-04	1.199E-05	6.318E-08
4800000.	4.524E-04	2.402E-07	4.768E-05	4.182E-05	2.369E-04	1.248E-05	6.714E-08
5000000.	4.784E-04	2.492E-07	4.975E-05	4.442E-05	2.502E-04	1.286E-05	7.213E-08
5200000.	4.970E-04	2.580E-07	5.122E-05	4.655E-05	2.600E-04	1.324E-05	7.897E-08
5400000.	5.108E-04	2.675E-07	5.225E-05	4.790E-05	2.672E-04	1.358E-05	8.619E-08
5600000.	5.209E-04	2.782E-07	5.332E-05	4.888E-05	2.724E-04	1.392E-05	9.987E-08
5800000.	5.282E-04	2.902E-07	5.430E-05	4.965E-05	2.760E-04	1.427E-05	1.136E-07
6000000.	5.334E-04	3.031E-07	5.527E-05	5.028E-05	2.786E-04	1.462E-05	1.287E-07
6200000.	5.372E-04	3.165E-07	5.625E-05	5.075E-05	2.805E-04	1.496E-05	1.443E-07
6400000.	5.405E-04	3.298E-07	5.723E-05	5.114E-05	2.819E-04	1.528E-05	1.600E-07
6500000.	5.429E-04	3.429E-07	5.816E-05	5.145E-05	2.829E-04	1.557E-05	1.759E-07
6800000.	5.447E-04	3.563E-07	5.900E-05	5.171E-05	2.836E-04	1.583E-05	1.931E-07
7000000.	5.460E-04	3.747E-07	5.974E-05	5.192E-05	2.841E-04	1.605E-05	2.128E-07
7200000.	5.470E-04	4.000E-07	6.036E-05	5.211E-05	2.843E-04	1.623E-05	2.357E-07
7400000.	5.477E-04	4.370E-07	6.087E-05	5.229E-05	2.847E-04	1.637E-05	2.611E-07
7600000.	5.482E-04	4.863E-07	6.127E-05	5.245E-05	2.849E-04	1.648E-05	2.872E-07
7800000.	5.487E-04	5.430E-07	6.155E-05	5.260E-05	2.851E-04	1.657E-05	3.122E-07
8000000.	5.490E-04	6.010E-07	6.182E-05	5.273E-05	2.851E-04	1.663E-05	3.344E-07

LAST ITERATION + 1

ALT	OJD2	OJD3	OJOF2	OJOF3	OJD1	PREVD2	DOZINT	D4INT	PREVDH
0.	7.785E-35	3.743E-07	1.+84E-32	5.210E-31	7.772E-06	7.231E+11	8.915E+18	2.134E+25	3.519E+06
200000.	3.955E-31	5.794E-07	1.1[illegible]E-26	7.754E-27	8.146E-06	5.052E+11	8.783E+18	1.747E+25	2.321E+06
400000.	6.505E-28	3.837E-05	2.7[illegible]E-25	5.769E-24	8.273E-06	4.050E+11	8.675E+18	1.567E+25	1.939E+06
600000.	3.199E-25	3.875E-05	1.379E-22	4.081E-21	8.485E-06	4.390E+11	8.582E+18	1.058E+25	1.767E+06
800000.	3.382E-23	3.91[illegible]E-05	3.352E-20	1.476E-19	8.681E-06	4.169E+11	8.497E+18	8.233E+24	7.978E+05
1000000.	1.237E-20	3.947E-05	2.131E-17	2.798E-16	8.889E-06	4.643E+11	8.409E+18	6.292E+24	4.720E+05
1200000.	3.847E-19	3.953E-05	1.381E-15	2.709E-14	9.149E-06	5.079E+11	8.302E+18	4.727E+24	3.036E+05
1400000.	3.494E-17	4.753E-05	9.357E-14	2.036E-12	9.491E-06	7.577E+11	8.167E+18	3.443E+24	1.626E+05
1600000.	7.255E-16	4.1[illegible]E-05	2.154E-12	2.724E-11	1.039E-05	1.473E+12	7.944E+18	2.439E+24	2.912E+05
1800000.	7.483E-15	4.799E-05	7.522E-11	2.533E-10	1.155E-05	3.747E+12	7.462E+18	1.747E+24	5.370E+05
2000000.	4.587E-14	4.865E-05	1.813E-10	1.759E-09	1.451E-05	4.433E+12	6.685E+18	1.254E+24	7.530E+05
2200000.	2.424E-13	5.595E-05	3.242E-10	8.262E-09	1.950E-05	5.072E+12	5.734E+18	9.213E+23	1.001E+06
2400000.	9.423E-13	6.595E-05	3.578E-09	7.703E-08	2.734E-05	5.384E+12	4.689E+18	6.732E+23	1.352E+06
2600000.	3.082E-12	8.419E-05	1.433E-08	1.542E-07	4.190E-05	5.931E+12	3.627E+18	4.970E+23	1.869E+06
2800000.	8.674E-12	1.115E-04	3.255E-08	2.809E-07	6.599E-05	4.535E+12	2.638E+18	3.689E+23	2.690E+06
3000000.	2.109E-11	1.563E-04	7.350E-08	5.320E-07	1.081E-04	3.726E+12	1.799E+18	2.735E+23	4.050E+06
3200000.	4.474E-11	2.323E-04	1.531E-07	1.200E-06	1.824E-04	2.697E+12	1.158E+18	2.056E+23	6.194E+06
3400000.	8.126E-11	3.556E-04	2.182E-07	2.906E-06	3.026E-04	1.759E+12	7.120E+17	1.552E+23	9.265E+06
3600000.	1.313E-10	5.505E-04	3.015E-07	2.710E-06	4.958E-04	1.072E+12	4.290E+17	1.175E+23	1.322E+07
3800000.	1.892E-10	8.592E-04	3.741E-07	3.424E-06	8.136E-04	5.216E+11	2.596E+17	8.935E+22	1.769E+07
4000000.	2.463E-10	1.343E-03	4.344E-07	3.994E-06	1.233E-03	3.099E+11	1.615E+17	6.838E+22	2.124E+07
4200000.	2.973E-10	1.937E-03	4.913E-07	4.436E-06	1.876E-03	2.188E+11	1.056E+17	5.278E+22	2.261E+07
4400000.	3.404E-10	2.525E-03	5.153E-07	4.768E-06	2.458E-03	1.788E+11	6.781E+16	4.083E+22	2.204E+07
4600000.	3.752E-10	3.051E-03	5.434E-07	5.067E-06	2.994E-03	8.903E+10	4.503E+16	3.173E+22	2.019E+07
4800000.	4.047E-10	3.477E-03	5.735E-07	5.237E-06	3.417E-03	5.780E+10	3.035E+16	2.475E+22	1.773E+07
5000000.	4.374E-10	3.795E-03	6.115E-07	5.423E-06	3.738E-03	3.874E+10	2.069E+16	1.934E+22	1.555E+07
5200000.	4.665E-10	4.033E-03	6.713E-07	5.608E-06	3.977E-03	2.602E+10	1.422E+16	1.511E+22	1.345E+07
5400000.	5.088E-10	4.207E-03	7.047E-07	5.826E-06	4.153E-03	1.608E+10	9.808E+15	1.179E+22	1.178E+07
5600000.	5.637E-10	4.372E-03	7.776E-07	6.033E-06	4.275E-03	1.021E+10	6.779E+15	9.151E+21	1.048E+07
5800000.	6.329E-10	4.429E-03	8.438E-07	6.282E-06	4.367E-03	8.257E+09	4.732E+15	7.082E+21	9.158E+06
6000000.	7.117E-10	4.480E-03	9.343E-07	6.546E-06	4.423E-03	5.576E+09	3.349E+15	5.457E+21	7.989E+06
6200000.	8.000E-10	4.523E-03	1.024E-06	6.817E-06	4.466E-03	4.106E+09	2.381E+15	4.179E+21	6.651E+06
6400000.	8.970E-10	4.559E-03	1.112E-06	7.062E-06	4.498E-03	3.050E+09	1.669E+15	3.274E+21	5.367E+06
6600000.	1.015E-09	4.579E-03	1.195E-06	7.330E-06	4.522E-03	2.180E+09	1.142E+15	2.389E+21	4.461E+06
6800000.	1.176E-09	4.595E-03	1.271E-06	7.592E-06	4.538E-03	1.441E+09	7.798E+14	1.779E+21	4.093E+06
7000000.	1.417E-09	4.606E-03	1.374E-06	7.744E-06	4.549E-03	8.672E+08	5.490E+14	1.310E+21	4.078E+06
7200000.	1.762E-09	4.613E-03	1.533E-06	7.967E-06	4.555E-03	6.123E+08	4.011E+14	9.540E+20	3.543E+06
7400000.	2.214E-09	4.618E-03	1.474E-06	8.031E-06	4.561E-03	4.247E+08	2.974E+14	6.853E+20	3.103E+06
7600000.	2.742E-09	4.622E-03	1.455E-06	8.132E-06	4.564E-03	3.347E+08	2.214E+14	4.845E+20	2.305E+06
7800000.	3.298E-09	4.624E-03	1.491E-06	8.299E-06	4.567E-03	2.737E+08	1.606E+14	3.362E+20	1.567E+06
8000000.	3.829E-09	4.627E-03	1.511E-06	8.267E-06	4.571E-03	2.290E+08	1.110E+14	2.278E+20	1.012E+06

LAST ITERATION + 1

ALT	CJCL2	CJN2O	CJHNO3	CJH2O2	CJN2O5	CJCCL4	CJCH3CL
0.	3.476E-05	2.[illegible]E-33	1.943E-[illegible]	1.[illegible]E-06	1.407E-05	3.269E-35	2.007E-33
200000.	3.503E-05	1.4[illegible]E-28	1.9[illegible]E-07	1.5[illegible]E-06	1.413E-05	1.795E-25	1.335E-29
400000.	3.507E-05	2.0[illegible]E-[illegible]	2.[illegible]E-07	1.524E-06	1.419E-05	3.032E-27	2.623E-26
600000.	3.707E-05	1.0[illegible]E-[illegible]	2.127E-07	1.[illegible]72E-06	1.423E-05	1.[illegible]56E-23	2.037E-23
800000.	3.712E-05	5.[illegible]E-[illegible]	2.0[illegible]E-07	1.540E-06	1.428E-05	4.391E-19	9.792E-21
1000000.	3.721E-05	1.1[illegible]E-17	2.073E-07	1.649E-06	1.432E-05	5.889E-16	2.213E-18
1200000.	3.732E-05	3.303E-16	2.1[illegible]E-07	1.[illegible]58E-06	1.438E-05	5.115E-14	2.048E-16
1400000.	3.747E-05	4.441E-14	2.141E-07	1.671E-06	1.445E-05	2.052E-12	9.737E-15
1600000.	3.772E-05	1.[illegible]E-11	2.2[illegible]E-07	1.[illegible]96E-06	1.457E-05	4.378E-11	2.304E-13
1800000.	3.830E-05	1.1[illegible]E-11	2.352E-07	1.744E-06	1.485E-05	4.419E-10	2.778E-12
2000000.	3.936E-05	7.[illegible]E-11	2.7[illegible]E-07	1.839E-06	1.537E-05	2.910E-09	1.960E-11
2200000.	4.096E-05	3.927E-10	3.775E-07	1.956E-06	1.514E-05	1.398E-08	1.048E-10
2400000.	4.334E-05	1.[illegible]E-[illegible]	5.355E-07	2.212E-06	1.723E-05	5.549E-08	4.028E-10
2600000.	4.705E-05	4.[illegible]E-09	1.232E-06	2.579E-06	1.942E-05	1.717E-07	1.321E-09
2800000.	5.316E-05	1.293E-08	3.75[illegible]E-06	3.208E-06	2.237E-05	4.[illegible]E-07	3.606E-09
3000000.	6.362E-05	2.9[illegible]E-08	5.[illegible]E-06	4.031E-06	2.850E-05	1.[illegible]E-06	8.192E-09
3200000.	8.136E-05	5.51[illegible]E-08	1.015E-05	6.128E-06	3.948E-05	2.270E-06	1.547E-08
3400000.	1.097E-04	1.[illegible]E-07	1.[illegible]E-05	9.926E-06	5.672E-05	7.942E-06	2.465E-08
3600000.	1.563E-04	1.240E-07	2.278E-05	1.277E-05	7.392E-05	5.396E-06	3.413E-08
3800000.	2.124E-04	1.501E-07	2.837E-05	1.750E-05	1.073E-04	7.706E-06	4.259E-08
4000000.	2.649E-04	1.923E-07	3.333E-05	2.314E-05	1.395E-04	9.300E-06	4.951E-08
4200000.	3.204E-04	2.0[illegible]E-07	3.852E-05	2.681E-05	1.593E-04	1.047E-05	5.498E-08
4400000.	3.737E-04	2.[illegible]E-07	4.[illegible]E-05	3.400E-05	1.963E-04	1.134E-05	5.937E-08
4600000.	4.289E-04	2.[illegible]E-07	4.549E-05	3.038E-05	2.192E-04	1.199E-05	6.318E-08
4800000.	4.524E-04	2.454E-07	4.755E-05	4.182E-05	2.339E-04	1.248E-05	6.745E-08
5000000.	4.781E-04	2.492E-07	4.970E-05	4.442E-05	2.502E-04	1.288E-05	7.213E-08
5200000.	4.976E-04	2.5[illegible]E-07	5.112E-05	4.655E-05	2.61[illegible]E-04	1.324E-05	7.897E-08
5400000.	5.109E-04	2.573E-07	5.229E-05	4.761E-05	2.672E-04	1.358E-05	8.819E-08
5600000.	5.209E-04	2.79[illegible]E-07	5.332E-05	4.889E-05	2.724E-04	1.392E-05	9.987E-08
5800000.	5.282E-04	2.9[illegible]E-07	5.437E-05	4.958E-05	2.761E-04	1.427E-05	1.136E-07
6000000.	5.334E-04	3.071E-07	5.527E-05	5.028E-05	2.795E-04	1.462E-05	1.287E-07
6200000.	5.373E-04	3.155E-07	5.525E-05	5.075E-05	2.815E-04	1.496E-05	1.447E-07
6400000.	5.405E-04	3.291E-07	5.723E-05	5.114E-05	2.819E-04	1.528E-05	1.608E-07
6600000.	5.429E-04	3.422E-07	5.816E-05	5.145E-05	2.829E-04	1.557E-05	1.759E-07
6800000.	5.447E-04	3.5[illegible]E-07	5.905E-05	5.171E-05	2.835E-04	1.580E-05	1.931E-07
7000000.	5.460E-04	3.747E-07	5.974E-05	5.192E-05	2.841E-04	1.605E-05	2.120E-07
7210000.	5.470E-04	4.005E-07	6.07[illegible]E-05	5.211E-05	2.845E-04	1.623E-05	2.357E-07
7400000.	5.476E-04	4.379E-07	6.087E-05	5.229E-05	2.847E-04	1.637E-05	2.611E-07
7600000.	5.482E-04	4.96[illegible]E-07	6.127E-05	5.245E-05	2.849E-04	1.648E-05	2.872E-07
7800000.	5.487E-04	5.473E-07	6.[illegible]E-05	5.256E-05	2.852E-04	1.657E-05	3.122E-07
8000000.	5.490E-04	6.010E-07	6.132E-05	5.275E-05	2.851E-04	1.[illegible]E-05	3.344E-07

K	ALT	H	OH	HO2	H2O2	O	O3	O3INT	O(D)
1	0.	4.0250E-01	7.5195E+06	1.1724E+09	1.0951E+11	2.2250E+03	7.2341E+11	8.9146E+18	8.1849E-03
2	200000.	2.4350E-01	2.7213E+06	7.9342E+08	1.1177E+11	2.2631E+03	5.9520E+11	8.7828E+18	7.8476E-03
3	400000.	2.0774E-01	1.8330E+06	5.9098E+08	6.5786E+10	2.7108E+03	4.8503E+11	8.5747E+18	8.2619E-03
4	600000.	1.5183E-01	1.3571E+06	4.4202E+08	3.6401E+10	7.4450E+03	4.3971E+11	8.5826E+18	9.2901E-03
5	800000.	9.9260E-02	7.9705E+05	2.6133E+08	1.4762E+10	4.4555E+03	4.1580E+11	8.4967E+18	1.0868E-02
6	1000000.	4.9577E-02	4.7238E+05	1.7996E+08	5.6790E+09	6.8342E+03	4.6406E+11	8.4087E+18	1.5054E-02
7	1200000.	2.0731E-02	3.3365E+05	1.1200E+08	2.0004E+09	1.2902E+04	5.9767E+11	8.3025E+18	2.4518E-02
8	1400000.	1.4961E-02	1.0236E+05	5.2067E+07	5.2520E+08	1.8267E+04	7.5770E+11	8.1069E+18	3.6409E-02
9	1600000.	2.3708E-02	2.9122E+05	5.3147E+07	9.6539E+08	6.7839E+04	1.4733E+12	7.9438E+18	1.0703E-01
10	1800000.	4.9685E-02	5.0704E+05	7.7034E+07	1.4107E+09	3.4656E+05	3.3437E+12	7.4621E+18	4.0786E-01
11	2000000.	9.5835E-02	7.2235E+05	9.0590E+07	1.8816E+09	9.8471E+05	4.4326E+12	6.6846E+18	9.6870E-01
12	2200000.	1.5541E-01	1.0039E+06	1.0402E+08	2.3626E+09	2.7891E+06	5.0716E+12	5.7341E+18	2.1070E+00
13	2400000.	2.0731E-01	1.7317E+06	1.1993E+08	2.7659E+09	5.2753E+06	5.3835E+12	4.6885E+18	4.4552E+00
14	2600000.	3.9769E-01	1.3558E+06	1.3057E+08	2.8610E+09	1.1068E+07	5.6300E+12	3.6272E+18	9.1208E+00
15	2800000.	1.7627E+00	9.3129E+06	1.3392E+08	2.6748E+09	2.1701E+07	4.6645E+12	2.6377E+18	1.7727E+01
16	3000000.	5.4151E+00	4.1438E+06	1.2755E+08	1.5970E+09	4.0154E+07	3.7136E+12	1.7993E+18	3.1918E+01
17	3200000.	1.7198E+01	6.1343E+06	1.0953E+08	8.2235E+08	6.8294E+07	2.6972E+12	1.1576E+18	5.3138E+01
18	3400000.	6.2390E+01	3.2367E+06	8.0755E+07	3.7561E+08	1.4070E+08	1.7587E+12	7.1201E+17	7.8998E+01
19	3600000.	2.0422E+02	1.3264E+07	5.9351E+07	1.2031E+08	1.7371E+08	1.0718E+12	4.2896E+17	1.0709E+02
20	3800000.	6.2057E+02	1.0336E+07	4.2146E+07	4.5472E+07	2.7005E+08	6.2155E+11	2.5962E+17	1.3760E+02
21	4000000.	2.8515E+03	2.1204E+07	3.1874E+07	2.6781E+07	4.1978E+08	3.5995E+11	1.6146E+17	1.6989E+02
22	4200000.	8.3168E+03	2.2038E+07	2.6146E+07	1.2028E+07	5.4146E+08	2.1894E+11	1.0358E+17	1.9994E+02
23	4400000.	2.1038E+04	2.2055E+07	2.2752E+07	8.0247E+06	9.7692E+08	1.3881E+11	6.7813E+16	2.2139E+02
24	4600000.	4.6056E+04	2.1432E+07	1.9141E+07	5.6146E+06	1.2755E+09	8.9029E+10	4.5030E+16	2.2727E+02
25	4800000.	8.7592E+04	1.7732E+07	1.6177E+07	3.9251E+06	1.6153E+09	5.7738E+10	3.0347E+16	2.1957E+02
26	5000000.	1.4843E+05	1.3652E+07	1.3643E+07	2.8100E+06	1.9284E+09	3.8736E+10	2.0694E+16	2.0601E+02
27	5200000.	2.3539E+05	1.0481E+07	1.1756E+07	1.9940E+06	2.2172E+09	2.6020E+10	1.4218E+16	1.8746E+02
28	5400000.	3.5468E+05	1.2767E+07	1.0127E+07	1.4377E+06	2.4931E+09	1.8078E+10	9.8081E+15	1.7088E+02
29	5600000.	5.0654E+05	1.0457E+07	8.9003E+06	1.0790E+06	2.7108E+09	1.2214E+10	6.7789E+15	1.5044E+02
30	5800000.	7.7860E+05	9.1589E+06	7.6781E+06	7.8500E+05	2.9778E+09	8.2369E+09	4.7316E+15	1.3095E+02
31	6000000.	1.1214E+06	7.9394E+06	6.6270E+06	5.6450E+05	3.1093E+09	5.5756E+09	3.3486E+15	1.1341E+02
32	6200000.	1.5736E+06	6.5512E+06	5.3812E+06	3.5544E+05	3.5370E+09	4.1051E+09	2.3804E+15	1.0556E+02
33	6400000.	2.6972E+06	5.7570E+06	4.2151E+06	2.6662E+05	4.0366E+09	3.0499E+09	1.6648E+15	9.9444E+01
34	6600000.	2.3779E+06	4.5038E+06	3.4568E+06	1.2691E+05	4.4704E+09	2.2796E+09	1.1418E+15	9.0540E+01
35	6800000.	4.0393E+06	4.2225E+06	3.6900E+06	9.7340E+04	4.5557E+09	1.4437E+09	7.7983E+14	7.6338E+01
36	7000000.	6.1751E+06	4.0705E+06	3.0901E+06	9.0146E+04	4.4178E+09	8.6726E+08	5.4904E+14	5.9545E+01
37	7200000.	9.2027E+06	3.5428E+06	2.5816E+06	5.8140E+04	4.9071E+09	5.1237E+08	4.0108E+14	5.4619E+01
38	7400000.	1.5934E+07	3.1130E+06	2.1672E+06	3.7594E+04	5.6266E+09	4.2469E+08	2.9738E+14	4.9598E+01
39	7600000.	1.3771E+07	2.7056E+06	1.4603E+06	1.5752E+04	7.3024E+09	3.3469E+08	2.2144E+14	5.1638E+01
40	7800000.	2.6231E+07	1.5688E+06	8.6073E+05	4.8376E+03	9.0796E+09	2.7373E+08	1.6060E+14	5.6323E+01
41	8000000.	3.2625E+07	1.1122E+06	4.6132E+05	1.2679E+03	1.7741E+10	2.2204E+08	1.1102E+14	6.1563E+01

K	ALT	NO	NO2	HNO3	HO2	N2O5	NOX
1	[illegible]	5.9690E+08	[illegible]E+09	3.9608E+10	4.4359E+08	6.[illegible]274E+08	4.4915E+10
2	200000.	5.1295E+08	[illegible]E+09	1.[illegible]E+10	1.1346E+08	7.3251E+07	2.1777E+10
3	400000.	3.3705E+08	4.2[illegible]E+[illegible]	5.9[illegible]E+09	2.8126E+08	7.7697E+06	9.7811E+09
4	600000.	2.2770E+08	3.1179E+09	1.3771E+10	8.7391E+07	1.[illegible]978E+06	4.8476E+09
5	800000.	2.2[illegible]E+08	[illegible]E+09	2.4715E+09	3.7347E+07	7.6365E+05	2.8480E+09
6	1000000.	2.7[illegible]E+08	1.1397E+09	1.5[illegible]E+09	1.7[illegible]E+07	1.2481E+05	1.9789E+09
7	1200000.	3.5[illegible]E+08	1.[illegible]712E+09	[illegible].7412E+09	1.5727E+07	1.5332E+05	2.2572E+09
8	1400000.	4.4[illegible]E+08	2.8[illegible]E+08	[illegible].7[illegible]77E+09	1.4549E+07	2.1634E+05	2.6826E+09
9	1600000.	5.1[illegible]E+08	[illegible].77E+08	7.8[illegible]E+09	2.2[illegible]9E+07	3.9292E+05	4.6838E+09
10	1800000.	5.3[illegible]E+08	[illegible].1403E+09	9.5125E+09	1.1743E+08	3.4222E+06	9.8782E+09
11	2000000.	5.9[illegible]E+09	5.8297E+08	1.[illegible]707E+10	[illegible].0745E+08	9.7911E+06	1.2102E+10
12	2200000.	2.9[illegible]E+08	[illegible].73[illegible]E+08	1.[illegible]E+10	5.1587E+08	2.3167E+07	1.2449E+10
13	2400000.	3.6[illegible]E+09	1.7[illegible]E+09	9.0112E+09	[illegible].2295E+08	5.2093E+07	1.1772E+10
14	2600000.	5.[illegible]E+08	[illegible].5E+09	6.8[illegible]02E+09	1.0[illegible]E+08	1.2652E+08	1.0437E+10
15	2800000.	6.8[illegible]E+08	[illegible]E+09	[illegible].5[illegible]E+10	2.4314E+08	1.7951E+08	8.8929E+09
16	3000000.	8.7[illegible]E+07	[illegible]E+09	2.7[illegible]E+09	2.579[illegible]E+08	1.4859E+08	7.2907E+09
17	3200000.	1.0[illegible]E+08	[illegible].7512E+09	[illegible].5585E+09	2.[illegible]996E+06	7.2225E+07	5.7866E+09
18	3400000.	1.[illegible]E+09	[illegible]E+09	1.5707E+09	1.7775E+08	2.3214E+07	4.4596E+09
19	3600000.	1.6[illegible]E+09	1.[illegible]E+09	[illegible].[illegible]E+09	7.3768E+08	5.4075E+06	3.3714E+09
20	3800000.	1.2[illegible]E+09	1.[illegible]E+09	2.0711E+08	3.2732E+05	9.7387E+05	2.5136E+09
21	4000000.	1.[illegible]E+09	[illegible]E+09	3.1[illegible]E+07	[illegible].2443E+05	1.2367E+05	1.8572E+09
22	4200000.	1.0[illegible]E+09	[illegible]E+08	2.5151E+07	4.3121E+04	1.3593E+04	1.3639E+09
23	4400000.	6.7[illegible]E+08	1.1720E+08	7.2[illegible]75E+06	1.[illegible]042E+04	1.3223E+03	9.9731E+08
24	4600000.	6.7[illegible]E+08	[illegible]E+07	1.[illegible]E+06	4.7914E+[illegible]	1.2215E+02	7.2746E+08
25	4800000.	5.1[illegible]E+08	[illegible]E+07	[illegible].8218E+05	1.3221E+07	1.1222E+01	5.3101E+08
26	5000000.	[illegible]E+[illegible]	[illegible]E+[illegible]	1.3[illegible]E+05	3.7[illegible]57E+07	1.[illegible]137E+00	3.9217E+08
27	5200000.	2.8[illegible]E+08	7.8[illegible]E+05	3.8[illegible]56E+04	1.0306E+02	9.1362E-02	2.8866E+08
28	5400000.	2.[illegible]E+08	[illegible]E+08	1.1[illegible]E+04	2.3654E+01	7.8476E-03	2.1713E+08
29	5600000.	1.5[illegible]E+08	6.[illegible]79E+05	3.5[illegible]1E+03	6.5983E+00	6.3858E-04	1.5589E+08
30	5800000.	[illegible].1[illegible]E+08	[illegible]E+05	1.96[illegible]E+[illegible]	1.6131E+[illegible]	5.[illegible]657E-05	1.1296E+08
31	6000000.	8.4[illegible]E+07	1.[illegible]96[illegible]E+[illegible]	3.1147E+02	7.7639E-01	3.7993E-06	8.0973E+07
32	6200000.	5.7[illegible]E+07	[illegible].7[illegible]3E+[illegible]	8.9376E+01	8.[illegible]812E-02	2.6[illegible]0E-07	5.7967E+07
33	6400000.	4.0[illegible]E+07	1.[illegible]E+04	2.4[illegible]E+01	1.7505E-02	1.6878E-08	4.0917E+07
34	6600000.	2.8[illegible]E+07	[illegible].7[illegible]E+[illegible]	6.[illegible]E+06	3.7336E-03	9.[illegible]74[illegible]E-10	2.8284E+07
35	6800000.	1.9142E+[illegible]	2.7323E+03	1.[illegible]197E+07	[illegible].55[illegible]E-04	4.2570E-11	1.9197E+07
36	7000000.	1.3[illegible]E+07	[illegible].3116E+02	5.07[illegible]E-01	7.5475E-[illegible]	1.4440E-12	1.3597E+07
37	7200000.	8.[illegible]317E+06	6.7247E+02	1.2141E-01	1.[illegible]734E-05	5.2497E-14	8.0543E+06
38	7400000.	[illegible].951[illegible]	1.2244E+01	2.[illegible]06E-02	1.[illegible]755E-06	1.5844E-15	4.9775E+06
39	7600000.	2.9400E+06	1.2379E+01	4.9796E-03	2.1[illegible]6E-07	4.[illegible]949E-17	2.9603E+06
40	7800000.	1.5[illegible]E+06	[illegible].[illegible]85E+01	7.5365E-04	3.7011E-08	1.1247E-18	1.6859E+06
41	8000000.	9.0974E+05	[illegible].1[illegible]E+01	1.0276E-04	3.1156E-09	3.1[illegible]7E-20	9.6107E+05

K	ALT	CL		CLO		HCL		CLNO3		OCLX
1	0.	1.2385E+04	5.2770E-16	7.4637E+06	7.0936E-13	2.2739E+10	9.4742E-10	1.2304E+09	5.1031E-11	1.1000E-09
2	20000.	5.3000E+03	2.5009E-16	3.8[illegible]3E+06	1.8077E-13	1.1225E+10	5.6649E-10	3.0865E+09	1.4663E-11	5.7000E-10
3	40000.	3.5227E+03	1.0123E-16	2.5959E+06	1.5481E-13	5.7213E+09	3.4654E-10	8.2118E+07	4.9738E-12	3.1000E-10
4	60000.	1.8344E+03	1.3575E-16	1.3009E+06	1.3440E-13	2.9815E+09	2.2250E-10	2.7501E+07	2.0523E-12	1.7000E-10
5	80000.	9.8439E+02	9.0147E-17	8.3335E+05	8.2410E-14	1.7798E+09	1.6359E-10	9.2725E+06	8.5225E-13	1.2000E-10
6	100000.	5.7397E+02	5.5715E-17	5.3105E+05	5.0901E-14	1.1148E+09	1.2765E-10	4.5997E+06	5.2670E-13	8.4000E-11
7	120000.	3.5940E+02	3.0325E-17	4.0350E+05	5.8785E-14	1.0755E+09	1.4972E-10	4.9495E+06	7.1597E-13	1.1000E-10
8	140000.	2.5637E+02	1.7[illegible]E-17	3.1419E+05	3.5114E-14	1.0124E+09	1.7069E-10	4.5705E+06	7.7062E-13	1.3000E-10
9	160000.	1.5363E+03	7.5715E-18	2.6320E+05	3.3739E-13	1.[illegible]865E+09	2.6480E-10	3.5410E+07	8.6303E-12	2.4000E-10
10	180000.	4.4981E+03	1.5024E-17	2.7345E+07	6.1418E-12	1.2646E+09	4.4762E-10	4.0575E+08	1.4368E-10	6.0000E-10
11	200000.	5.7145E+03	3.3277E-17	4.0734E+07	2.0367E-11	9.9246E+08	4.9623E-10	7.9573E+08	3.9767E-10	9.5000E-10
12	220000.	6.5936E+03	5.1175E-18	5.3397E+07	4.1215E-11	7.[illegible]912E+08	4.9624E-10	9.6510E+08	6.7536E-10	1.3000E-09
13	240000.	1.1018E+04	1.0377E-14	6.5408E+07	6.3457E-11	4.5808E+08	4.8264E-10	9.6929E+08	9.5923E-10	1.6000E-09
14	260000.	1.5036E+04	2.7183E-14	6.5481E+07	8.5267E-11	3.6947E+08	4.9627E-10	8.4657E+08	1.1371E-09	1.8000E-09
15	280000.	2.3119E+04	4.2[illegible]E-14	5.4243E+07	1.1846E-10	2.9271E+08	5.3975E-10	6.7576E+08	1.2454E-09	2.0000E-09
16	300000.	4.2178E+04	1.0[illegible]E-13	7.3610E+07	1.8396E-10	2.5577E+08	6.4497E-10	4.8037E+08	1.2100E-09	2.2000E-09
17	320000.	5.5.13E+04	2.9[illegible]E-13	5.3703E+07	3.0639E-10	2.3645E+08	8.0865E-10	2.9631E+08	1.0134E-09	2.3000E-09
18	340000.	1.[illegible]95E+05	3.7755E-13	1.0046E+08	4.9310E-10	2.2114E+08	1.0243E-09	1.4473E+08	6.7074E-10	2.3000E-09
19	360000.	3.4508E+05	2.1573E-12	1.0395E+08	8.8433E-10	1.9234E+08	1.2042E-09	5.7829E+07	2.3559E-10	2.4000E-09
20	380000.	5.5262E+05	4.8507E-12	9.4[illegible]2E+07	7.9234E-10	1.5954E+08	1.3235E-09	1.5046E+07	1.2559E-10	2.4000E-09
21	400000.	8.3355E+05	9.7[illegible]5E-12	6.9580E+07	7.7320E-10	1.2952E+08	1.4592E-09	3.2426E+06	3.6033E-11	2.4000E-09
22	420000.	1.1255E+06	1.5182E-11	4.4753E+07	6.5835E-10	1.0756E+08	1.5823E-09	5.7002E+05	8.3851E-12	2.4000E-09
23	440000.	1.0978E+06	2.1271E-11	2.5756E+07	4.9304E-10	9.0[illegible]E+07	1.7454E-09	8.6056E+04	1.6674E-12	2.4000E-09
24	460000.	1.0548E+06	2.7037E-11	1.3507E+07	3.4291E-10	7.4801E+07	1.8990E-09	1.1893E+04	3.0194E-13	2.4000E-09
25	480000.	9.5345E+05	3.1744E-11	6.7314E+06	2.2377E-10	6.2140E+07	2.0147E-09	1.6817E+03	5.5410E-14	2.4000E-09
26	500000.	8.4325E+05	3.5245E-11	3.4960E+06	1.4726E-10	4.9571E+07	2.0882E-09	2.6951E+02	1.1362E-14	2.4000E-09
27	520000.	7.1039E+05	3.8315E-11	1.7967E+06	9.5738E-11	3.9768E+07	2.1370E-09	4.4687E+01	2.4025E-15	2.4000E-09
28	540000.	6.2405E+05	4.1826E-11	9.4276E+05	6.4030E-11	3.1867E+07	2.1563E-09	8.1950E+00	5.5710E-16	2.4000E-09
29	560000.	5.6264E+05	4.7369E-11	4.9165E+05	4.2437E-11	2.5374E+07	2.1859E-09	1.4722E+00	1.2702E-16	2.4000E-09
30	580000.	4.1246E+05	5.5295E-11	2.5335E+05	2.7824E-11	2.0119E+07	2.1987E-09	2.5970E-01	2.8523E-17	2.4000E-09
31	600000.	3.7[illegible]E+05	4.7044E-11	1.5041E+05	1.8252E-11	1.5754E+07	2.2066E-09	4.5711E-02	6.3986E-18	2.4000E-09
32	620000.	2.7301E+05	1.5794E-11	8.3971E+04	1.2415E-11	1.2450E+07	2.2107E-09	8.6870E-03	1.5413E-18	2.4000E-09
33	640000.	2.2476E+05	5.7[illegible]E-11	5.7139E+04	8.4236E-12	9.7705E+06	2.2126E-09	1.5890E-03	3.5982E-19	2.4000E-09
34	660000.	1.5317E+05	5.7324E-11	1.3[illegible]E+04	5.6745E-12	7.6016E+06	2.2130E-09	2.7475E-04	7.9984E-20	2.4000E-09
35	680000.	1.4563E+05	5.4375E-11	9.5[illegible]1E+03	3.7374E-12	5.8325E+06	2.2136E-09	4.4808E-05	1.6832E-20	2.4000E-09
36	700000.	1.1053E+05	5.4545E-11	4.7116E+03	2.3207E-12	4.4870E+06	2.2151E-09	8.1799E-06	3.0503E-21	2.4000E-09
37	720000.	8.9528E+04	5.7522E-11	2.3583E+03	1.5273E-12	3.3957E+06	2.2128E-09	8.7686E-07	5.7125E-22	2.4000E-09
38	740000.	7.7949E+04	5.1580E-11	1.1470E+03	9.9633E-13	2.5453E+06	2.2095E-09	1.1549E-07	1.0025E-22	2.4000E-09
39	760000.	5.5158E+04	7.3834E-11	5.6[illegible]7E+02	7.2103E-13	1.8707E+06	2.1975E-09	1.5694E-08	1.8347E-23	2.4000E-09
40	780000.	3.2555E+04	9.3594E-11	7.6721E+02	5.7[illegible]2E-13	1.3542E+06	2.1719E-09	2.1584E-09	3.4523E-24	2.4000E-09
41	800000.	6.8405E+03	1.5.15E-10	2.3231E+02	5.0989E-13	9.6651E+05	2.1214E-09	3.0077E-10	6.6016E-25	2.4000E-09

K	ALT	[illegible] + O3	O4 + O3	HO2 + O3	HO2 + O	OH + O	NO2 + O	CLO + O	O + O3	O2 + HV
1	0.	7.9417E+00	[illegible]	5.4765E+05	1.2636E+02	3.6164E-01	8.8136E+01	1.7855E+00	8.8991E+01	7.4835E-16
2	200000.	5.8444E+00	5.5239E+04	2.4308E+05	7.7405E+01	2.2654E-01	4.1214E+01	8.6970E-01	2.2102E+01	3.2922E-12
3	400000.	2.5775E+01	7.5805E+04	1.2619E+05	6.9392E+01	2.1305E-01	2.2037E+01	6.9632E-01	1.6249E+01	4.2505E-09
4	600000.	1.7378E+01	2.0279E+04	6.5652E+04	6.2644E+01	1.9374E-01	1.5987E+01	5.0268E-01	1.3468E+01	1.6987E-06
5	800000.	9.2444E-01	9.5745E+03	2.7892E+04	4.9936E+01	1.3878E-01	1.2168E+01	3.6900E-01	1.0559E+01	3.6228E-04
6	1000000.	5.9876E-01	4.5248E+03	1.3922E+04	4.5281E+01	1.1891E-01	1.5191E+01	3.1958E-01	1.0947E+01	4.2985E-02
7	1200000.	4.7788E-01	2.7775E+03	7.5964E+03	4.7742E+01	1.2870E-01	3.7021E+01	4.1427E-01	1.4508E+01	2.4349E+00
8	1400000.	[illegible]	1.3536E+03	3.3377E+03	7.5975E+01	9.4879E-02	8.2393E+01	3.0273E-01	1.4495E+01	8.2552E+01
9	1600000.	9.1092E-01	7.8302E+02	5.1224E+03	1.3198E+02	6.0859E-01	3.7909E+02	8.3717E+00	7.3107E+01	1.1865E+03
10	1800000.	4.5220E+00	1.8217E+04	1.6511E+04	8.4158E+02	5.8556E+00	3.4245E+03	4.6015E+02	1.0468E+03	8.4255E+03
11	2000000.	9.8058E+00	5.7061E+04	4.3952E+04	2.8817E+03	2.5950E+01	1.3093E+04	3.1373E+03	4.8776E+03	3.9724E+04
12	2200000.	2.1052E+01	1.7387E+05	4.3593E+04	8.2721E+03	7.8990E+01	4.2756E+04	1.1224E+04	1.6464E+04	1.3824E+05
13	2400000.	4.3649E+01	5.5379E+04	6.1952E+04	2.1258E+04	2.3971E+02	1.3443E+05	2.7987E+04	4.4728E+04	3.8819E+05
14	2600000.	3.4910E+01	1.4769E+05	7.4922E+04	4.3516E+04	7.1164E+02	4.2241E+05	5.8134E+04	1.1156E+05	9.1633E+05
15	2800000.	2.1375E+02	2.9639E+05	7.7498E+04	1.0145E+05	2.0179E+03	1.0835E+06	1.1556E+05	2.2713E+05	1.8784E+06
16	3000000.	4.9847E+02	7.7227E+05	6.7934E+04	1.7417E+05	5.5702E+03	2.1428E+06	2.7869E+05	3.7980E+05	3.3449E+06
17	3200000.	1.2051E+03	3.2515E+06	4.5597E+04	2.5834E+05	1.4547E+04	3.4268E+06	5.0720E+05	5.4674E+05	5.1818E+06
18	3400000.	2.5304E+03	3.4184E+06	2.5771E+04	3.2517E+05	3.6249E+04	4.5557E+06	9.9717E+05	6.8903E+05	7.0137E+06
19	3600000.	6.5258E+03	3.7123E+06	1.2644E+04	3.7182E+05	8.2830E+04	5.1730E+06	1.6374E+06	7.8262E+05	8.4190E+06
20	3800000.	1.3796E+04	2.5273E+06	5.5356E+03	4.1813E+05	1.7550E+05	5.0903E+06	2.2380E+06	8.3284E+05	9.0646E+06
21	4000000.	2.6626E+04	2.1195E+06	2.8744E+03	5.0145E+05	3.3397E+05	4.3282E+06	2.5950E+06	8.7918E+05	8.8813E+06
22	4200000.	4.7324E+04	1.4568E+06	1.5996E+03	6.3951E+05	5.5308E+05	3.1633E+06	2.5899E+06	9.5217E+05	8.0973E+06
23	4400000.	7.5938E+04	9.3744E+04	9.5306E+02	8.1239E+05	8.0107E+05	2.0029E+06	2.2110E+06	1.0227E+06	7.0271E+06
24	4600000.	1.6522E+05	5.2322E+04	5.3357E+02	9.5321E+05	1.0151E+06	1.1297E+06	1.6073E+06	1.0295E+06	5.9112E+06
25	4800000.	1.3163E+05	2.7759E+04	3.4455E+02	1.0428E+06	1.0470E+06	5.9306E+05	1.0308E+06	9.3355E+05	4.9129E+06
26	5000000.	1.7989E+05	2.2275E+04	1.9759E+02	1.0573E+06	1.1771E+06	2.9849E+05	5.3249E+05	7.4696E+05	4.1122E+06
27	5200000.	1.5925E+05	1.2712E+04	1.1159E+02	1.0766E+06	1.1851E+06	1.4575E+05	3.6985E+05	5.6024E+05	3.4706E+06
28	5400000.	1.5671E+05	7.7657E+03	6.0842E+01	9.9052E+05	1.1520E+06	6.9678E+04	2.1752E+05	3.8972E+05	2.9935E+06
29	5600000.	1.6871E+05	4.1755E+03	3.1665E+01	9.3348E+05	1.0995E+06	3.1832E+04	1.2185E+05	2.5402E+05	2.6134E+06
30	5800000.	1.7705E+05	2.3729E+03	1.7721E+01	8.5031E+05	1.0251E+06	1.4359E+04	6.7126E+04	1.6460E+05	2.3018E+06
31	6000000.	1.5207E+05	1.3386E+03	9.2812E+00	7.8418E+05	9.4721E+03	6.2961E+03	3.6482E+04	1.0276E+05	2.0337E+06
32	6200000.	1.6372E+05	6.5470E+02	4.6423E+00	6.9274E+05	8.5522E+03	2.8233E+03	2.1412E+04	6.6016E+04	1.8036E+06
33	6400000.	1.5413E+05	3.4014E+02	2.2319E+00	6.0016E+05	7.6421E+03	1.2467E+03	1.2632E+04	4.2793E+04	1.5855E+06
34	6600000.	1.6002E+05	1.7594E+02	1.0594E+00	5.1957E+05	6.8034E+03	5.1110E+02	7.1146E+03	2.5456E+04	1.3940E+06
35	6800000.	1.5101E+05	9.1485E+01	5.7755E-01	4.5665E+05	5.1708E+05	1.8672E+02	3.6084E+03	1.2737E+04	1.2525E+06
36	7000000.	1.3833E+05	4.5117E+01	2.4235E-01	4.3236E+05	5.7059E+05	5.0865E+01	1.5865E+03	5.3336E+03	1.1483E+06
37	7200000.	1.4651E+05	2.3635E+01	1.1497E-01	3.9271E+05	5.7891E+05	2.4184E+01	8.0142E+02	3.0131E+03	1.0826E+06
38	7400000.	1.5386E+05	1.1804E+01	4.9855E-02	3.5538E+05	5.8837E+05	7.1064E+00	4.5788E+02	1.6211E+03	1.0202E+06
39	7600000.	1.7205E+05	7.5158E+00	2.9903E-02	2.9657E+05	4.8826E+05	2.5812E+00	3.0622E+02	1.1111E+03	9.3831E+05
40	7800000.	2.5633E+05	3.4806E+00	7.5532E-03	2.2715E+05	4.1740E+05	9.1168E-01	2.3555E+02	8.0636E+02	8.2851E+05
41	8000000.	1.9815E+05	1.0163E+00	2.2208E-03	1.6038E+05	3.4826E+05	2.9826E-01	1.9754E+02	5.6441E+02	6.9775E+05

INTEGRATED LOSS FOR OZONE

	4.4776E+11	5.4850E+11	9.4193E+10	2.8573E+12	2.9056E+12	6.7753E+12	3.4700E+12	2.1652E+12	1.9295E+13

K	ALT	H2O + HV	H2O + O1D	CH4 + O1D	HNO3 + HV	CO + OH	NO + HO2	JH2O2+HO2O2	CL + CH4
1	0.	1.5734E+01	2.2071E+06	6.2082E+01	7.7040E+03	1.2178E+06	3.2572E+05	6.3616E+05	5.2160E+04
2	200000.	1.6374E+01	8.5143E+05	5.8835E+01	3.9061E+03	5.5737E+05	1.4152E+05	3.6073E+05	1.7363E+04
3	400000.	1.5483E+01	4.7351E+05	5.6576E+01	1.7952E+03	7.8147E+05	5.0915E+04	2.1856E+05	6.3570E+03
4	600000.	1.2276E+01	2.5751E+05	5.1500E+01	8.6550E+02	2.1400E+05	2.6538E+04	1.1907E+05	2.3681E+03
5	800000.	1.1047E+01	7.528 2E+04	4.8647E+01	5.0045E+02	9.5249E+04	1.3182E+04	4.8396E+04	7.8246E+02
6	1000000.	2.2964E+01	3.4932E+04	5.4107E+01	3.2897E+02	4.2693E+04	6.8509E+03	1.8711E+04	2.7244E+02
7	1200000.	1.5662E+01	8.5247E+03	5.9531E+01	3.6587E+02	1.9588E+04	5.0321E+03	6.5307E+03	1.5077E+02
8	1400000.	3.1145E+01	2.2198E+03	8.8772E+01	3.8457E+02	8.3048E+03	3.7745E+03	2.7545E+03	7.2608E+01
9	1600000.	4.2242E+01	5.5537E+02	1.7502E+02	8.4770E+02	6.5573E+03	2.6435E+03	3.2627E+03	1.3055E+02
10	1800000.	1.0-01E+02	2.2736E+02	4.2831E+02	2.6499E+03	5.7620E+03	2.3145E+03	4.9198E+03	2.0259E+02
11	2000000.	1.6502E+02	3.6244E+02	5.5236E+02	2.8732E+03	4.3210E+03	2.5756E+03	6.9197E+03	3.1078E+02
12	2200000.	2.4121E+02	5.5474E+03	9.5347E+02	3.6502E+03	3.6499E+03	3.3607E+03	9.3794E+03	2.8959E+02
13	2400000.	3.4865E+02	9.3751E+03	1.2730E+03	5.7140E+03	3.5019E+03	5.0534E+03	1.2230E+04	2.6122E+02
14	2600000.	4.9432E+02	1.5426E+04	2.6545E+03	6.8715E+03	3.7405E+03	8.3297E+03	1.4442E+04	2.5411E+02
15	2800000.	5.8299E+02	2.8377E+04	2.0984E+03	1.2557E+04	4.3275E+03	1.2528E+04	1.5228E+04	2.7058E+02
16	3000000.	5.8265E+02	6.1147E+04	2.2230E+03	1.5250E+04	5.2520E+03	1.6438E+04	1.3728E+04	3.3308E+02
17	3200000.	1.1474E+03	7.1371E+04	2.2372E+03	1.5805E+04	6.7517E+03	2.7941E+04	1.0079E+04	4.4997E+02
18	3400000.	1.2344E+03	7.5583E+04	2.9097E+03	1.3501E+04	7.2897E+03	1.5490E+04	5.9521E+03	6.2137E+02
19	3600000.	1.0454E+03	5.3308E+04	1.5525E+03	9.9465E+03	7.7194E+03	1.3535E+04	3.0845E+03	7.7006E+02
20	3800000.	5.8232E+02	3.7015E+04	1.1555E+03	5.0775E+03	7.5260E+03	1.0606E+04	1.5991E+03	8.3049E+02
21	4000000.	5.0149E+02	5.0110E+04	9.4259E+02	2.7608E+03	6.5667E+03	8.3245E+03	9.6167E+02	7.6911E+02
22	4200000.	5.7405E+02	3.0530E+04	5.9293E+02	1.5076E+03	5.1307E+03	6.4856E+03	6.9264E+02	6.1450E+02
23	4400000.	5.6762E+02	2.2555E+04	4.0094E+02	3.0770E+02	3.0245E+03	4.8618E+03	5.4564E+02	4.4496E+02
24	4600000.	3.0575E+02	1.7572E+04	2.7057E+02	8.4045E+01	2.8964E+03	3.4509E+03	4.3103E+02	3.0398E+02
25	4800000.	4.3425E+02	1.7125E+04	1.7757E+02	2.3005E+01	2.1479E+03	2.3052E+03	3.2830E+02	1.9792E+02
26	5000000.	3.5402E+02	9.5453E+03	1.1302E+02	6.7305E+00	1.6503E+03	1.4738E+03	2.4963E+02	1.2375E+02
27	5200000.	3.3593E+02	5.8327E+03	7.9912E+01	1.0766E+00	1.2892E+03	9.2119E+02	1.8486E+02	7.6250E+01
28	5400000.	7.7440E+02	4.9519E+03	5.5041E+01	6.1427E-01	1.0432E+03	5.5796E+02	1.3743E+02	4.5638E+01
29	5600000.	2.5805E+02	3.4327E+03	3.7307E+01	1.9104E-01	8.5895E+02	3.4020E+02	1.0548E+02	2.7162E+01
30	5800000.	9.1915E+02	2.5375E+03	2.5160E+01	5.7642E-02	6.9009E+02	2.0105E+02	7.7798E+01	1.6020E+01
31	6000000.	9.4150E+02	1.5334E+03	1.6932E+01	1.7225E-02	5.4418E+02	1.1504E+02	5.5775E+01	9.2909E+00
32	6200000.	7.7223E+02	1.0158E+03	1.2345E+01	5.0277E-03	4.0105E+02	5.0158E+01	3.6080E+01	5.1360E+00
33	6400000.	5.0396E+02	5.9355E+02	9.0777E+00	1.3779E-03	2.7576E+02	2.9296E+01	2.1132E+01	2.8000E+00
34	6600000.	2.6550E+02	2.8067E+02	6.4173E+00	3.7166E-04	1.8895E+02	1.4821E+01	1.3059E+01	1.4954E+00
35	6800000.	5.3425E+02	1.1957E+02	4.1859E+00	1.0578E-04	1.3629E+02	7.6456E+00	1.0066E+01	7.6922E-01
36	7000000.	7.0705E+02	1.2773E+02	2.4814E+00	3.6771E-05	5.8706E+02	4.3035E+00	9.3611E+00	3.6664E-01
37	7200000.	9.2097E+02	5.1237E+01	1.7273E+00	7.3283E-06	7.2466E+02	1.9557E+00	6.0596E+00	1.8130E-01
38	7400000.	7.7035E+02	2.5574E+01	1.2778E+00	1.6742E-06	8.4726E+02	8.5155E-01	3.9316E+00	8.7495E-02
39	7600000.	7.2985E+01	1.3405E+01	9.0714E-01	3.0509E-07	9.2572E+02	2.8257E-01	1.6340E+00	4.5673E-02
40	7800000.	2.2977E+02	7.5155E+00	7.2071E-01	4.7029E-08	7.2294E+02	7.7378E-02	5.1523E-01	2.5751E-02
41	8000000.	3.2530E+02	7.9130E+00	5.7973E-01	5.3489E-09	5.9028E+02	1.8327E-02	1.3501E-01	1.5500E-02

K	ALT	H2O2 + OH	HO2 + OH	HCL + OH	CH4 + OH	O3 + NO2	OH + HNO3	OH + OH	H + HO2	CL + HO2
1	0.	4.1009E+06	1.6383E+05	5.7270E+04	1.0950E+06	2.7184E+04	1.9480E+04	4.7118E+01	9.5663E-03	4.2866E+02
2	200000.	7.8324E+05	7.8341E+04	1.8732E+04	4.6746E+05	9.6911E+03	5.7859E+03	1.8320E+01	3.9399E-03	1.4038E+02
3	400000.	1.6276E+05	4.0852E+04	5.6213E+03	2.2350E+05	3.6797E+03	1.8935E+03	1.1490E+01	2.4408E-03	5.9699E+01
4	600000.	3.9827E+04	2.4172E+04	2.5130E+03	1.0445E+05	1.5149E+03	6.2939E+02	6.3547E+00	1.3422E-03	2.4590E+01
5	800000.	1.2465E+04	8.3782E+03	6.2131E+02	3.4525E+04	6.8917E+02	1.8305E+02	2.1642E+00	4.7973E-04	8.3081E+00
6	1000000.	2.3591E+03	3.4915E+03	1.8345E+02	1.0998E+04	3.6955E+02	6.0580E+01	7.5974E-01	1.7842E-04	3.0982E+00
7	1200000.	7.2346E+02	1.5077E+03	1.6579E+02	3.5557E+03	4.0234E+02	3.5482E+01	3.1338E-01	6.9287E-05	1.0899E+00
8	1400000.	1.8440E+01	4.1172E+02	7.4441E+01	9.8644E+02	4.7158E+02	1.5912E+01	8.9930E-02	1.9452E-05	8.4540E-01
9	1600000.	1.5994E+02	7.3055E+01	1.7550E+02	8.9215E+02	9.0505E+02	5.0350E+01	2.8836E-01	2.9942E-05	2.0528E+00
10	1800000.	4.7238E+02	1.6553E+03	4.3965E+02	1.2490E+03	2.3952E+03	2.5670E+02	9.8062E-01	7.6560E-05	1.0383E+01
11	2000000.	8.2055E+02	3.7267E+03	3.4058E+02	1.3499E+03	3.3234E+03	4.5670E+02	1.9277E+00	1.5562E-04	1.8216E+01
12	2200000.	1.4586E+03	4.1351E+03	3.3268E+02	1.7996E+03	4.4948E+03	6.5445E+02	3.4054E+00	3.2662E-04	2.7004E+01
13	2400000.	2.4424E+03	5.4792E+03	3.2260E+02	1.3730E+03	6.5019E+03	7.8792E+02	5.2126E+00	7.7650E-04	3.9570E+01
14	2600000.	3.6706E+03	6.7106E+03	3.4101E+02	1.3722E+03	9.7397E+03	8.7677E+02	1.1874E+01	1.8144E-03	5.8534E+01
15	2800000.	4.7508E+03	1.4410E+04	3.6317E+02	1.4139E+03	1.3478E+04	8.7365E+02	2.4606E+01	4.7192E-03	9.2965E+01
16	3000000.	5.1379E+03	2.3524E+04	3.3688E+02	1.4865E+03	1.6092E+04	8.2390E+02	5.5765E+01	1.3141E-02	1.6132E+02
17	3200000.	4.2364E+03	3.7023E+04	2.7547E+02	1.5551E+03	1.6557E+04	7.5744E+02	1.3045E+02	3.7548E-02	2.8191E+02
18	3400000.	2.7243E+03	5.1881E+04	1.4145E+02	1.5855E+03	1.4735E+04	6.5449E+02	2.9184E+02	1.0502E-01	4.5219E+02
19	3600000.	1.4989E+03	6.1393E+04	1.4225E+03	1.5196E+03	1.6455E+04	5.1064E+02	5.9456E+02	2.7807E-01	6.1622E+02
20	3800000.	7.0892E+02	7.1830E+04	1.3074E+03	1.3479E+03	6.2360E+03	3.3512E+02	1.0635E+03	7.1894E-01	7.3610E+02
21	4000000.	4.6469E+02	2.7800E+04	1.5033E+03	4.0757E+02	2.9282E+02	1.6441E+02	1.5338E+03	1.8178E+00	8.0290E+02
22	4200000.	3.1706E+02	2.0653E+04	1.4549E+03	7.7372E+02	1.0561E+02	5.8496E+01	1.7379E+03	4.3490E+00	8.0423E+02
23	4400000.	2.3561E+02	1.2702E+04	1.2165E+03	5.2608E+02	3.2375E+02	1.5466E+01	1.6539E+03	9.4050E+00	7.3515E+02
24	4600000.	1.5324E+02	1.5450E+04	9.4277E+02	3.4983E+02	8.8895E+01	4.0406E+00	1.3862E+03	1.7633E+01	6.1146E+02
25	4800000.	9.3475E+01	1.1475E+04	5.5655E+02	2.2569E+02	2.4028E+01	9.4695E-01	1.0691E+03	2.8339E+01	4.6756E+02
26	5000000.	5.5500E+01	7.5180E+03	4.3706E+02	1.4143E+02	6.9528E+00	2.7232E-01	8.2263E+02	4.1094E+01	3.5017E+02
27	5200000.	3.3715E+01	5.3225E+03	3.3710E+02	8.6155E+01	2.0335E+00	5.0890E-02	6.1515E+02	5.5344E+01	2.5266E+02
28	5400000.	2.1452E+01	4.7706E+03	2.3264E+02	5.3442E+01	6.2892E-01	1.4648E-02	4.7155E+02	7.1839E+01	1.8360E+02
29	5600000.	1.7105E+01	3.7324E+03	1.6179E+02	3.7199E+01	1.9490E-01	3.8464E-03	3.7371E+02	9.4058E+01	1.3421E+02
30	5800000.	7.9557E+00	2.5235E+03	1.1359E+02	2.0714E+01	5.8504E-02	9.6176E-04	2.8516E+02	1.1947E+02	9.4996E+01
31	6000000.	4.7519E+00	2.1145E+03	7.3735E+01	1.2226E+01	1.7451E-02	2.3616E-04	2.1703E+02	1.4841E+02	6.6716E+01
32	6200000.	2.2796E+00	1.4324E+03	4.6756E+01	6.6202E+00	5.6802E-03	5.2589E-05	1.5041E+02	1.6505E+02	4.4396E+01
33	6400000.	9.7337E-01	9.4837E+02	2.8452E+01	3.7144E+00	1.7885E-03	1.0598E-05	9.7947E+01	1.7448E+02	2.8446E+01
34	6600000.	4.4956E-01	5.0100E+02	1.7545E+01	1.7015E+00	5.7792E-04	2.1581E-06	6.7659E+01	1.9336E+02	1.8720E+01
35	6800000.	2.9442E-01	5.1589E+02	1.2094E+01	9.4750E-01	1.0729E-04	5.1490E-07	5.6956E+01	2.4964E+02	1.3508E+01
36	7000000.	2.5421E-01	5.4245E+02	8.6365E+00	5.5375E-01	3.4078E-05	1.3140E-07	5.6540E+01	3.7916E+02	1.0246E+01
37	7200000.	1.1060E-01	5.5287E+02	5.4283E+00	2.7300E-01	7.3531E-06	2.4766E-08	4.2674E+01	4.7516E+02	6.8588E+00
38	7400000.	5.7783E-02	2.5393E+01	3.3741E+00	1.3434E-01	1.6797E-06	4.4271E-09	3.2737E+01	6.0395E+02	4.6129E+00
39	7600000.	1.5451E-02	1.3427E+02	1.7462E+00	5.3931E-02	3.6562E-07	5.7225E-10	1.8074E+01	5.7741E+02	2.7668E+00
40	7800000.	6.8380E-03	5.3305E+01	8.0649E-01	1.9052E-02	4.7378E-08	4.9148E-11	8.3470E+00	4.5190E+02	1.6153E+00
41	8000000.	4.0972E-04	1.8973E+01	3.4561E-01	6.1443E-03	6.3527E-09	3.7456E-12	3.4836E+00	3.0415E+02	9.5650E-01

MIXING RATIOS:

ALT	N2O	NOX	CH4	FC11	FC12	CH3C	CLX	CCL4	H2
0.	2.5000E-07	1.8523E-08	1.5001E-06	7.7938E-11	1.6168E-10	1.5000E-09	9.9451E-10	1.3000E-10	5.0000E-07
200000.	2.4932E-07	1.8326E-08	1.4809E-06	7.7087E-11	1.6161E-10	1.4264E-09	5.8133E-10	1.2991E-10	4.9620E-07
400000.	2.4881E-07	5.9245E-10	1.4813E-06	7.7829E-11	1.6152E-10	1.3836E-09	3.5166E-10	1.2980E-10	4.9418E-07
600000.	2.4969E-07	3.5175E-10	1.4775E-06	7.7745E-11	1.6142E-10	1.3588E-09	2.2468E-10	1.2966E-10	4.9308E-07
800000.	2.4983E-07	2.5175E-10	1.4753E-06	7.7657E-11	1.6120E-10	1.3459E-09	1.6452E-10	1.2949E-10	4.9249E-07
1000000.	2.4906E-07	2.2202E-10	1.4723E-06	7.7426E-11	1.6098E-10	1.3322E-09	1.2824E-10	1.2907E-10	4.9170E-07
1200000.	2.4633E-07	3.2652E-10	1.4672E-06	7.6936E-11	1.6031E-10	1.3146E-09	1.5050E-10	1.2818E-10	4.9035E-07
1400000.	2.4737E-07	4.5230E-10	1.4640E-06	7.6342E-11	1.5951E-10	1.2991E-09	1.7156E-10	1.2711E-10	4.8885E-07
1600000.	2.4195E-07	1.1426E-10	1.4315E-06	7.7157E-11	1.5505E-10	1.2276E-09	2.7376E-10	1.2114E-10	4.8602E-07
1800000.	2.2314E-07	5.4588E-09	1.3300E-06	6.1690E-11	1.7963E-10	1.0106E-09	5.9704E-10	1.0045E-10	4.5348E-07
2000000.	2.0207E-07	6.0560E-09	1.2420E-06	4.9107E-11	1.2247E-10	8.1104E-10	9.1366E-10	7.7587E-11	4.2374E-07
2200000.	1.7900E-07	8.7120E-09	1.1073E-06	3.5085E-11	1.0379E-10	6.7761E-10	1.2122E-09	5.3892E-11	3.9221E-07
2400000.	1.5646E-07	1.1407E-08	9.5973E-07	2.3582E-11	8.4014E-11	4.6695E-10	1.4650E-09	3.1836E-11	3.5903E-07
2600000.	1.2617E-07	1.6014E-08	8.6857E-07	1.2427E-11	6.4047E-11	3.5897E-10	1.7187E-09	1.4924E-11	3.2460E-07
2800000.	1.1145E-07	1.6739E-08	7.4617E-07	5.2306E-12	4.5164E-11	2.5221E-10	1.9042E-09	5.0982E-12	2.8919E-07
3000000.	7.5371E-08	1.3765E-08	6.2608E-07	1.7240E-12	2.9408E-11	1.6802E-10	2.0384E-09	1.2607E-12	2.5422E-07
3200000.	5.5148E-08	1.0720E-08	5.1267E-07	4.4189E-13	1.7047E-11	1.0591E-10	2.1295E-09	1.9533E-13	2.2102E-07
3400000.	3.9333E-08	2.6556E-09	4.1247E-07	3.7680E-14	1.0307E-11	6.3097E-11	2.1888E-09	2.3047E-14	1.9070E-07
3600000.	2.8124E-08	7.1133E-10	3.6489E-07	1.8053E-14	5.8427E-12	3.5967E-11	2.2251E-09	2.2232E-15	1.6457E-07
3800000.	1.9412E-08	2.3926E-09	2.5674E-07	3.3973E-15	3.3216E-12	1.9878E-11	2.2463E-09	1.9628E-16	1.4334E-07
4000000.	1.4311E-08	5.7678E-09	1.9683E-07	6.6819E-16	1.9308E-12	1.0987E-11	2.2580E-09	1.7761E-17	1.2778E-07
4200000.	1.0517E-08	1.0657E-08	1.5677E-07	1.4657E-16	1.1505E-12	6.2680E-12	2.2643E-09	1.7668E-18	1.1811E-07
4400000.	7.9510E-09	1.5324E-08	1.2720E-07	3.4019E-17	7.2500E-13	3.7979E-12	2.2676E-09	2.0374E-19	1.1417E-07
4600000.	6.2002E-09	1.9469E-08	1.0734E-07	9.1781E-18	4.7772E-13	2.4757E-12	2.2694E-09	2.7845E-20	1.1537E-07
4800000.	4.9525E-09	1.7625E-08	9.5163E-06	2.7530E-18	3.2164E-13	1.7736E-12	2.2705E-09	4.4525E-21	1.2102E-07
5000000.	4.0131E-09	1.5132E-08	8.6983E-06	9.2645E-19	2.2505E-13	1.3048E-12	2.2711E-09	8.3802E-22	1.3021E-07
5200000.	3.4471E-09	1.5515E-08	8.0850E-08	3.4601E-19	1.6341E-13	1.0469E-12	2.2715E-09	1.8539E-22	1.4201E-07
5400000.	2.7706E-09	1.4459E-08	7.8623E-08	1.4193E-19	1.2196E-13	8.8211E-13	2.2717E-09	4.7096E-23	1.5575E-07
5600000.	2.5151E-09	1.3451E-08	7.0818E-08	6.3684E-20	9.3421E-14	7.7315E-13	2.2719E-09	1.3651E-23	1.7077E-07
5800000.	2.3451E-09	1.2402E-08	7.5354E-08	3.0415E-20	7.3263E-14	6.9812E-13	2.2720E-09	4.4563E-24	1.8667E-07
6000000.	2.1370E-09	1.1734E-08	7.4581E-08	1.5106E-20	5.8531E-14	6.4448E-13	2.2721E-09	1.6036E-24	2.0321E-07
6200000.	1.9717E-09	1.0989E-08	7.4109E-08	8.4894E-21	4.8037E-14	6.0641E-13	2.2721E-09	6.4177E-25	2.1951E-07
6400000.	1.8470E-09	9.2657E-09	7.3625E-08	4.8931E-21	4.0557E-14	5.7686E-13	2.2722E-09	2.8716E-25	2.3521E-07
6600000.	1.7478E-09	8.2341E-09	7.3645E-08	3.0352E-21	3.4944E-14	5.5730E-13	2.2722E-09	1.3890E-25	2.5090E-07
6800000.	1.6689E-09	7.2146E-09	7.3561E-08	2.0228E-21	3.0775E-14	5.4448E-13	2.2722E-09	7.2620E-26	2.6618E-07
7000000.	1.5535E-09	6.2179E-09	7.3458E-08	1.3397E-21	2.7706E-14	5.2729E-13	2.2722E-09	4.1235E-26	2.8053E-07
7200000.	1.3534E-09	5.2471E-09	7.3408E-08	1.0142E-21	2.5304E-14	5.1678E-13	2.2722E-09	2.5028E-26	2.9345E-07
7400000.	1.5113E-09	4.3267E-09	7.3372E-08	7.6820E-22	2.3656E-14	5.0846E-13	2.2722E-09	1.6156E-26	3.0400E-07
7600000.	1.4812E-09	3.4807E-09	7.3345E-08	6.0536E-22	2.2351E-14	5.0192E-13	2.2722E-09	1.0992E-26	3.1142E-07
7800000.	1.4546E-09	2.5842E-09	7.3324E-08	4.9209E-22	2.1255E-14	4.9677E-13	2.2722E-09	7.7367E-27	3.1525E-07
8000000.	1.4336E-09	2.0217E-09	7.3317E-08	4.0949E-22	2.0505E-14	4.9275E-13	2.2722E-09	5.4942E-27	3.1592E-07

FN2O = -1.32171E+09 FNOX = -1.94491E+10 FCH4 = -2.85427E+11 FF11 = -8.62317E+05 FF12 = -1.09231E+06

FCH3C = -1.59402E+09 FCLX = -3.41764E+10 FCCL4 = -1.44844E+06 FH2 = -9.21821E+10

K	ALT	MR 00	FC11	FC12	CH3CL	CCL4	CLX
1	0.	2.9928E-08	1.3771E+09	3.8330E+09	7.6165E+10	3.1343E+09	2.3978E+10
2	20000.	2.8975E-08	1.1385E+09	3.4013E+09	3.0020E+10	2.7346E+09	1.2237E+10
3	40000.	2.9378E-08	1.2040E+09	2.5557E+09	2.2843E+10	2.1429E+09	5.8059E+09
4	60000.	3.2760E-08	1.4148E+09	2.1577E+09	1.9208E+10	1.7774E+09	3.0108E+09
5	80000.	3.3708E-08	5.4487E+08	1.7594E+09	1.4045E+10	1.4888E+09	1.7906E+09
6	100000.	3.3145E-08	8.7626E+08	1.4058E+09	1.1034E+10	1.1272E+09	1.1139E+09
7	120000.	3.6488E-08	3.3686E+08	1.1298E+09	9.0876E+09	8.5614E+08	1.0404E+09
8	140000.	1.2775E-07	4.5276E+08	9.4506E+08	7.7652E+09	7.5387E+08	1.0171E+09
9	160000.	3.5001E-07	2.3715E+08	8.7516E+08	5.0357E+09	4.9712E+08	1.1232E+09
10	180000.	1.3795E-06	1.7462E+08	3.9431E+08	2.9539E+09	2.9357E+08	1.6860E+09
11	200000.	2.2485E-06	9.8214E+07	2.4457E+08	1.6237E+09	1.5517E+08	1.8273E+09
12	220000.	3.5431E-06	5.1861E+07	1.4801E+08	9.1114E+10	7.7011E+07	1.7323E+09
13	240000.	5.2157E-06	2.7821E+07	8.0725E+07	5.2253E+10	3.2855E+07	1.5265E+09
14	260000.	7.0357E-06	1.3716E+07	4.7531E+07	2.5723E+10	1.1111E+07	1.2796E+09
15	280000.	8.6014E-06	7.3676E+06	2.4534E+07	1.3677E+08	2.7548E+06	1.0327E+09
16	300000.	9.5697E-06	3.8462E+06	1.4875E+07	5.6734E+07	4.7650E+05	8.0926E+08
17	320000.	9.2467E-06	1.2321E+06	5.2185E+06	3.3695E+07	5.7116E+04	5.2268E+08
18	340000.	9.2493E-06	2.5477E+05	2.2240E+06	1.3073E+07	4.9757E+03	4.7257E+08
19	360000.	9.5837E-06	2.9387E+04	9.7715E+05	5.7691E+06	3.5651E+02	3.5691E+08
20	380000.	5.1390E-06	9.7150E+02	7.9792E+05	2.7814E+06	2.3515E+01	2.6911E+08
21	400000.	7.9393E-06	5.1370E+02	1.6375E+05	9.0876E+05	1.5983E+00	2.0326E+08
22	420000.	5.2.937E-06	9.5375E+00	7.8787E+04	4.2010E+05	1.2611E-01	1.5392E+08
23	440000.	2.5898E-06	1.7508E+00	3.7417E+04	2.9001E+05	1.0515E-02	1.1703E+08
24	460000.	2.0317E-06	3.5158E-01	1.8655E+04	9.7510E+04	1.0958E-03	8.9392E+07
25	480000.	1.9447E-06	3.7708E-02	9.7745E+03	5.2514E+04	1.7513E-04	6.8909E+07
26	500000.	1.6372E-06	2.1376E-02	5.7331E+03	3.0958E+04	1.9878E-05	5.3870E+07
27	520000.	1.7389E-06	8.4485E-03	3.0394E+03	1.9455E+04	3.4482E-06	4.2249E+07
28	540000.	1.6790E-07	3.6977E-03	1.7345E+03	1.2976E+04	6.9278E-07	3.3427E+07
29	560000.	1.0038E-07	7.7346E-04	1.0368E+03	8.9618E+03	1.5892E-07	2.6371E+07
30	580000.	9.0785E-07	2.7802E-04	5.9870E+02	6.7507E+03	4.0575E-08	2.0685E+07
31	600000.	7.3462E-07	1.4098E-04	4.2814E+02	4.6041E+03	1.1456E-08	1.6232E+07
32	620000.	7.2851E-07	4.7796E-05	2.7172E+02	3.4177E+03	3.6148E-09	1.2806E+07
33	640000.	9.9067E-07	2.2509E-05	1.7008E+02	2.5562E+03	1.2681E-09	1.0034E+07
34	660000.	9.3071E-07	1.0872E-05	1.2047E+02	1.9145E+03	4.7713E-10	7.8049E+05
35	680000.	5.4113E-07	5.0508E-06	8.1334E+01	1.4769E+03	1.9372E-10	6.0486E+06
36	700000.	4.2909E-07	2.3385E-06	5.6172E+01	1.0603E+03	8.3542E-11	4.6035E+06
37	720000.	3.3994E-07	1.0581E-06	3.8973E+01	7.9726E+02	3.3418E-11	3.4879E+06
38	740000.	3.6300E-07	5.0497E-07	2.7254E+01	5.8575E+02	1.8611E-11	2.6176E+06
39	760000.	3.0127E-07	2.1825E-07	1.9119E+01	4.2935E+02	9.4023E-12	1.9437E+06
40	780000.	4.0581E-07	9.6908E-08	1.3414E+01	3.1202E+02	4.8594E-12	1.4272E+06
41	800000.	4.9732E-07	1.3850E-07	9.7629E+00	2.2450E+02	2.5032E-12	1.0352E+06

K	ALT	N2O	NOX	CH4
1	0.	5.0275E+12	4.4[illegible]5E+10	3.6165E+17
2	20000.	5.2607E+12	2.1737E+10	3.1327E+17
3	40000.	4.1344E+12	3.7611E+09	2.4457E+13
4	60000.	3.7456E+12	4.3476E+09	1.9798E+17
5	80000.	2.7159E+12	2.5490E+09	1.6152E+17
6	100000.	2.1759E+12	1.9389E+09	1.2858E+17
7	120000.	1.7169E+12	2.2772E+09	1.0143E+17
8	140000.	1.4[illegible]1E+12	2.6620E+09	8.6685E+12
9	160000.	9.9271E+11	4.5375E+09	5.8735E+12
10	180000.	6.3[illegible]E+11	9.6782E+09	3.7556E+12
11	200000.	4.0415E+11	1.2102E+10	2.4421E+12
12	220000.	2.5579E+11	1.2149E+10	1.5823E+12
13	240000.	1.5837E+11	1.1772E+10	1.0210E+12
14	260000.	9.5195E+10	1.0473E+10	6.4072E+11
15	280000.	5.5[illegible]E+10	8.5929E+09	4.0465E+11
16	300000.	3.0[illegible]E+10	7.2907E+09	2.4876E+11
17	320000.	1.6[illegible]E+10	5.7[illegible]E+09	1.5[illegible]E+11
18	340000.	8.6[illegible]E+09	4.4596E+09	8.9052E+10
19	360000.	4.5[illegible]E+09	7.3[illegible]E+09	5.2112E+10
20	380000.	2.[illegible]E+09	2.5136E+09	3.0278E+10
21	400000.	1.2[illegible]E+09	1.5772E+09	1.7[illegible]E+10
22	420000.	7.1[illegible]E+08	1.[illegible]E+09	1.0590E+10
23	440000.	4.1086E+08	9.[illegible]E+08	6.5647E+09
24	460000.	2.4[illegible]E+08	[illegible]E+08	4.2516E+09
25	480000.	1.[illegible]E+08	5.7191E+08	2.8832E+09
26	500000.	9.67[illegible]E+07	3.9[illegible]E+08	2.0[illegible]E+09
27	520000.	6.[illegible]E+07	2.8866E+08	1.5[illegible]E+09
28	540000.	4.[illegible]E+07	2.1[illegible]E+08	1.1566E+09
29	560000.	3.0321E+07	1.5589E+08	8.6800E+08
30	580000.	2.1[illegible]E+07	1.1[illegible]E+08	6.8619E+08
31	600000.	1.5[illegible]E+07	[illegible]E+07	5.3291E+08
32	620000.	1.1107E+07	5.7[illegible]E+07	4.1[illegible]E+08
33	640000.	8.1[illegible]E+06	4.0917E+07	3.2601E+08
34	660000.	6.[illegible]E+06	2.8284E+07	2.5[illegible]E+08
35	680000.	4.4[illegible]E+06	1.9[illegible]E+07	1.9574E+08
36	700000.	3.2[illegible]E+06	1.2597E+07	1.4[illegible]E+08
37	720000.	2.[illegible]E+06	8.[illegible]E+06	1.1258E+08
38	740000.	1.7445E+06	[illegible]E+06	8.4524E+07
39	760000.	1.2[illegible]E+06	2.[illegible]E+06	6.2773E+07
40	780000.	9.1[illegible]E+05	1.6859E+05	4.6[illegible]E+07
41	800000.	6.5[illegible]E+05	9.2107E+05	3.3339E+07

NORMAL JOB END.

CASE 2

LAST ITERATION = 7

ALT	CJO2	CJO3	CJOF2	CJOF3	CJO21	PREVO2	DO3INT	O4INT	PREVOH
0.	5.585E-22	2.284E-04	8.955E-06	4.048E-29	5.307E-06	7.216E+11	8.417E+18	2.194E+25	2.678E+06
200000.	5.139E-22	2.234E-04	1.539E-26	5.512E-03	1.910E-05	5.025E+11	8.284E+18	1.743E+25	3.072E+06
400000.	7.521E-06	3.078E-04	1.136E-23	3.786E-26	1.214E-05	4.389E+11	8.175E+18	1.367E+25	2.838E+06
600000.	5.767E-24	3.151E-04	7.355E-21	7.645E-20	1.353E-05	4.372E+11	8.083E+18	1.163E+25	2.305E+06
800000.	5.317E-22	3.195E-04	7.283E-19	1.106E-17	1.453E-05	4.104E+11	7.998E+18	8.253E+24	1.459E+06
1000000.	4.649E-20	3.265E-04	7.275E-17	9.785E-16	1.535E-05	4.402E+11	7.912E+18	6.292E+24	8.983E+05
1200000.	4.718E-18	3.241E-04	3.605E-15	4.416E-14	1.588E-05	5.672E+11	7.808E+18	4.727E+24	5.735E+05
1400000.	4.891E-17	3.245E-04	1.259E-13	1.415E-12	1.635E-05	7.105E+11	7.685E+18	3.497E+24	3.071E+05
1600000.	8.893E-16	3.243E-04	2.534E-12	2.626E-11	1.601E-05	1.370E+12	7.475E+18	2.439E+24	4.253E+05
1800000.	3.850E-15	3.242E-04	3.913E-12	3.981E-10	1.735E-05	3.040E+12	7.033E+18	1.747E+24	7.035E+05
2000000.	3.790E-14	3.253E-04	6.139E-10	3.402E-09	1.349E-05	4.050E+12	6.323E+18	1.254E+24	9.053E+05
2200000.	2.790E-13	3.299E-04	4.030E-09	9.976E-09	2.390E-05	4.657E+12	5.451E+18	9.217E+23	1.148E+06
2400000.	1.672E-12	3.335E-04	6.337E-09	4.703E-08	3.136E-05	4.394E+12	4.485E+18	6.752E+23	1.525E+06
2600000.	8.497E-12	3.539E-04	1.471E-08	1.211E-07	4.591E-05	4.871E+12	3.499E+18	4.976E+23	2.090E+06
2800000.	3.736E-12	3.737E-04	3.833E-08	3.231E-07	6.832E-05	4.303E+12	2.576E+18	3.639E+23	2.395E+06
3000000.	2.291E-11	4.223E-04	9.247E-08	7.245E-07	1.100E-04	3.495E+12	1.796E+18	2.730E+23	4.416E+06
3200000.	4.642E-11	4.362E-04	1.545E-07	1.236E-06	1.906E-04	2.612E+12	1.180E+18	2.060E+23	6.610E+06
3400000.	3.295E-11	6.115E-04	2.775E-07	2.024E-06	2.903E-04	1.971E+12	7.418E+17	1.552E+23	9.742E+06
3600000.	1.327E-10	7.976E-04	3.153E-07	2.806E-06	4.912E-04	1.123E+12	4.524E+17	1.176E+23	1.380E+07
3800000.	1.915E-10	1.113E-03	3.308E-07	3.525E-06	7.959E-04	6.674E+11	2.734E+17	8.956E+22	1.849E+07
4000000.	2.513E-10	1.605E-03	4.376E-07	4.109E-06	1.288E-03	3.946E+11	1.680E+17	6.858E+22	2.225E+07
4200000.	3.044E-10	2.212E-03	4.975E-07	4.557E-06	1.995E-03	2.315E+11	1.061E+17	5.278E+22	2.356E+07
4400000.	3.480E-10	2.927E-03	5.347E-07	4.897E-06	2.593E-03	1.459E+11	5.859E+16	4.083E+22	2.271E+07
4600000.	3.835E-10	3.769E-03	5.509E-07	5.150E-06	3.947E-03	9.087E+10	4.511E+16	3.173E+22	2.054E+07
4800000.	4.154E-10	3.791E-03	5.333E-07	5.350E-06	3.473E-03	5.823E+10	3.024E+16	2.475E+22	1.797E+07
5000000.	4.419E-10	4.111E-03	5.258E-07	5.594E-06	3.793E-03	3.876E+10	2.050E+16	1.934E+22	1.568E+07
5200000.	4.449E-10	4.347E-03	5.056E-07	5.708E-06	4.923E-03	2.592E+10	1.404E+16	1.511E+22	1.351E+07
5400000.	5.170E-10	4.513E-03	7.437E-07	5.938E-06	4.209E-03	1.796E+10	9.649E+15	1.170E+22	1.180E+07
5600000.	5.719E-10	4.644E-03	7.644E-07	6.163E-06	4.323E-03	1.209E+10	6.644E+15	9.151E+21	1.045E+07
5800000.	5.491E-10	4.673E-03	8.325E-07	6.421E-06	4.499E-03	8.161E+09	4.618E+15	7.032E+21	9.162E+06
6000000.	7.107E-10	4.780E-03	9.756E-07	6.675E-06	4.458E-03	5.505E+09	3.252E+15	5.437E+21	7.984E+06
6200000.	5.081E-10	4.829E-03	1.377E-06	6.947E-06	4.519E-03	4.156E+09	2.296E+15	4.179E+21	6.641E+06
6400000.	3.657E-10	4.833E-03	1.235E-06	7.216E-06	4.542E-03	3.132E+09	1.578E+15	3.174E+21	5.129E+06
6600000.	1.023E-09	4.837E-03	1.219E-06	7.461E-06	4.555E-03	1.852E+09	1.080E+15	2.339E+21	3.190E+06
6800000.	1.184E-09	4.837E-03	1.235E-06	7.684E-06	4.579E-03	1.293E+09	7.654E+14	1.773E+21	4.486E+06
7000000.	1.425E-09	4.917E-03	1.376E-06	7.975E-06	4.599E-03	8.873E+08	5.469E+14	1.313E+21	3.908E+06
7200000.	1.274E-09	4.914E-03	1.416E-06	8.234E-06	4.695E-03	6.120E+08	3.979E+14	9.546E+20	3.473E+06
7400000.	2.222E-09	4.919E-03	1.442E-06	8.152E-06	4.601E-03	4.207E+08	2.977E+14	6.853E+20	3.067E+06
7600000.	2.750E-09	4.923E-03	1.478E-06	8.648E-06	4.613E-03	3.345E+08	2.186E+14	4.845E+20	2.284E+06
7800000.	3.306E-09	4.925E-03	1.505E-06	8.342E-06	4.517E-03	2.703E+08	1.585E+14	3.752E+20	1.952E+06
8000000.	3.637E-09	4.923E-03	1.525E-06	8.495E-06	4.615E-03	2.191E+08	1.046E+14	2.273E+20	1.002E+06

LAST ITERATION = 7

ALT	CJCLO3	CJNO	CJHNO3	CJH2O2	CJN2O5	CJCL4	CJCH3CL
0.	3.311E-05	1.643E-24	1.488E-27	2.787E-06	1.206E-05	2.385E-27	1.214E-30
20000.	5.705E-05	2.193E-26	2.517E-07	2.256E-06	2.011E-05	2.705E-24	1.930E-27
40000.	5.415E-05	1.251E-23	3.279E-07	2.601E-06	2.240E-05	1.462E-21	1.306E-24
60000.	5.394E-05	3.179E-21	3.356E-07	2.804E-06	2.465E-05	2.823E-19	4.021E-22
80000.	5.651E-05	4.314E-19	3.574E-07	2.946E-06	2.573E-05	3.299E-17	7.445E-20
100000.	5.823E-05	3.883E-17	3.721E-07	3.141E-06	2.655E-05	2.540E-15	7.365E-18
120000.	5.912E-05	1.872E-15	3.318E-07	3.055E-06	2.627E-05	9.811E-14	3.358E-16
140000.	5.951E-05	5.123E-14	3.952E-07	3.118E-06	2.715E-05	2.852E-12	1.348E-14
160000.	5.736E-05	1.245E-12	3.370E-07	3.175E-06	2.715E-05	5.224E-11	2.903E-13
180000.	5.896E-05	1.340E-11	3.372E-07	3.165E-06	2.772E-05	5.182E-10	7.268E-12
200000.	5.691E-05	9.205E-11	4.217E-07	3.145E-06	2.705E-05	3.361E-09	2.332E-10
220000.	5.946E-05	4.543E-10	3.437E-07	3.215E-06	2.773E-05	1.395E-08	1.194E-10
240000.	7.495E-05	1.751E-09	3.889E-07	3.845E-06	4.875E-05	6.170E-08	4.764E-10
260000.	7.465E-05	5.554E-09	1.520E-06	3.715E-06	3.951E-05	1.930E-07	1.508E-09
280000.	7.682E-05	1.353E-08	7.214E-06	4.385E-06	3.265E-05	5.658E-07	4.349E-09
300000.	8.001E-05	3.265E-08	5.294E-06	5.415E-06	3.966E-05	1.210E-06	9.481E-09
320000.	1.075E-04	5.933E-08	1.133E-05	7.194E-06	4.944E-05	2.375E-06	1.706E-08
340000.	1.348E-04	8.994E-08	1.871E-05	8.932E-06	6.073E-05	4.038E-06	2.638E-08
360000.	1.748E-04	1.283E-07	2.312E-05	1.372E-05	8.924E-05	5.947E-06	3.591E-08
380000.	2.274E-04	1.611E-07	2.919E-05	1.965E-05	1.175E-04	7.904E-06	4.445E-08
400000.	2.883E-04	1.875E-07	3.578E-05	2.433E-05	1.492E-04	9.493E-06	5.142E-08
420000.	3.498E-04	2.033E-07	3.950E-05	3.021E-05	1.908E-04	1.070E-05	5.695E-08
440000.	4.054E-04	2.246E-07	4.356E-05	3.551E-05	2.393E-04	1.164E-05	6.125E-08
460000.	4.503E-04	2.507E-07	4.559E-05	4.009E-05	2.727E-04	1.227E-05	6.500E-08
480000.	4.859E-04	2.463E-07	4.381E-05	4.366E-05	2.906E-04	1.277E-05	6.883E-08
500000.	5.107E-04	2.559E-07	5.038E-05	4.615E-05	3.639E-04	1.316E-05	7.381E-08
520000.	5.293E-04	2.643E-07	5.231E-05	4.806E-05	2.737E-04	1.353E-05	8.059E-08
540000.	5.432E-04	2.734E-07	5.347E-05	4.951E-05	2.808E-04	1.388E-05	8.974E-08
560000.	5.532E-04	2.842E-07	5.449E-05	5.058E-05	2.863E-04	1.423E-05	1.014E-07
580000.	5.604E-04	2.951E-07	5.547E-05	5.137E-05	2.996E-04	1.458E-05	1.151E-07
600000.	5.656E-04	3.031E-07	5.646E-05	5.177E-05	2.922E-04	1.493E-05	1.301E-07
620000.	5.695E-04	3.224E-07	5.742E-05	5.244E-05	2.940E-04	1.527E-05	1.457E-07
640000.	5.727E-04	3.357E-07	5.841E-05	5.266E-05	2.954E-04	1.561E-05	1.614E-07
660000.	5.750E-04	3.489E-07	5.932E-05	5.313E-05	2.965E-04	1.589E-05	1.773E-07
680000.	5.767E-04	3.623E-07	6.017E-05	5.336E-05	2.971E-04	1.615E-05	1.945E-07
700000.	5.780E-04	3.875E-07	6.108E-05	5.359E-05	2.976E-04	1.637E-05	2.143E-07
720000.	5.795E-04	4.204E-07	6.122E-05	5.378E-05	2.980E-04	1.654E-05	2.376E-07
740000.	5.797E-04	4.435E-07	6.233E-05	5.396E-05	2.982E-04	1.669E-05	2.629E-07
760000.	5.803E-04	4.924E-07	6.244E-05	5.412E-05	2.984E-04	1.680E-05	2.887E-07
780000.	5.807E-04	5.489E-07	6.275E-05	5.427E-05	2.985E-04	1.689E-05	3.137E-07
800000.	5.815E-04	5.674E-07	6.304E-05	5.444E-05	2.989E-04	1.696E-05	3.360E-07

LAST ITERATION + 1

ALT	CJO2	CJO3	CJOF2	CJOF3	CJO31	PREVO3	DOSINT	DMINT	PREVOM
0.	5.596E-32	2.204E-04	8.166E-30	4.025E-28	5.589E-06	7.225E+11	8.415E+18	2.134E+25	2.703E+06
200000.	3.149E-29	2.932E-04	1.591E-26	5.521E-25	1.019E-05	6.022E+11	8.207E+18	1.747E+25	3.072E+06
400000.	3.025E-26	3.178E-04	1.137E-23	3.182E-22	1.255E-05	4.885E+11	8.174E+18	1.357E+25	2.847E+06
600000.	5.773E-24	3.191E-04	3.309E-21	7.649E-20	1.353E-05	4.360E+11	9.081E+18	1.069E+25	2.305E+06
800000.	3.322E-22	3.196E-04	7.287E-19	1.111E-17	1.453E-05	4.099E+11	7.957E+18	8.253E+24	1.459E+06
1000000.	4.251E-20	3.209E-04	7.232E-17	9.763E-15	1.535E-05	4.480E+11	7.911E+18	6.292E+24	8.933E+05
1200000.	1.713E-18	3.241E-04	3.248E-15	4.418E-14	1.583E-05	5.676E+11	7.895E+18	4.727E+24	5.735E+05
1400000.	4.895E-17	3.245E-04	1.258E-13	1.416E-12	1.626E-05	7.113E+11	7.681E+18	3.443E+24	3.021E+05
1600000.	8.895E-16	3.243E-04	3.397E-12	2.862E-11	1.601E-05	1.306E+12	7.474E+18	2.439E+24	4.219E+05
1800000.	9.847E-15	3.242E-04	3.070E-11	2.980E-10	1.735E-05	7.045E+12	7.033E+18	1.747E+24	7.025E+05
2000000.	3.792E-14	3.255E-04	2.198E-10	2.019E-09	1.949E-05	4.949E+12	6.324E+18	1.204E+24	9.039E+05
2200000.	2.788E-13	3.299E-04	1.293E-09	9.869E-09	2.391E-05	4.667E+12	5.452E+18	9.213E+23	1.148E+06
2400000.	1.671E-12	3.385E-04	4.32[illegible]E-09	3.78[illegible]E-08	3.[illegible]5E-05	4.390E+12	4.407E+18	6.73[illegible]E+23	1.523E+06
2600000.	3.494E-12	3.537E-04	1.470E-08	1.210E-07	4.583E-05	4.873E+12	3.501E+18	4.976E+23	2.090E+06
2800000.	3.726E-12	3.437E-04	3.332E-08	3.230E-07	6.980E-05	4.367E+12	2.572E+18	3.633E+23	2.995E+06
3000000.	2.291E-11	4.269E-04	5.455E-08	7.046E-07	1.179E-04	3.497E+12	1.790E+18	2.750E+23	4.416E+06
3200000.	4.645E-11	4.347E-04	1.313E-07	1.486E-06	1.848E-04	2.612E+12	1.173E+18	2.003E+23	6.613E+06
3400000.	8.361E-11	6.119E-04	2.376E-07	2.025E-06	2.965E-04	1.770E+12	7.411E+17	1.552E+23	9.742E+06
3600000.	1.327E-10	7.281E-04	3.135E-07	2.309E-06	4.816E-04	1.122E+12	4.519E+17	1.176E+23	1.581E+07
3800000.	1.916E-10	1.114E-03	3.375E-07	3.926E-06	7.966E-04	6.667E+11	2.731E+17	8.956E+22	1.849E+07
4000000.	2.511E-10	1.605E-03	4.307E-07	4.[illegible]9E-06	1.283E-03	3.860E+11	1.678E+17	6.853E+22	2.265E+07
4200000.	3.041E-10	2.213E-03	4.978E-07	4.557E-06	1.895E-03	2.312E+11	1.061E+17	5.278E+22	2.355E+07
4400000.	3.481E-10	2.927E-03	5.375E-07	4.637E-06	2.542E-03	1.438E+11	6.857E+16	4.083E+22	2.271E+07
4600000.	3.835E-10	3.363E-03	5.632E-07	5.158E-06	3.047E-03	9.081E+10	4.510E+16	3.173E+22	2.054E+07
4800000.	4.132E-10	3.741E-03	5.348E-07	5.768E-06	3.435E-03	5.022E+10	3.021E+16	2.473E+22	1.797E+07
5000000.	4.419E-10	4.111E-03	5.255E-07	5.544E-06	3.793E-03	3.875E+10	2.059E+16	1.934E+22	1.568E+07
5200000.	4.749E-10	4.347E-03	5.535E-07	5.738E-06	4.129E-03	2.592E+10	1.404E+16	1.511E+22	1.351E+07
5400000.	5.170E-10	4.713E-03	7.187E-07	5.938E-06	4.200E-03	1.796E+10	9.648E+15	1.175E+22	1.180E+07
5600000.	5.719E-10	4.641E-03	7.344E-07	6.163E-06	4.323E-03	1.209E+10	6.643E+15	9.151E+21	1.054E+07
5800000.	6.401E-10	4.727E-03	8.510E-07	6.411E-06	4.439E-03	8.161E+09	4.618E+15	7.082E+21	9.162E+06
6000000.	7.197E-10	4.786E-03	8.725E-07	6.676E-06	4.463E-03	5.553E+09	3.251E+15	5.457E+21	7.984E+06
6200000.	8.081E-10	4.828E-03	1.037E-06	6.947E-06	4.510E-03	4.052E+09	2.296E+15	4.179E+21	6.649E+06
6400000.	9.057E-10	4.861E-03	1.225E-06	7.212E-06	4.542E-03	3.132E+09	1.578E+15	3.174E+21	5.129E+06
6600000.	1.023E-09	4.867E-03	1.398E-06	7.461E-06	4.565E-03	1.852E+09	1.079E+15	2.389E+21	5.190E+06
6800000.	1.184E-09	4.897E-03	1.233E-06	7.687E-06	4.573E-03	1.293E+09	7.650E+14	1.773E+21	4.480E+06
7000000.	1.425E-09	4.917E-03	1.347E-06	7.955E-06	4.599E-03	8.872E+08	5.469E+14	1.310E+21	3.948E+06
7200000.	1.776E-09	4.914E-03	1.411E-06	8.234E-06	4.526E-03	6.120E+08	3.970E+14	9.540E+20	3.473E+06
7400000.	2.222E-09	4.919E-03	1.444E-06	8.162E-06	4.601E-03	4.207E+08	2.977E+14	6.853E+20	3.067E+06
7600000.	2.756E-09	4.923E-03	1.470E-06	8.264E-06	4.605E-03	3.305E+08	2.185E+14	4.945E+20	2.846E+06
7800000.	3.306E-09	4.925E-03	1.515E-06	8.341E-06	4.517E-03	2.705E+08	1.585E+14	3.362E+20	1.552E+06
8000000.	3.837E-09	4.933E-03	1.3[illegible]E-06	8.405E-06	4.615E-03	2.131E+08	1.096E+14	2.278E+20	1.002E+06

LAST ITERATION + 1

ALT	CJCL03	CJNO	CJHNO3	CJH2O2	CJN2O5	CJCCL4	CJCH3CL
0.	3.312E-05	1.651E-24	1.088E-07	1.731E-06	1.205E-05	2.242E-27	1.216E-20
20000.	3.375E-05	2.192E-26	2.017E-07	2.256E-06	2.012E-05	3.709E-24	1.939E-27
40000.	3.416E-05	1.253E-23	3.183E-07	2.641E-06	2.331E-05	1.404E-21	1.302E-24
60000.	3.395E-05	3.041E-21	3.339E-07	2.504E-06	2.452E-05	2.826E-19	4.024E-22
80000.	3.652E-05	4.312E-19	3.378E-07	2.946E-06	2.579E-05	3.702E-17	7.451E-20
100000.	3.824E-05	3.831E-17	3.328E-07	3.041E-06	2.655E-05	2.544E-15	7.368E-18
120000.	3.925E-05	1.873E-15	3.306E-07	3.296E-06	2.637E-05	9.816E-14	7.863E-16
140000.	3.952E-05	6.126E-14	3.287E-07	3.418E-06	2.713E-05	2.854E-12	1.349E-14
160000.	3.972E-05	1.246E-12	3.372E-07	3.417E-06	2.761E-05	5.226E-11	2.904E-13
180000.	3.896E-05	1.370E-11	3.358E-07	3.215E-06	2.702E-05	5.281E-10	3.267E-12
200000.	3.691E-05	9.197E-11	3.213E-07	3.105E-06	2.735E-05	3.359E-09	2.730E-11
220000.	3.345E-05	4.540E-10	3.103E-07	3.215E-06	2.738E-05	1.595E-08	1.197E-10
240000.	2.890E-05	1.732E-09	2.816E-07	3.384E-06	2.817E-05	6.030E-08	4.76E-10
260000.	2.469E-05	5.852E-09	1.323E-06	3.714E-06	2.960E-05	1.929E-07	1.587E-09
280000.	2.982E-05	1.504E-08	3.213E-06	4.328E-06	3.265E-05	5.256E-07	4.348E-09
300000.	3.001E-05	3.269E-08	5.205E-06	5.413E-06	3.956E-05	1.21[illegible]E-06	9.481E-09
320000.	1.772E-04	5.305E-08	1.031E-05	7.009E-06	4.945E-05	2.376E-06	1.746E-08
340000.	1.348E-04	9.238E-08	1.571E-05	9.937E-06	6.636E-05	4.041E-06	2.659E-08
360000.	1.749E-04	1.286E-07	2.336E-05	1.373E-05	8.923E-05	5.949E-06	3.542E-08
380000.	2.275E-04	1.611E-07	3.319E-05	1.851E-05	1.175E-04	7.906E-06	4.445E-08
400000.	2.684E-04	1.378E-07	3.478E-05	2.433E-05	1.492E-04	9.495E-06	5.143E-08
420000.	3.198E-04	2.000E-07	3.350E-05	3.022E-05	1.809E-04	1.371E-05	5.604E-08
440000.	4.056E-04	2.742E-07	4.376E-05	3.561E-05	2.133E-04	1.366E-05	5.255E-08
460000.	4.504E-04	2.367E-07	4.559E-05	4.009E-05	2.337E-04	1.227E-05	6.504E-08
480000.	4.854E-04	2.460E-07	4.358E-05	4.356E-05	2.506E-04	1.277E-05	6.886E-08
500000.	5.107E-04	2.535E-07	5.190E-05	4.615E-05	2.641E-04	1.610E-05	7.381E-08
520000.	5.295E-04	2.645E-07	5.231E-05	4.848E-05	2.737E-04	1.653E-05	8.654E-08
540000.	5.472E-04	2.774E-07	5.347E-05	4.951E-05	2.845E-04	1.388E-05	8.974E-08
560000.	5.532E-04	2.842E-07	5.445E-05	5.056E-05	2.864E-04	1.423E-05	1.014E-07
580000.	5.604E-04	2.964E-07	5.547E-05	5.137E-05	2.896E-04	1.458E-05	1.151E-07
600000.	5.656E-04	3.093E-07	5.544E-05	5.187E-05	2.922E-04	1.490E-05	1.341E-07
620000.	5.695E-04	3.224E-07	5.642E-05	5.244E-05	2.940E-04	1.527E-05	1.457E-07
640000.	5.727E-04	3.357E-07	5.414E-05	5.244E-05	2.954E-04	1.560E-05	1.614E-07
660000.	5.750E-04	3.489E-07	5.372E-05	5.243E-05	2.965E-04	1.589E-05	1.773E-07
680000.	5.767E-04	3.623E-07	5.317E-05	5.338E-05	2.971E-04	1.615E-05	1.945E-07
700000.	5.780E-04	3.057E-07	5.300E-05	5.359E-05	2.976E-04	1.637E-05	2.143E-07
720000.	5.790E-04	4.064E-07	5.152E-05	5.378E-05	2.980E-04	1.654E-05	2.372E-07
740000.	5.798E-04	4.436E-07	5.203E-05	5.398E-05	2.982E-04	1.669E-05	2.625E-07
760000.	5.803E-04	4.824E-07	5.244E-05	5.412E-05	2.984E-04	1.680E-05	2.887E-07
780000.	5.807E-04	5.238E-07	5.275E-05	5.427E-05	2.985E-04	1.689E-05	3.137E-07
800000.	5.815E-04	5.672E-07	5.304E-05	5.444E-05	2.983E-04	1.696E-05	3.364E-07

K	ALT	H	OH	HO2	H2O2	O	O3	O3INT	O(D)
1	0.	3.2455E-01	2.7033E+06	9.5321E+08	1.6860E+11	2.3378E+03	7.2253E+11	8.4194E+16	9.8849E-03
2	200000.	3.2819E-1	7.3717E+06	9.1658E+08	1.1874E+11	2.9089E+03	6.0225E+11	8.2829E+18	9.9872E-03
3	400000.	3.1467E-01	2.8472E+06	7.5105E+08	7.5654E+10	3.8470E+03	4.8349E+11	8.1779E+18	1.2235E-02
4	600000.	2.5523E-1	2.3146E+06	5.0187E+08	4.4437E+10	4.9341E+03	4.3577E+11	8.0813E+18	1.4769E-02
5	800000.	1.5562E-01	1.4599E+06	3.8695E+08	1.9327E+10	6.3894E+03	4.0996E+11	7.9967E+18	1.7991E-02
6	1000000.	9.3512E-02	3.3137E+05	2.5303E+08	7.7439E+09	9.7083E+03	4.4830E+11	7.9108E+18	2.5141E-02
7	1200000.	5.7949E-02	5.7347E+05	1.5846E+08	2.7340E+09	1.7919E+04	5.6737E+11	7.8097E+18	4.0431E-02
8	1400000.	2.7753E-02	3.3217E+05	8.5678E+07	7.4317E+08	2.5190E+04	7.1130E+11	7.6814E+18	5.8561E-02
9	1600000.	3.4297E-02	1.2188E+05	4.6565E+07	6.6105E+08	9.4379E+04	1.3616E+12	7.4741E+18	1.6370E-01
10	1800000.	6.4804E-02	7.1245E+05	8.4723E+07	9.7464E+09	4.5586E+05	3.0449E+12	7.0334E+18	5.5893E-01
11	2000000.	1.2664E-01	9.0331E+05	9.4796E+07	1.2450E+09	1.2920E+06	4.0489E+12	6.3240E+18	1.1903E+00
12	2200000.	1.7795E-01	1.1434E+06	1.0821E+08	1.5588E+09	3.0707E+06	4.6607E+12	5.4525E+18	2.3783E+00
13	2400000.	3.4680E-01	1.5246E+06	1.1611E+08	1.8353E+09	6.7285E+06	4.9890E+12	4.4860E+18	4.7421E+00
14	2600000.	7.4227E-1	2.3996E+06	1.2428E+08	1.8604E+09	1.3929E+07	4.8728E+12	3.5006E+18	9.3119E+00
15	2800000.	2.0437E+00	3.9347E+06	1.2485E+08	1.5955E+09	2.6114E+07	4.3667E+12	2.5766E+18	1.7560E+01
16	3000000.	6.6026E+00	4.1306E+06	1.1605E+08	1.0893E+09	4.7644E+07	3.4367E+12	1.7943E+18	3.0728E+01
17	3200000.	2.0155E+01	6.3195E+06	9.9699E+07	6.0147E+08	7.9079E+07	2.5126E+12	1.1794E+18	5.1238E+01
18	3400000.	7.3711E+01	2.4424E+06	7.8237E+07	2.6865E+08	1.2722E+08	1.7703E+12	7.4113E+17	7.7858E+01
19	3600000.	2.7429E+02	1.3837E+07	5.7814E+07	1.0763E+08	1.9861E+08	1.1216E+12	4.5194E+17	1.0885E+02
20	3800000.	9.0053E+03	1.3432E+07	4.2367E+07	4.7654E+07	3.0779E+08	6.6605E+11	2.7311E+17	1.4448E+02
21	4000000.	3.3374E+07	2.2951E+07	3.2558E+07	2.0775E+07	4.7549E+08	3.8524E+11	1.6762E+17	1.8173E+02
22	4200000.	9.5232E+3	2.3353E+07	2.6833E+07	1.0150E+07	7.1407E+08	2.3124E+11	1.1607E+17	2.1357E+02
23	4400000.	2.7352E+04	2.2722E+07	2.2863E+07	8.0515E+06	1.0147E+09	1.4383E+11	6.8566E+16	2.3331E+02
24	4600000.	4.9681E+04	2.0542E+07	1.9346E+07	5.5501E+06	1.3572E+09	9.0810E+10	4.5102E+16	2.3603E+02
25	4800000.	9.2665E+04	1.7958E+07	1.6762E+07	3.8774E+06	1.6893E+09	5.3219E+10	3.0200E+16	2.2485E+02
26	5000000.	1.5489E+05	1.5307E+07	1.3947E+07	2.7600E+06	1.9953E+09	3.3749E+10	2.0503E+16	2.0916E+02
27	5200000.	2.4316E+05	1.3729E+07	1.1619E+07	1.9495E+06	2.2786E+09	2.5319E+10	1.4036E+16	1.8921E+02
28	5400000.	3.6391E+05	1.2737E+07	1.0152E+07	1.4008E+06	2.5507E+09	1.7453E+10	9.6482E+15	1.7181E+02
29	5600000.	5.4219E+05	1.2024E+07	8.9308E+06	1.0536E+06	2.7507E+09	1.2089E+10	6.6433E+15	1.5017E+02
30	5800000.	7.9216E+05	9.1526E+06	7.6977E+06	7.6300E+05	2.9038E+09	8.1666E+09	4.6183E+15	1.3078E+02
31	6000000.	1.1391E+06	7.3878E+06	6.6206E+06	5.4921E+05	3.1974E+09	5.5140E+09	3.2518E+15	1.1311E+02
32	6200000.	1.5650E+06	5.5118E+06	5.3862E+06	3.4634E+05	3.5828E+09	4.0316E+09	2.2962E+15	1.0518E+02
33	6400000.	2.2779E+06	5.1336E+06	4.6026E+06	1.8096E+05	4.0754E+09	3.1316E+09	1.5778E+15	1.0310E+02
34	6600000.	2.3842E+06	5.1[illegible]E+06	4.1090E+06	1.7802E+05	3.3972E+09	1.8519E+09	1.0795E+15	7.7656E+01
35	6800000.	4.1051E+06	4.4307E+06	3.4745E+06	1.1002E+05	4.2317E+09	1.2334E+09	7.6496E+14	6.9144E+01
36	7000000.	6.1284E+06	3.9073E+06	2.9461E+06	7.9534E+04	4.6300E+09	8.8724E+08	5.4694E+14	6.1455E+01
37	7200000.	9.2327E+06	3.4723E+06	2.5329E+06	5.4238E+04	5.1311E+09	6.1203E+08	3.9698E+14	5.5074E+01
38	7400000.	1.4013E+07	3.0336E+06	2.1481E+06	3.5815E+04	5.7141E+09	4.2066E+08	2.9371E+14	4.9559E+01
39	7600000.	1.9926E+07	2.2936E+06	1.4524E+06	1.4939E+04	7.3941E+09	3.3154E+08	2.1859E+14	5.1446E+01
40	7800000.	2.6478E+07	1.5[illegible]E+06	8.5047E+05	4.7007E+03	1.0103E+10	2.7036E+08	1.5850E+14	5.6106E+01
41	8000000.	3.2959E+07	1.7018E+06	4.6400E+05	1.2361E+03	1.7015E+10	2.1912E+08	1.0956E+14	6.1352E+01

K	ALT	NO	NO2	HNO3	NO3	N2O5	NOX
1	0.	6.8983E+08	2.0862E+09	3.9649E+10	4.4290E+06	7.1223E+08	4.4917E+10
2	39663.	7.6671E+08	2.7201E+08	1.9707E+10	1.1406E+06	5.1676E+07	2.1740E+10
3	60000.	5.7329E+08	4.0543E+08	8.7651E+09	2.7737E+05	4.8408E+06	9.7841E+09
4	80000.	3.8995E+08	3.1062E+08	4.2411E+09	8.3502E+04	6.7437E+05	4.8520E+09
5	80676.	7.7202E+08	1.0001E+09	2.3465E+09	3.0102E+04	1.3907E+05	2.8546E+09
6	100000.	3.8131E+08	1.2675E+08	1.4609E+09	1.4014E+04	5.9506E+04	1.9528E+09
7	120000.	5.8527E+05	1.3595E+05	1.5947E+09	4.2974E+04	5.8157E+04	2.2885E+09
8	140000.	1.8107E+03	1.3269E+03	1.5122E+09	1.1167E+04	7.0132E+04	2.7273E+09
9	150000.	1.0787E+09	7.0498E+08	3.5675E+09	2.2024E+04	2.1428E+05	4.7639E+09
10	160000.	8.1125E+08	5.8546E+08	8.3853E+09	1.2856E+05	2.4730E+06	9.9928E+09
11	200000.	6.9533E+08	5.0068E+05	1.0210E+10	2.3647E+05	7.4737E+06	1.2151E+10
12	220000.	6.5112E+08	1.0730E+09	1.0035E+10	5.4572E+05	1.6621E+07	1.2398E+10
13	240000.	7.5787E+08	1.4458E+08	5.8026E+09	9.1226E+05	5.3777E+07	1.1630E+10
14	260000.	3.3145E+06	2.0867E+03	6.5045E+09	1.5944E+06	7.3884E+07	1.0234E+10
15	280000.	1.2[illegible]E+07	1.0786E+ 8	4.2172E+09	2.2778E+ 6	1.0794E+08	8.6633E+09
16	300000.	1.4296E+08	2.5235E+09	2.4495E+09	2.2365E+06	8.7555E+07	7.0680E+09
17	320000.	1.5344E+08	1.4172E+09	1.5807E+09	1.7805E+06	4.7906E+07	5.5949E+09
18	340000.	1.5502E+08	1.2318E+09	7.2956E+08	1.1652E+06	1.1187E+07	4.3485E+09
19	360000.	1.5194E+08	1.3712E+08	3.5747E+08	5.2934E+05	3.3670E+06	7.2580E+09
20	380000.	1.7315E+08	6.1944E+	1.6825E+08	2.7844E+05	5.7755E+05	2.4305E+09
21	400000.	1.2877E+08	4.3867E+08	5.4545E+07	1.1379E+05	7.4156E+04	1.7966E+09
22	420000.	1.9216E+08	6.3756E+08	2.0414E+07	3.3111E+04	7.9655E+03	1.3196E+09
23	440000.	8.6587E+08	3.1181E+07	5.8495E+06	1.1308E+04	7.7636E+02	9.6510E+08
24	450000.	6.0467E+06	5.8467E+07	1.4329E+06	3.5430E+03	7.3427E+01	7.6392E+08
25	480000.	4.9867E+08	1.5760E+07	7.8426E+05	1.7326E+03	6.9394E+00	5.1466E+08
26	500000.	3.7239E+08	5.3487E+05	1.3[illegible]E+07	5.7807E+02	6.4495E-01	3.7956E+08
27	520000.	2.7673E+08	3.8[illegible]E+05	3.1510E+04	8.5195E+01	5.9544E-02	2.7948E+08
28	540000.	2.2512E+08	1.2589E+05	9.0[illegible]E+03	2.2221E+01	5.2241E-03	2.0643E+08
29	560000.	1.5627E+08	5.4482E+04	2.9720E+03	5.5239E+00	4.3465E-04	1.5146E+08
30	580000.	4.3381E+07	2.2338E+04	8.5439E+02	1.5876E+00	3.4832E-05	1.0948E+08
31	600000.	7.8993E+07	3.4777E+03	2.6150E+02	3.1856E-01	2.5732E-06	7.8550E+07
32	620000.	5.6245E+07	5.7346E+	7.5730E+01	7.0791E-02	1.8607E-07	5.6272E+07
33	640000.	3.3775E+07	1.6912E+	2.9864E+01	1.5948E-02	1.2992E-08	3.9756E+07
34	660000.	2.7487E+07	7.4376E+02	9.6785E+00	2.4405E-03	5.5876E-10	2.7503E+07
35	680000.	1.5707E+07	2.3474E+02	1.5962E+00	4.3477E-04	2.7757E-11	1.8668E+07
36	700000.	1.2[illegible]E+07	6.3984E+	4.2436E-01	6.8639E-05	1.1144E-12	1.2278E+07
37	720000.	7.8475E+06	2.1773E+02	1.4785E-01	1.0159E-05	4.3097E-14	7.8617E+06
38	740000.	4.8515E+06	5.2314E+01	2.4004E-02	1.3687E-06	1.2134E-15	4.8668E+06
39	760000.	2.8857E+06	1.7606E+01	4.4172E-03	1.9704E-07	3.0087E-17	2.9005E+06
40	780000.	1.5435E+06	4.5[illegible]E+00	6.8717E-04	2.5238E-08	6.0854E-18	1.6564E+06
41	800000.	8.9750E+05	1.1736E+00	9.3714E-05	2.9789E-09	1.8057E-20	9.0771E+05

K	ALT	CL	CLO	HCL	CLNO3	DCLX
1	0.	9.7579E+03	4.2473E-16	5.9587E+06	2.4032E-13	2.3206E+10	9.5249E-10	1.0836E+09	4.4943E-11	1.1000E-09
2	200000.	5.1117E+03	7.8535E-16	3.5681E+06	1.6351E-13	1.2383E+10	5.8826E-10	1.9895E+08	9.4515E-12	5.7000E-10
3	400000.	5.4610E+03	3.3077E-16	2.6274E+06	1.5914E-13	6.0728E+09	3.5782E-10	5.0732E+07	3.0728E-12	3.1000E-10
4	600000.	3.4117E+03	2.3461E-16	1.9776E+06	1.4707E-13	3.2831E+09	2.4277E-10	1.6760E+07	1.2507E-12	1.7000E-10
5	800000.	2.0094E+03	1.3482E-16	1.0314E+06	9.9394E-14	1.9856E+09	1.8250E-10	5.7476E+06	5.2827E-13	1.2000E-10
6	1000000.	1.2438E+03	1.4243E-16	6.7345E+15	7.7116E-14	1.2764E+09	1.4616E-10	2.8083E+06	3.2158E-13	8.4100E-11
7	1200000.	1.2321E+03	1.7823E-16	5.2345E+05	7.4270E-14	1.2036E+09	1.7411E-10	2.9188E+06	4.2222E-13	1.1000E-10
8	1400000.	9.8696E+02	1.3504E-16	4.7469E+05	4.6246E-14	1.1718E+09	1.9757E-10	2.5725E+06	4.3373E-13	1.3040E-10
9	1600000.	7.5321E+02	5.1988E-16	1.2014E+06	2.0292E-13	1.2326E+09	3.0042E-10	1.4873E+07	3.6248E-12	2.4000E-10
10	1800000.	7.5088E+02	2.6735E-16	1.1074E+07	3.9212E-12	1.5375E+09	5.6567E-10	1.7260E+08	6.1149E-11	6.0000E-10
11	2000000.	1.2258E+04	6.1285E-15	2.8494E+07	1.4247E-11	1.4702E+09	7.3508E-10	3.8502E+08	1.9251E-10	9.5000E-10
12	2200000.	1.5309E+04	1.1833E-14	4.8574E+07	3.3389E-11	1.1741E+09	8.1684E-10	5.3873E+08	3.7700E-10	1.3000E-09
13	2400000.	2.2677E+04	2.1974E-14	6.3315E+07	6.1352E-11	8.6776E+08	8.3698E-10	5.0934E+09	5.9044E-10	1.6000E-09
14	2600000.	3.8827E+04	4.1401E-14	6.555E+07	8.9390E-11	6.3532E+08	8.5335E-10	5.6845E+08	7.6354E-10	1.8000E-09
15	2800000.	4.5322E+04	5.5946E-14	6.9336E+07	1.2767E-10	4.7956E+08	8.8265E-10	4.6856E+08	8.6402E-10	2.0000E-09
16	3000000.	7.5585E+04	1.3020E-13	7.7023E+07	1.9401E-10	3.4446E+08	9.6825E-10	3.3416E+08	8.3163E-10	2.2000E-09
17	3200000.	1.3188E+05	4.5034E-13	8.1915E+07	3.2435E-10	2.4565E+08	1.0659E-09	2.0219E+08	6.9147E-10	2.3000E-09
18	3400000.	2.3473E+05	1.4876E-12	1.5544E+08	4.8832E-10	2.5416E+08	1.1772E-09	9.8280E+07	4.5521E-10	2.3000E-09
19	3600000.	3.9537E+05	2.4549E-12	2.5791E+08	6.7277E-10	2.3981E+08	1.2457E-09	3.7060E+07	2.3105E-10	2.4000E-09
20	3800000.	5.1732E+05	5.1523E-12	9.3308E+07	7.8789E-10	2.5432E+08	1.2882E-09	1.0554E+07	8.8101E-11	2.4000E-09
21	4000000.	8.6098E+05	9.3655E-12	6.8820E+07	7.7537E-10	1.2312E+08	1.3679E-09	2.2808E+06	2.5434E-11	2.4000E-09
22	4200000.	1.3315E+06	1.5655E-11	4.3215E+07	6.5777E-10	1.0209E+08	1.5048E-09	4.4206E+05	5.9144E-12	2.4000E-09
23	4400000.	1.1057E+06	2.1415E-11	2.5453E+07	4.9225E-10	8.6255E+07	1.5715E-09	6.0881E+04	1.1796E-12	2.4000E-09
24	4600000.	1.7655E+05	2.7145E-11	1.3157E+07	3.3437E-10	7.1945E+07	1.8265E-09	8.5071E+03	2.1597E-13	2.4000E-09
25	4800000.	9.5917E+05	3.1614E-11	6.5574E+06	2.1539E-10	5.8895E+07	1.9405E-09	1.2224E+03	4.0278E-14	2.4000E-09
26	5000000.	8.7476E+05	3.5132E-11	3.3566E+06	1.4151E-10	4.7732E+07	2.0123E-09	1.9867E+02	8.3755E-15	2.4000E-09
27	5200000.	7.1015E+05	3.7365E-11	1.7081E+06	9.1720E-11	3.8309E+07	2.0596E-09	7.3350E+01	1.7930E-15	2.4000E-09
28	5400000.	5.3324E+05	4.0362E-11	9.0022E+05	6.1.28E-11	3.0714E+07	2.0886E-09	6.1756E+00	4.1982E-16	2.4000E-09
29	5600000.	4.3175E+05	4.2277E-11	4.6833E+05	4.1408E-11	2.4418E+07	2.1068E-09	1.1164E+00	9.6325E-17	2.4000E-09
30	5800000.	4.0236E+05	4.4191E-11	2.4109E+05	2.5425E-11	1.9235E+07	2.1191E-09	1.9820E-01	2.1768E-17	2.4000E-09
31	6000000.	3.2712E+05	4.5730E-11	1.2304E+05	1.7717E-11	1.5195E+07	2.1267E-09	3.5067E-02	4.9087E-18	2.4000E-09
32	6200000.	2.6717E+05	4.7405E-11	6.9235E+04	1.1752E-11	1.2008E+07	2.1307E-09	6.7217E-03	1.1926E-18	2.4000E-09
33	6400000.	2.2011E+05	4.8845E-11	3.5474E+04	8.0730E-12	9.4149E+06	2.1320E-09	1.2593E-03	2.8517E-19	2.4000E-09
34	6600000.	1.7035E+05	4.9782E-11	1.7068E+04	5.1557E-12	7.3377E+06	2.1350E-09	2.0312E-04	5.9133E-20	2.4000E-09
35	6800000.	1.3605E+05	5.1355E-11	9.1027E+03	3.4195E-12	5.6838E+06	2.1351E-09	3.3777E-05	1.2688E-20	2.4000E-09
36	7000000.	1.0826E+05	5.3423E-11	4.4916E+03	2.2470E-12	4.3240E+06	2.1343E-09	4.9573E-06	2.4468E-21	2.4000E-09
37	7200000.	8.0326E+04	5.6143E-11	2.2435E+03	1.4437E-12	3.2773E+06	2.1324E-09	7.0139E-07	4.5693E-22	2.4000E-09
38	7400000.	6.0609E+04	5.7604E-11	1.0835E+03	9.4056E-13	2.4530E+06	2.1294E-09	9.2689E-08	8.0460E-23	2.4000E-09
39	7600000.	8.1093E+04	7.1427E-11	5.8191E+02	5.8128E-13	1.8116E+06	2.1178E-09	1.2767E-08	1.4926E-23	2.4000E-09
40	7800000.	6.1506E+04	2.6657E-11	3.4314E+02	5.4032E-13	1.3146E+06	2.0929E-09	1.7916E-09	2.8524E-24	2.4000E-09
41	8000000.	6.3347E+04	1.4563E-10	2.1357E+02	4.8193E-13	9.3117E+05	2.0478E-09	2.5122E-10	5.5140E-25	2.4000E-09

K	ALT	H + O3	OH + O3	HO2 + O3	HO2 + O	OH + O	NO2 + O	CLO + O	O + O3	O2 + HV
1	0.	5.7904E+06	1.1155E+05	4.6328E+05	1.7740E+04	2.9140E-01	9.2319E+01	1.4863E+00	4.0837E+01	5.3865E-13
2	200000.	2.2409E+06	5.7443E+04	2.8314E+05	1.2411E+02	4.0322E-01	3.5916E+01	1.1113E+00	3.0460E+01	5.1698E-10
3	400000.	4.0001E+06	5.5857E+04	1.5185E+05	1.2360E+02	4.6955E-01	3.0668E+01	4.0173E+00	2.3259E+01	1.9952E-07
4	600000.	2.3014E+06	3.4027E+04	8.0078E+04	1.1823E+02	4.6828E-01	1.3703E+01	9.4771E+01	1.9224E+01	3.0912E-05
5	800000.	1.5594E+06	2.5593E+04	3.7751E+04	9.6511E+01	3.6425E-01	1.6042E+01	6.4256E-01	1.4914E+01	2.7491E-03
6	1000000.	1.1496E+06	8.2173E+03	1.8833E+04	9.1347E+01	3.1897E-01	1.9076E+01	5.7346E-01	1.4998E+01	1.4842E-01
7	1200000.	8.5458E-01	4.8151E+03	1.0058E+04	9.7997E+01	7.3981E-01	4.4758E+01	7.2944E-01	1.9228E+01	4.7507E+00
8	1400000.	5.1258E-01	2.3374E+03	4.3467E+03	6.8146E+01	2.4717E-01	9.2704E+01	5.3266E-01	1.8742E+01	1.1644E+02
9	1600000.	1.2220E+00	5.2302E+03	5.7193E+03	2.0051E+02	1.1078E+00	5.4221E+02	8.4629E+00	9.2170E+01	1.4595E+03
10	1800000.	5.1752E+00	2.1605E+04	1.6573E+04	1.2128E+03	1.1145E+01	2.4254E+03	3.8788E+02	1.2567E+03	9.9972E+03
11	2000000.	1.2809E+01	4.1475E+04	2.8610E+04	3.9211E+03	7.7791E+01	2.0654E+04	2.8537E+03	5.7910E+03	4.6366E+04
12	2200000.	2.1594E+01	6.7247E+04	4.2478E+04	1.0270E+04	1.1636E+02	8.3171E+04	1.1895E+04	1.9469E+04	1.5946E+05
13	2400000.	4.4992E+01	1.0329E+05	6.5095E+04	2.6593E+04	7.4327E+02	1.8198E+05	7.4323E+04	5.2596E+04	4.4263E+05
14	2600000.	1.0033E+02	1.5772E+05	5.6392E+04	5.9412E+04	3.0239E+03	5.3146E+05	7.5834E+04	1.2946E+05	1.0414E+06
15	2800000.	2.7183E+02	2.1563E+05	8.6479E+04	1.1406E+05	2.7850E+03	1.2777E+06	1.5136E+05	2.5867E+05	2.1106E+06
16	3000000.	5.5906E+02	2.7755E+05	5.6362E+05	1.8709E+05	7.1194E+03	2.3375E+06	2.9727E+05	4.2154E+05	3.6383E+06
17	3200000.	1.3688E+03	3.3041E+05	4.0450E+04	2.7414E+05	1.6143E+04	3.4349E+06	6.0289E+05	6.1466E+05	5.4298E+06
18	3400000.	3.3988E+03	3.5914E+05	2.4379E+04	3.5172E+05	4.3708E+04	4.4117E+06	1.1436E+06	7.9695E+05	7.1634E+06
19	3600000.	7.3389E+03	3.5190E+05	1.0389E+04	4.1491E+05	9.6816E+04	4.8201E+06	1.8383E+06	9.3612E+05	8.5112E+06
20	3800000.	1.7429E+04	3.1423E+05	5.3193E+03	4.7462E+05	2.1832E+05	4.5949E+06	2.5321E+06	1.0162E+06	9.1775E+06
21	4000000.	3.3515E+04	2.7327E+05	3.1502E+03	5.7972E+05	7.9470E+05	3.7845E+06	2.9323E+06	1.0632E+06	9.0341E+06
22	4200000.	7.7437E+04	2.6308E+05	1.7378E+03	7.2312E+05	6.3756E+05	2.5975E+06	2.8636E+06	1.1134E+06	8.2672E+06
23	4400000.	8.7367E+04	2.7527E+05	1.0216E+03	9.0002E+05	3.9785E+05	2.5857E+06	2.3617E+06	1.1474E+06	7.1846E+06
24	4600000.	1.1173E+05	6.3224E+05	6.5325E+02	1.0369E+06	1.0932E+06	9.4925E+05	1.6581E+06	1.1156E+06	6.0420E+06
25	4800000.	1.4027E+05	7.8591E+04	3.5100E+02	1.1424E+06	1.2106E+06	4.3950E+05	1.0418E+06	9.8287E+05	5.0164E+06
26	5000000.	1.5335E+05	2.2331E+04	2.3914E+02	1.1105E+06	1.2485E+06	2.5289E+05	6.2930E+05	7.7311E+05	4.1929E+06
27	5200000.	1.5706E+05	1.2705E+04	1.1046E+02	1.0702E+06	1.2243E+06	1.2431E+05	3.6417E+05	5.7352E+05	3.5332E+06
28	5400000.	1.6337E+05	7.2711E+03	6.0076E+01	1.0160E+06	1.1806E+06	5.9827E+04	2.1250E+05	3.9609E+05	3.0422E+06
29	5600000.	1.7042E+05	4.0714E+03	3.2376E+01	9.5358E+05	1.1216E+06	2.7409E+04	1.1812E+05	2.5597E+05	2.6512E+06
30	5800000.	1.5608E+05	2.4473E+03	1.7594E+01	8.7577E+05	1.0427E+06	1.2430E+04	6.4772E+04	1.6522E+05	2.3312E+06
31	6000000.	1.5302E+05	1.2221E+03	9.1769E+00	7.8366E+05	9.5573E+05	5.4772E+03	3.5076E+04	1.0287E+05	2.0567E+06
32	6200000.	1.5381E+05	6.7071E+02	4.9349E+00	7.0235E+05	8.6592E+05	2.4777E+03	2.0532E+04	6.5983E+04	1.8217E+06
33	6400000.	1.5943E+05	3.3906E+02	2.1791E+00	6.0560E+05	7.8956E+05	1.1571E+03	1.2695E+04	4.6305E+04	1.5999E+06
34	6600000.	1.3695E+05	1.7487E+02	1.2774E+00	5.4631E+05	6.9910E+05	5.8408E+02	5.6348E+03	1.8856E+04	1.4052E+06
35	6800000.	1.4073E+05	8.9353E+01	5.2735E-01	4.3296E+05	6.2353E+05	1.4995E+02	3.0394E+03	1.0527E+04	1.2610E+06
36	7000000.	1.4127E+05	4.2341E+01	2.3672E-01	4.3241E+05	5.7358E+05	5.4886E+01	1.5898E+03	5.7240E+03	1.1548E+06
37	7200000.	1.4692E+05	2.3137E+01	1.0344E-01	3.9469E+05	5.4137E+05	1.3401E+01	8.3641E+02	3.0863E+03	1.0869E+06
38	7400000.	1.3327E+05	1.1657E+01	4.8948E-02	3.8773E+05	5.1595E+05	6.4947E+00	4.3897E+02	1.6307E+03	1.0238E+06
39	7600000.	1.7126E+05	5.4703E+00	1.3351E-02	2.9669E+05	4.6951E+05	2.3853E+00	2.9254E+02	1.1111E+03	9.4098E+05
40	7800000.	1.1009E+05	2.2576E+00	6.9464E-03	2.2882E+05	4.1454E+05	8.3434E-01	2.2505E+02	8.0614E+02	8.3048E+05
41	8000000.	1.3777E+05	9.3305E-01	2.1015E-03	1.6150E+05	3.4908E+05	2.8274E-01	1.8908E+02	5.6407E+02	6.9928E+05

INTEGRATED LOSS FOR OZONE

	4.5906E+11	5.9520E+11	8.5518E+10	3.0197E+12	3.6765E+12	5.3669E+12	3.8006E+12	2.4182E+12	1.9774E+13

K	ALT	H2O + HV	H2O + O1D	CH4 + O1D	HNO3 + HV	CO + OH	NO + HO2	JH2O2+H2O2	CL + CH4
1	0.	1.4189E+01	1.5143E+06	5.9592E+01	5.9007E+03	9.3548E+05	2.7354E+05	4.4862E+05	4.1093E+04
2	200000.	2.0690E+01	1.0310E+06	8.7324E+01	5.1560E+03	8.6989E+05	2.4946E+05	5.3571E+05	2.3793E+04
3	400000.	1.9864E+01	6.4138E+05	8.3320E+01	2.6993E+03	5.0050E+05	1.2256E+05	3.9353E+05	1.0387E+04
4	600000.	1.3702E+01	3.7044E+05	8.1692E+01	1.4289E+03	3.6226E+05	5.8314E+04	2.4922E+05	4.3242E+03
5	800000.	1.9145E+01	1.1727E+05	8.0624E+01	8.3967E+02	1.7416E+05	3.0410E+04	1.1387E+05	1.5841E+03
6	1000000.	2.1430E+01	4.1454E+04	8.9742E+01	5.4586E+02	8.0704E+04	1.5361E+04	4.7097E+04	5.8532E+02
7	1200000.	2.7195E+01	1.4216E+04	1.1367E+02	5.9557E+02	3.7004E+04	1.1896E+04	1.5925E+04	3.2898E+02
8	1400000.	3.3586E+01	3.5639E+03	1.4072E+02	5.8211E+02	1.5428E+04	8.3235E+03	4.3854E+03	1.5531E+02
9	1600000.	5.4031E+01	1.3239E+03	2.6645E+02	1.3076E+03	9.4074E+03	6.0319E+03	4.1209E+03	2.1444E+02
10	1800000.	1.4171E+02	3.1158E+02	5.7758E+02	3.2989E+03	7.5357E+03	6.0775E+03	6.4722E+03	4.6731E+02
11	2000000.	2.0037E+02	4.5332E+02	7.9502E+02	4.3050E+03	5.9712E+03	6.4522E+03	7.8213E+03	5.5515E+02
12	2200000.	2.6924E+02	6.7487E+02	1.0220E+03	5.1938E+03	4.1883E+03	7.5318E+03	1.0025E+04	5.5358E+02
13	2400000.	3.7034E+02	9.5525E+02	1.3070E+03	6.9407E+03	3.0196E+03	9.9655E+03	1.2425E+04	5.1935E+02
14	2600000.	5.1974E+02	1.3268E+03	1.6107E+03	1.0026E+04	4.1832E+03	1.4773E+04	1.3819E+04	5.0100E+02
15	2800000.	7.1180E+02	1.8738E+03	1.8933E+03	1.3563E+04	4.8174E+03	2.0576E+04	1.5811E+04	5.4809E+02
16	3000000.	9.9458E+02	2.4316E+03	2.0224E+03	1.5364E+04	5.7387E+03	2.4412E+04	1.1792E+04	5.6376E+02
17	3200000.	1.0646E+03	2.3574E+03	2.0242E+03	1.4822E+04	6.7776E+03	2.4238E+04	8.6584E+03	6.4641E+02
18	3400000.	1.1201E+03	3.3182E+03	2.0093E+03	1.2122E+04	7.6555E+03	2.4954E+04	5.3362E+03	7.5165E+02
19	3600000.	1.0731E+03	7.4434E+03	1.4702E+03	8.4575E+03	9.0562E+03	1.6349E+04	2.9538E+03	8.1453E+02
20	3800000.	3.6624E+02	3.4168E+03	1.1270E+03	4.9118E+03	7.8689E+03	1.2220E+04	1.6243E+03	8.0966E+02
21	4000000.	8.3310E+02	3.2283E+03	8.2494E+02	2.2441E+03	6.8794E+03	9.1305E+03	1.0107E+03	7.2175E+02
22	4200000.	6.9756E+02	2.9360E+03	5.7732E+02	8.0836E+02	5.4173E+03	6.8352E+03	7.3436E+02	5.6777E+02
23	4400000.	5.6223E+02	2.7753E+03	3.9006E+02	2.4606E+02	4.3479E+03	4.9565E+03	5.7338E+02	4.0764E+02
24	4600000.	3.0872E+02	1.3553E+03	2.5833E+02	6.8302E+01	2.0467E+03	3.4369E+03	4.4542E+02	2.7633E+02
25	4800000.	4.9785E+02	1.7471E+03	1.6519E+02	1.8860E+01	9.1765E+02	2.2762E+03	3.3779E+02	1.7900E+02
26	5000000.	5.5538E+02	9.7436E+02	1.0979E+02	5.5586E+00	1.6636E+03	1.4516E+03	2.5476E+02	1.1131E+02
27	5200000.	5.5479E+02	6.9472E+02	7.3308E+01	1.6483E+00	1.2348E+03	8.9935E+02	1.8745E+02	6.8309E+01
28	5400000.	4.7242E+02	4.2883E+02	5.0584E+01	5.1656E-01	1.0450E+03	5.4334E+02	1.3870E+02	4.4729E+01
29	5600000.	9.6617E+02	3.4357E+02	3.3953E+01	1.6196E-01	8.6062E+02	3.3100E+02	1.0658E+02	2.4163E+01
30	5800000.	3.1709E+02	2.3316E+02	2.2854E+01	4.9149E-02	5.9440E+02	1.9388E+02	7.8395E+01	1.4215E+01
31	6000000.	9.2012E+02	1.5931E+02	1.5349E+01	1.4703E-02	5.4380E+02	1.1297E+02	5.7085E+01	8.2257E+00
32	6200000.	7.7148E+02	1.0030E+02	1.1190E+01	4.3497E-03	4.0540E+02	5.8474E+01	3.6218E+01	4.5391E+00
33	6400000.	3.0416E+02	6.2057E+01	8.5322E+00	1.1600E-03	2.6445E+02	2.7081E+01	1.9118E+01	2.4924E+00
34	6600000.	6.6292E+02	3.6337E+01	5.0045E+00	3.7246E-04	2.1385E+02	1.6310E+01	1.8917E+01	1.2686E+00
35	6800000.	6.3236E+02	1.9837E+01	3.4680E+00	1.0205E-04	1.4977E+02	9.3861E+00	1.2706E+01	6.5672E-01
36	7000000.	7.8187E+02	1.1125E+01	2.3300E+00	2.5845E-05	5.6261E+02	4.0122E+00	8.5241E+00	3.2671E-01
37	7200000.	3.1956E+02	5.2553E+01	1.5810E+00	6.4202E-06	7.4246E+02	1.8757E+00	5.8338E+00	1.6024E-01
38	7400000.	8.7756E+02	2.6833E+01	1.0676E+00	1.4892E-06	8.3730E+02	8.2680E-01	3.8650E+00	7.7049E-02
39	7600000.	7.1905E+02	1.3358E+01	8.2229E-01	2.7579E-07	8.1745E+02	2.7586E-01	1.6171E+00	4.0197E-02
40	7800000.	6.0832E+02	7.8272E+00	6.5829E-01	4.3110E-08	7.1590E+02	7.5712E-02	5.1021E-01	2.2694E-02
41	8000000.	7.2481E+02	3.8039E+00	5.2203E-01	5.0820E-09	5.9712E+02	1.8006E-02	1.3459E-01	1.3686E-02

K	ALT	H2O2 + OH	HO2 + OH	HCL + OH	CH4 + OH	O1 + NO2	OH + HNO3	OH + OH	H + HO2	CL + HO2
1	0.	7.7692E+05	1.0372E+05	4.4398E+04	8.4210E+05	2.0851E+04	1.4950E+04	2.4847E+01	6.2262E-03	2.8880E+02
2	20000.	5.4718E+05	1.1133E+05	2.5832E+04	6.1673E+05	1.2777E+04	7.6209E+03	3.2081E+01	5.9768E-03	3.2152E+02
3	40000.	2.8978E+05	8.5335E+04	1.1206E+04	3.4728E+05	5.7336E+03	2.8804E+03	2.7562E+01	4.7268E-03	1.2299E+02
4	60000.	[illegible]784E+05	5.3578E+04	[illegible]314E+03	1.7.83E+05	2.4580E+03	[illegible]429.E+03	1.8057E+01	2.9782E-03	5.0832E+01
5	80000.	2.8893E+04	2.2581E+04	[illegible]760E+03	6.2630E+04	1.1576E+03	7.1785E+02	7.2368E+00	1.2036E-03	2.3318E+01
6	100000.	5.3521E+03	3.3415E+03	6.1375E+02	2.3512E+04	6.5163E+02	1.0577E+04	2.7133E+00	4.7322E-04	8.4395E+00
7	120000.	1.1090E+03	[illegible]3F0E+03	3.4221E+02	6.6743E+03	5.0746E+02	6.1894E+01	1.1181E+00	1.9366E-04	5.8569E+00
8	140000.	1.2348E+02	1.3[illegible]E+02	1.5807E+02	1.0149E+03	6.0831E+02	2.6402E+01	3.1036E-01	4.7557E-05	2.5369E+00
9	160000.	1.7[illegible]3E+02	1.1923E+03	2.2290E+02	1.2775E+03	1.3820E+03	7.4744E+01	6.0514E-01	4.8465E-05	5.3037E+00
10	180000.	3.6798E+2	2.3[illegible]E+[illegible]	[illegible]360E+2	1.0[illegible]56E+03	3.6254E+03	3.2608E+02	1.6727E+00	1.0960E-04	1.9209E+01
11	200000.	5.5207E+02	3.4273E+02	5.0634E+02	1.5828E+03	4.8482E+03	5.4321E+02	2.7780E+00	1.9459E-04	3.4853E+01
12	220000.	1.1106E+03	4.3788E+02	6.7080E+02	1.5146E+03	5.9147E+03	7.2500E+02	4.4842E+00	3.7708E-04	5.3878E+01
13	240000.	1.8233E+03	7.2[illegible]5E+03	5.3187E+02	1.4592E+03	7.8182E+03	8.5949E+02	7.9026E+00	6.1920E-04	8.0308E+01
14	260000.	2.7660E+03	1.0[illegible]E+04	6.5704E+02	1.4715E+03	1.0963E+04	9.4083E+02	1.4850E+01	1.9692E-03	1.1511E+02
15	280000.	3.5531E+03	1.4356E+04	7.2789E+02	1.4968E+03	1.4471E+04	9.0770E+02	3.0492E+01	5.1031E-03	1.7101E+02
16	300000.	3.7836E+03	2.[illegible]	7.7812E+02	1.6317E+03	1.6173E+04	8.0981E+02	6.6356E+01	1.3938E-02	2.6288E+02
17	320000.	3.7016E+03	2.6417E+04	1.0921E+03	1.5571E+03	1.5528E+04	7.0561E+02	1.4850E+02	4.0257E-02	3.9452E+02
18	340000.	2.7116E+03	3.[illegible]E+04	1.3476E+03	1.5536E+03	1.2714E+04	5.8665E+02	3.2271E+02	1.5746E-01	5.5093E+02
19	360000.	1.3909E+03	3.1[illegible]E+04	1.5395E+03	1.4597E+03	8.8952E+03	4.3869E+02	6.4774E+02	3.1716E-01	6.8574E+02
20	380000.	8.2262E+02	3.[illegible]E+04	1.6305E+03	1.2367E+03	5.0937E+03	2.8159E+02	1.1626E+03	8.5184E-01	7.8462E+02
21	400000.	4.3608E+02	2.[illegible]E+04	1.5023E+03	1.0314E+03	2.3801E+03	1.3692E+02	1.6834E+03	2.1799E+00	8.4347E+02
22	420000.	1.1761E+02	2.[illegible]E+04	[illegible]415E+03	7.3431E+02	8.[illegible]88E+02	4.7560E+01	1.8865E+03	5.1206E+00	8.3835E+02
23	440000.	2.1551E+02	2.[illegible]E+04	1.1374E+03	4.9306E+02	2.5028E+02	1.7224E+01	1.7529E+03	1.0679E+01	7.5839E+02
24	460000.	1.0135E+02	[illegible]5923E+04	9.6252E+02	3.2739E+02	7.1527E+01	3.2246E+00	1.4348E+03	1.9272E+01	6.1988E+02
25	480000.	8.9559E+01	1.[illegible]50E+04	8.7009E+02	2.0775E+02	1.9621E+01	7.5448E-01	1.0977E+03	3.0323E+01	4.7081E+02
26	500000.	5.3910E+01	3.747[illegible]	4.7323E+02	1.2954E+02	5.7475E+00	1.8886E-01	8.3595E+02	4.3177E+01	3.4926E+02
27	520000.	3.5135E+01	5.331[illegible]	3.2571E+02	8.0468E+01	1.6049E+00	4.0563E-02	6.2051E+02	5.7432E+01	2.5017E+02
28	540000.	1.3361E+01	4.7314E+03	2.2[illegible]6E+02	4.3667E+01	[illegible].2863E-01	1.2467E-02	4.7315E+02	7.3889E+01	1.8068E+02
29	560000.	1.2821E+01	7.7325E+03	1.5624E+02	2.0775E+01	1.6546E-01	3.1960E-03	3.7516E+02	9.0845E+01	1.3175E+02
30	580000.	7.7576E+00	2.92[illegible]E+03	1.0577E+02	[illegible].8484E+01	4.9972E-02	8.0341E-04	2.8542E+02	1.2193E+02	9.2893E+01
31	600000.	4.6134E+00	2.1132E+03	7.1118E+01	1.4[illegible]5E+01	1.4051E-02	1.9819E-04	2.1672E+02	1.5096E+02	6.5031E+01
32	620000.	2.2112E+0[illegible]	1.4377E+03	[illegible]394E+01	5.7218E+00	[illegible].3342E-03	4.4474E-05	1.4993E+02	1.6751E+02	4.3171E+01
33	640000.	9.[illegible]458E-01	9.2111E+02	2.5[illegible]35E+01	2.8912E+0[illegible]	1.[illegible]084E-03	8.3047E-06	8.9429E+01	1.6634E+02	2.6430E+01
34	660000.	7.7372E-01	8.5[illegible]3E+02	1.3807E+01	1.8012E+00	3.7437E-04	[illegible].4669E-06	5.1598E+01	2.4524E+02	2.1054E+01
35	680000.	3.5[illegible]5E-01	5.2341E+02	1.2550E+01	9.4490E-01	1.0258E-04	5.2893E-07	5.8413E+01	2.9081E+02	1.4244E+01
36	700000.	[illegible].36,3E-1	4.6453E+2	[illegible].0204E+0[illegible]	4.3282E+00	2.5950E-05	1.0525E-07	[illegible].1925E+01	3.6110E+02	9.[illegible]673E+00
37	720000.	1.0629E-01	7.5183E+02	[illegible].2890E+00	2.4514E-01	6.4415E-06	2.0865E-08	4.1000E+01	4.6750E+02	6.5343E+00
38	740000.	5.[illegible]775E-02	2.635[illegible]E+02	3.2178E+00	1.2107E-01	1.4230E-06	3.4186E-09	3.1975E+01	6.0206E+02	4.4253E+00
39	760000.	1.4679E-02	1.3237E+02	1.5608E+0[illegible]	4.3500E-02	2.7625E-07	4.6767E-10	1.7730E+01	5.7888E+02	2.6620E+00
40	780000.	2.6376E-03	5.3153E+01	7.7151E-01	1.7166E-02	4.3154E-08	4.3786E-11	6.1852E+00	4.5354E+02	1.5568E+00
41	800000.	7.8950E-04	1.8394E+01	7.2355E-01	5.5329E-03	5.8854E-09	3.3603E-12	3.4124E+00	3.0586E+02	9.2356E-01

MIXING RATIOS:

ALT	N2O	NOX	CH4	FC11	FC12	CH3C	CLX	CCL4	H2
0.	2.5000E-07	1.8637E-13	1.5004E-06	7.5188E-11	1.5485E-10	1.5010E-09	1.0477E-09	1.3000E-10	5.0000E-07
200000.	2.4931E-07	1.0328E-13	1.4835E-06	7.5137E-11	1.5479E-10	1.5994E-09	5.9788E-10	1.2991E-10	4.9481E-07
400000.	2.4931E-07	5.3602E-11	1.4731E-06	7.5075E-11	1.5471E-10	1.5038E-09	3.7106E-10	1.2973E-10	4.9168E-07
600000.	2.4958E-07	3.8219E-10	1.4670E-06	7.4999E-11	1.5460E-10	1.2940E-09	2.4416E-10	1.2965E-10	4.8992E-07
800000.	2.4952E-07	2.5637E-10	1.4637E-06	7.4904E-11	1.5447E-10	1.2731E-09	1.8313E-10	1.2947E-10	4.8902E-07
1000000.	2.4913E-07	2.2351E-10	1.4597E-06	7.4676E-11	1.5416E-10	1.2526E-09	1.4656E-10	1.2905E-10	4.8801E-07
1200000.	2.4329E-07	3.3134E-10	1.4637E-06	7.4187E-11	1.5359E-10	1.2241E-09	1.7461E-10	1.2813E-10	4.8648E-07
1400000.	2.4728E-07	4.5987E-10	1.4475E-06	7.3594E-11	1.5268E-10	1.2113E-09	1.9805E-10	1.2702E-10	4.8488E-07
1600000.	2.4169E-07	1.1011E-09	1.4151E-06	7.0520E-11	1.4825E-10	1.1361E-09	3.0431E-10	1.2088E-10	4.7650E-07
1800000.	2.2239E-07	7.8385E-09	1.3071E-06	5.9005E-11	1.3203E-10	9.1675E-10	6.7069E-10	9.9626E-11	4.4820E-07
2000000.	2.1163E-07	6.2753E-09	1.1967E-06	4.6320E-11	1.1590E-10	7.2442E-10	9.4182E-10	7.6189E-11	4.1772E-07
2200000.	1.7533E-07	8.6752E-09	1.0748E-06	3.7488E-11	9.7488E-11	5.6007E-10	1.2299E-09	5.2079E-11	3.8564E-07
2400000.	1.5137E-07	1.1269E-08	9.5417E-07	2.1133E-11	7.8067E-11	4.2137E-10	1.4090E-09	2.9996E-11	3.5211E-07
2600000.	1.2459E-07	1.0741E-08	8.3224E-07	1.0911E-11	5.8668E-11	3.0578E-10	1.7068E-09	1.3533E-11	3.1751E-07
2800000.	9.3015E-08	1.5275E-08	7.3996E-07	4.4004E-12	4.0536E-11	2.1135E-10	1.8752E-09	4.3884E-12	2.8210E-07
3000000.	7.5616E-08	1.7004E-08	5.9201E-07	1.3572E-12	2.5823E-11	1.5858E-10	1.9033E-09	9.7791E-13	2.4729E-07
3200000.	5.3254E-08	1.3135E-08	4.8447E-07	3.3159E-13	1.5380E-11	8.6213E-11	2.0714E-09	1.5231E-13	2.1435E-07
3400000.	3.7572E-08	1.4955E-08	3.8423E-07	6.7553E-14	8.7374E-12	5.0625E-11	2.1212E-09	1.7467E-14	1.8434E-07
3600000.	2.6306E-08	2.3712E-08	3.0169E-07	1.2710E-14	4.8064E-12	2.8486E-11	2.1513E-09	1.6516E-15	1.5854E-07
3800000.	1.8433E-08	2.3868E-08	2.3248E-07	2.3351E-15	2.7429E-12	1.5567E-11	2.1685E-09	1.4302E-16	1.3767E-07
4000000.	1.3214E-08	1.9905E-08	1.8903E-07	4.4078E-16	1.5753E-12	8.4536E-12	2.1779E-09	1.2661E-17	1.2254E-07
4200000.	9.56 4E-09	1.3412E-08	1.4153E-07	9.3706E-17	9.3612E-13	4.7725E-12	2.1829E-09	1.2303E-18	1.1337E-07
4400000.	7.2745E-09	1.3628E-08	1.1534E-07	2.1927E-17	5.5090E-13	2.5633E-12	2.1855E-09	1.3862E-19	1.0998E-07
4600000.	5.5472E-09	1.7071E-08	9.5027E-08	5.8149E-18	3.7704E-13	1.8619E-12	2.1869E-09	1.8534E-20	1.1171E-07
4800000.	4.5111E-09	1.6953E-08	8.6338E-08	1.7217E-18	2.5383E-13	1.3001E-12	2.1877E-09	2.9042E-21	1.1786E-07
5000000.	3.5332E-09	1.5002E-08	7.8935E-08	5.7046E-19	1.7738E-13	9.7690E-13	2.1882E-09	5.3659E-22	1.2751E-07
5200000.	3.1055E-09	1.5026E-08	7.4344E-08	2.1095E-19	1.2835E-13	7.8272E-13	2.1885E-09	1.1674E-22	1.3974E-07
5400000.	2.5745E-09	1.4033E-08	7.1478E-08	8.5496E-20	9.5512E-14	6.5925E-13	2.1887E-09	2.9210E-23	1.5387E-07
5600000.	2.3514E-09	1.2224E-08	6.9623E-08	3.7780E-20	7.2384E-14	5.7744E-13	2.1888E-09	8.3520E-24	1.6927E-07
5800000.	2.1045E-09	1.2024E-08	6.8436E-08	1.8012E-20	5.7088E-14	5.2111E-13	2.1889E-09	2.6931E-24	1.8552E-07
6000000.	1.9119E-09	1.0436E-08	6.7745E-08	9.1259E-21	4.5352E-14	4.8081E-13	2.1890E-09	9.5843E-25	2.0242E-07
6200000.	1.7646E-09	9.7047E-09	6.7371E-08	4.9571E-21	3.7362E-14	4.5218E-13	2.1890E-09	3.7954E-25	2.1906E-07
6400000.	1.6525E-09	9.0106E-09	6.7118E-08	2.9142E-21	3.1474E-14	4.3146E-13	2.1890E-09	1.6844E-25	2.3509E-07
6600000.	1.5528E-09	3.0058E-09	6.6920E-08	1.7911E-21	2.7097E-14	4.1512E-13	2.1891E-09	8.0834E-26	2.5112E-07
6800000.	1.4913E-09	7.9211E-10	6.6857E-08	1.1655E-21	2.3878E-14	4.0244E-13	2.1891E-09	4.1960E-26	2.6652E-07
7000000.	1.4347E-09	6.6073E-09	6.6791E-08	8.0319E-22	2.1443E-14	3.9259E-13	2.1891E-09	2.3675E-26	2.8078E-07
7200000.	1.3888E-09	5.1216E-09	6.6745E-08	5.8413E-22	1.9639E-14	3.8473E-13	2.1891E-09	1.4288E-26	2.9366E-07
7400000.	1.3517E-09	4.2247E-09	6.6715E-08	4.3804E-22	1.8285E-14	3.7851E-13	2.1891E-09	9.1759E-27	3.0428E-07
7600000.	1.3219E-09	3.3948E-09	6.6608E-08	3.4421E-22	1.7267E-14	3.7362E-13	2.1891E-09	6.2133E-27	3.1165E-07
7800000.	1.2979E-09	2.6356E-09	5.6669E-08	2.7904E-22	1.6492E-14	3.6977E-13	2.1891E-09	4.3524E-27	3.1550E-07
8000000.	1.2730E-09	1.3923E-09	6.6534E-08	2.3155E-22	1.5893E-14	3.6676E-13	2.1891E-09	3.0728E-27	3.1617E-07

FN2O = -1.36690E+03 FNOX = -1.34494E+10 FCH4 = -3.3844E+11 FF11 = -8.42315E+05 FF12 = -1.09231E+06

FCH3C = -4.04628E+09 FCLX = -3.4915E+09 FCCL4 = -1.48964E+06 FH2 = -1.09772E+11

K	ALT	MR 03	FO41	FO12	CH3CL	CCL4	CLX
1	0.	2.9368E-08	1.3148E+09	3.4736E+09	3.6155E+10	7.1743E+09	2.4296E+10
2	200000.	2.8043E-08	4.5816E+09	3.2543E+09	2.9458E+10	2.7345E+09	1.2585E+10
3	400000.	2.9588E-08	1.2395E+09	2.5542E+09	2.2021E+10	2.1479E+09	6.1261E+09
4	500000.	3.2505E-08	1.8546E+09	2.7146E+09	1.7346E+10	1.7375E+09	3.2718E+09
5	800000.	3.7677E-08	3.1495E+08	1.6806E+09	1.0851E+10	1.4086E+09	1.5924E+09
6	1000000.	5.1734E-08	6.5215E+08	1.7465E+09	1.0939E+10	1.1278E+09	1.2749E+09
7	1200000.	8.2192E-08	5.2858E+08	1.0611E+09	8.4971E+09	8.8778E+08	1.2071E+09
8	1400000.	4.1337E-07	4.1659E+08	2.0557E+08	7.1843E+09	7.5338E+08	1.1746E+09
9	1500000.	3.3190E-07	2.3852E+08	6.0801E+08	4.6611E+09	4.9599E+08	1.2466E+09
10	1800000.	1.0786E-06	1.3631E+08	3.7506E+08	2.5889E+09	2.8134E+08	1.7811E+08
11	2000000.	2.0244E-06	3.3146E+07	2.3479E+08	1.4480E+09	1.5238E+08	1.0836E+09
12	2200000.	3.2657E-06	4.7854E+07	1.3931E+08	6.0034E+08	7.4420E+07	1.7575E+09
13	2400000.	4.5352E-06	2.1706E+07	8.0561E+07	4.3406E+08	3.0950E+07	1.5766E+09
14	2500000.	6.5450E-06	8.1736E+06	4.3635E+07	2.2765E+08	1.0675E+07	1.2707E+09
15	2800000.	8.0321E-06	2.3363E+06	2.1983E+07	1.1461E+08	2.3798E+06	1.6169E+09
16	3000000.	8.8273E-06	5.7680E+05	1.0254E+07	5.5016E+07	3.8623E+05	7.9134E+08
17	3200000.	8.3365E-06	9.5357E+04	4.4972E+06	2.5179E+07	4.4535E+04	6.0568E+08
18	3400000.	8.1937E-06	1.4655E+04	1.8604E+06	1.0930E+07	3.7725E+03	4.5707E+08
19	3600000.	8.3327E-06	2.1395E+03	7.8378E+05	4.5591E+06	2.6492E+02	3.4506E+08
20	3800000.	5.5647E-06	2.7974E+02	3.2459E+05	1.8601E+06	1.7134E+01	2.5979E+08
21	4000000.	4.2920E-06	4.5886E+01	1.4182E+05	7.6464E+05	1.1534E+00	1.9599E+08
22	4200000.	3.4015E-06	5.7705E+00	6.3637E+04	3.2444E+05	8.7634E-02	1.4839E+08
23	4400000.	2.7578E-06	1.4317E+00	2.9980E+04	1.4808E+05	7.1542E-03	1.1280E+08
24	4600000.	2.2094E-06	2.2856E-01	1.4052E+04	7.3759E+04	7.3005E-04	8.6144E+07
25	4800000.	1.8182E-06	3.2562E-02	7.7039E+03	3.9457E+04	8.8142E-05	6.6398E+07
26	5000000.	1.6376E-06	1.3531E-02	4.2075E+03	2.3172E+04	1.2728E-05	5.1955E+07
27	5200000.	1.0935E-06	7.9236E-03	2.7072E+03	1.4559E+04	2.1713E-06	4.0706E+07
28	5.0000.	1.2493E-06	1.2676E-03	1.4056E+03	9.6976E+03	4.2868E-07	3.2196E+07
29	5500000.	1.0471E-06	4.3787E-04	8.4589E+02	6.6925E+03	9.6800E-08	2.5368E+07
30	5600000.	8.9628E-07	1.3462E-04	5.1978E+02	4.7447E+03	2.4521E-08	1.9930E+07
31	6000000.	7.7025E-07	6.3295E-05	3.2542E+02	3.4349E+03	6.6470E-09	1.5638E+07
32	6200000.	7.1589E-07	2.7958E-05	2.1337E+02	2.5485E+03	2.1391E-09	1.2337E+07
33	6400000.	7.0914E-07	1.2825E-05	1.3899E+02	1.9515E+03	7.4385E-10	9.6668E+06
34	6600000.	5.7913E-07	5.1500E-06	9.3360E+01	1.4259E+03	2.7756E-10	7.5194E+06
35	6800000.	4.0586E-07	3.1027E-06	6.3458E+01	1.0713E+03	1.4170E-10	5.8273E+06
36	7000000.	4.3703E-07	1.5275E-06	4.3443E+01	7.9538E+02	4.7906E-11	4.4351E+06
37	7200000.	3.9872E-07	5.3050E-07	3.0146E+01	5.9057E+02	2.1932E-11	3.3603E+06
38	7400000.	3.6515E-07	3.1444E-07	2.1004E+01	4.3595E+02	1.0571E-11	2.5219E+06
39	7600000.	3.8642E-07	2.3444E-07	1.4779E+01	3.1968E+02	5.3149E-12	1.8726E+06
40	7800000.	4.2875E-07	1.7527E-07	1.0509E+01	2.3225E+02	2.7337E-12	1.3750E+06
41	8000000.	4.6094E-07	1.3560E-07	7.2475E+00	1.6710E+02	1.4000E-12	9.9736E+05

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K	ALT	N2O	NOX	CH4
1	0.	6.0275E+12	4.4917E+10	3.6165E+13
2	200000.	5.2657E+12	2.1740E+10	3.1227E+13
3	400000.	4.1245E+12	9.7841E+09	2.4321E+13
4	600000.	3.3457E+12	4.8520E+09	1.9658E+13
5	800000.	2.7147E+12	2.8546E+09	1.5925E+13
6	1000000.	2.1756E+12	1.9528E+09	1.2748E+13
7	1200000.	1.7164E+12	2.2885E+09	1.0049E+13
8	1400000.	1.4665E+12	2.7273E+09	8.5349E+12
9	1600000.	9.9165E+11	4.7679E+09	5.8063E+12
10	1800000.	6.2779E+11	9.9926E+09	3.6912E+12
11	2000000.	4.0125E+11	1.2151E+10	2.3853E+12
12	2200000.	2.5283E+11	1.2398E+10	1.5359E+12
13	2400000.	1.5621E+11	1.1630E+10	9.8470E+11
14	2600000.	9.2832E+10	1.0230E+10	6.1961E+11
15	2800000.	5.3149E+10	8.6673E+09	3.8501E+11
16	3000000.	2.9221E+10	7.0680E+09	2.3503E+11
17	3200000.	1.5574E+10	5.5949E+09	1.4107E+11
18	3400000.	8.1118E+09	4.3085E+09	8.2906E+10
19	3600000.	4.2195E+09	3.2580E+09	4.8231E+10
20	3800000.	2.2155E+09	2.4305E+09	2.7852E+10
21	4000000.	1.1892E+09	1.7906E+09	1.6206E+10
22	4200000.	6.5672E+08	1.3196E+09	9.6501E+09
23	4400000.	3.7544E+08	9.6500E+08	5.9681E+09
24	4600000.	2.2245E+08	7.0392E+08	3.8613E+09
25	4800000.	1.3661E+08	5.1466E+08	2.6222E+09
26	5000000.	8.7607E+07	3.7956E+08	1.8736E+09
27	5200000.	5.7763E+07	2.7948E+08	1.3320E+09
28	5400000.	3.9738E+07	2.0643E+08	1.0508E+09
29	5600000.	2.7252E+07	1.5106E+08	8.0695E+08
30	5800000.	1.9165E+07	1.0948E+08	6.2367E+08
31	6000000.	1.3658E+07	7.8550E+07	4.8432E+08
32	6200000.	9.9457E+06	5.6272E+07	3.7974E+08
33	6400000.	7.2976E+06	3.9752E+07	2.9639E+08
34	6600000.	6.3681E+06	2.7503E+07	2.3005E+08
35	6800000.	3.9699E+06	1.8668E+07	1.7797E+08
36	7000000.	2.9068E+06	1.2278E+07	1.3532E+08
37	7200000.	2.1319E+06	7.8617E+06	1.0245E+08
38	7400000.	1.5672E+06	4.8668E+06	7.6857E+07
39	7600000.	1.1307E+06	2.9005E+06	5.7045E+07
40	7800000.	8.1522E+05	1.6561E+06	4.1875E+07
41	8000000.	5.8271E+05	9.0771E+05	3.0368E+07

NORMAL JOB END.