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AFGL Atmospheric Constituent Profiles (0-120km)

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

An atmospheric data base consisting of volume mixing ratios (0-120km) for twenty-eight (28) minor and trace gases has been assembled for use with spectral radiance/transmittance models. Six reference atmospheres, each defining temperature, pressure and density as a function of altitude (selected from the U.S. Standard Supplements, 1966 and the U.S. Standard Atmosphere, 1976), provide a range of climatological choices. Analogous zonal-mean descriptions for H_2O, O_3, N_2O, CO, and CH_4 have been subsequently adapted from satellite data and/or dynamical-photochemical analyses. The remaining species are defined by single profiles, usually appropriate for U.S. Standard conditions. Because the entire profile set is preferentially based on available measurements, explicit photochemical consistency between the different species has not been maintained. Keywords:)

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AFGL Atmospheric Constituent Profiles (0-120km)

1. INTRODUCTION

Atmospheric radiance-transmittance spectral modeling requires an adequate description of the local thermal and constituent environment. A data base consisting of realistic vertical profiles for temperature and gas mixing ratios has been designed expressly for incorporation into such models. Its thermal structure is represented by a subset of the 1966 Atmospheric Supplements[1] (tropical (15N), middle latitude (45N) summer and winter, subarctic (60N) summer and winter) and the U.S. Standard Model Atmosphere, 1976[2]. The accompanying volume mixing ratio profiles rely as much as possible on current measurements and/or theoretical predictions (see Appendix B).

(Received for publication 14 May 1986)

1. NASA (1966), U.S. Standard Atmosphere Supplements, 1966, U.S. Government Printing Office, Washington, DC.

2. NASA (1976), U.S. Standard Atmosphere Supplements, 1976, U.S. Government Printing Office, Washington, DC.

More extensive literature reviews of atmospheric structure, variability, dynamics and chemistry are available (for example, Smith,[3] WMO,[4a, 4b] and Brasseur and Solomon[5]).

This compilation includes only those gases currently part of the AFGL molecular line parameter atlases[6, 7]. The range of tabulated atmospheric values for water vapor (H_2O), ozone (O_3), nitrous oxide (N_2O), and methane (CH_4) are primarily inferred from global satellite measurements[8, 9, 10]. The carbon monoxide (CO) seasonal profiles, however, rely on the predictions of a photochemical-dynamical model[11]. The remaining individual gas profiles have been derived from a variety of sources. All have been edited to produce the final tabulations; in most cases this consists of smoothing and interpolation to standard altitude levels. Some species, however, require additional extrapolation because of the unavailability of suitable data (particularly above the stratopause). In general, dayside estimates for diurnally varying species (O_3, NO, and NO_2, for example) have been adopted.

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11. Solomon, S., Garcia, R.R., Olivero, J.J., Bevilacqua, R.M., Schwartz, P.R., Clancy, R.T. and Mahleman, D.O. (1985) Photochemistry and transport of CO in the middle atmosphere, J. Atmos. Sci., 42, 1072-1083.

2. ATMOSPHERIC PROFILE DESCRIPTION

The six reference atmospheres, each with associated volume mixing ratio profiles for H_2O, O_3, N_2O, CO, and CH_4, are presented in Table 1. Along with CO_2, these are the most radiatively active molecules. Sample profiles, appropriate for the U. S. Standard atmosphere conditions (Model 6), are shown in Figure 1. Because the mixing ratios of CO_2 and O_2 have been held seasonally invariant, they are listed in Table 2, as part of a set of single profiles numbered according to the AFGL Line Atlas[6, 7] numbering system; i.e. H_2O is 1, CO_2 is 2, etc. The first seven molecules in Table 2 are the same as those in Figure 1 for the U.S. Standard Atmosphere. The 21 additional species, as identified on the AFGL trace gas compilation[7], are; NO, SO_2, NO_2, NH_3, HNO_3, OH, HF, HCl, HBr, HI, ClO, OCS, H_2CO, HOCl, N_2, HCN, CH_3Cl, H_2O_2, C_2H_2, C_2H_6, and PH_3. Graphical representations for all the tabular data are available in Appendix A. (Note: although N_2 is the dominant atmospheric gas, it appears as only a trace spectral contributor.)

Table 1. Reference Model Atmospheric Profiles

Model = 1 Tropic (15N Annual Average)
Model = 2 Mid-Latitude Summer (45N July)
Model = 3 Mid-Latitude Winter (45N Jan)
Model = 4 Sub Arctic Summer (60N July)
Model = 5 Sub-Arctic Winter (60N Jan)
Model = 6 U.S. Standard (1976)

This tabular presentation includes: Altitude (km), Pressure (mb), Density (cm^{-3}), and mixing ratios (ppmv) for H_2O, O_3, N_2O, CO, and CH_4. Profiles for CO_2 and O_2 can be found in Table 2.

[(*) indicates subsequent extrapolation adopted for that species]

Table 1a. Reference Atmospheric Model Profiles, Model 1. Tropical

MODEL = 1 TROPICAL

ALT (KM)	PRES (MB)	TEMP (K)	DENSITY (CM-3)	H2O (PPMV)	O3 (PPMV)	N2O (PPMV)	CO (PPMV)	CH4 (PPMV)
0.00	1.013E+03	299.7	2.450E+19	2.59E+04	2.87E-02	3.20E-01	1.50E-01	1.70E+00
1.00	9.040E+02	293.7	2.231E+19	1.95E+04	3.15E-02	3.20E-01	1.45E-01	1.70E+00
2.00	8.050E+02	287.7	2.028E+19	1.53E+04	3.34E-02	3.20E-01	1.40E-01	1.70E+00
3.00	7.150E+02	283.7	1.827E+19	8.60E+03	3.50E-02	3.20E-01	1.35E-01	1.70E+00
4.00	6.330E+02	277.0	1.656E+19	4.44E+03	3.56E-02	3.20E-01	1.31E-01	1.70E+00
5.00	5.590E+02	270.3	1.499E+19	3.35E+03	3.77E-02	3.20E-01	1.30E-01	1.70E+00
6.00	4.920E+02	263.6	1.353E+19	2.10E+03	3.99E-02	3.20E-01	1.29E-01	1.70E+00
7.00	4.320E+02	257.0	1.218E+19	1.29E+03	4.22E-02	3.20E-01	1.25E-01	1.70E+00
8.00	3.780E+02	250.3	1.095E+19	7.64E+02	4.47E-02	3.20E-01	1.19E-01	1.70E+00
9.00	3.290E+02	243.6	9.789E+18	4.10E+02	5.00E-02	3.20E-01	1.09E-01	1.69E+00
10.00	2.860E+02	237.0	8.747E+18	1.91E+02	5.60E-02	3.18E-01	9.96E-02	1.69E+00
11.00	2.470E+02	230.1	7.780E+18	7.31E+01	6.61E-02	3.14E-01	8.96E-02	1.68E+00
12.00	2.130E+02	223.6	6.904E+18	2.91E+01	7.82E-02	3.10E-01	7.81E-02	1.66E+00
13.00	1.820E+02	217.0	6.079E+18	9.90E+00	9.29E-02	3.05E-01	6.37E-02	1.65E+00
14.00	1.560E+02	210.3	5.377E+18	6.22E+00	1.05E-01	3.00E-01	5.03E-02	1.63E+00
15.00	1.320E+02	203.7	4.697E+18	4.00E+00	1.26E-01	2.94E-01	3.94E-02	1.61E+00
16.00	1.110E+02	197.0	4.084E+18	3.00E+00	1.44E-01	2.88E-01	3.07E-02	1.58E+00
17.00	9.370E+01	194.8	3.486E+18	2.90E+00	2.50E-01	2.78E-01	2.49E-02	1.55E+00
18.00	7.890E+01	198.8	2.877E+18	2.75E+00	5.00E-01	2.67E-01	1.97E-02	1.52E+00
19.00	6.660E+01	202.7	2.381E+18	2.60E+00	9.50E-01	2.53E-01	1.55E-02	1.48E+00
20.00	5.650E+01	206.7	1.981E+18	2.60E+00	1.40E+00	2.37E-01	1.33E-02	1.42E+00
21.00	4.800E+01	210.7	1.651E+18	2.65E+00	1.80E+00	2.19E-01	1.23E-02	1.36E+00
22.00	4.090E+01	214.6	1.381E+18	2.80E+00	2.40E+00	2.05E-01	1.23E-02	1.27E+00
23.00	3.500E+01	217.0	1.169E+18	2.90E+00	3.40E+00	1.97E-01	1.31E-02	1.19E+00
24.00	3.000E+01	219.2	9.920E+17	3.20E+00	4.30E+00	1.88E-01	1.40E-02	1.12E+00
25.00	2.570E+01	221.4	8.413E+17	3.25E+00	5.40E+00	1.76E-01	1.52E-02	1.06E+00
27.50	1.763E+01	227.0	5.629E+17	3.60E+00	7.80E+00	1.59E-01	1.72E-02	9.87E-01
30.00	1.220E+01	232.3	3.807E+17	4.00E+00	9.30E+00	1.42E-01	2.00E-02	9.14E-01
32.50	8.520E+00	237.7	2.598E+17	4.30E+00	9.85E+00	1.17E-01	2.27E-02	8.30E-01
35.00	6.000E+00	243.1	1.789E+17	4.60E+00	9.70E+00	9.28E-02	2.49E-02	7.46E-01
37.50	4.260E+00	248.5	1.243E+17	4.90E+00	8.80E+00	6.69E-02	2.74E-02	6.62E-01
40.00	3.050E+00	254.0	8.703E+16	5.20E+00	7.50E+00	4.51E-02	3.10E-02	5.64E-01
42.50	2.200E+00	259.4	6.147E+16	5.50E+00	5.90E+00	2.75E-02	3.51E-02	4.61E-01
45.00	1.590E+00	264.8	4.352E+16	5.70E+00	4.50E+00	1.59E-02	3.99E-02	3.63E-01
47.50	1.160E+00	269.6	3.119E+16	5.90E+00	3.45E+00	9.38E-03	4.48E-02	2.77E-01
50.00	8.540E-01	270.2	2.291E+16	6.00E+00	2.80E+00	4.75E-03*	5.09E-02	2.10E-01
55.00	4.560E-01	263.4	1.255E+16	6.00E+00	1.80E+00	3.00E-03	5.99E-02	1.65E-01
60.00	2.390E-01	253.1	6.844E+15	6.00E+00	1.10E+00	2.07E-03	6.96E-02	1.50E-01
65.00	1.210E-01	236.0	3.716E+15	5.40E+00	6.50E-01	1.51E-03	9.19E-02	1.50E-01
70.00	5.800E-02	218.9	1.920E+15	4.50E+00	3.00E-01	1.15E-03	1.94E-01	1.50E-01
75.00	2.600E-02	201.8	9.338E+14	3.30E+00	1.80E-01	8.89E-04	5.69E-01	1.50E-01
80.00	1.100E-02	184.8	4.314E+14	2.10E+00	3.30E-01	7.06E-04	1.55E+00	1.50E-01
85.00	4.400E-03	177.1	1.801E+14	1.30E+00	5.00E-01	5.72E-04	3.85E+00	1.50E-01
90.00	1.720E-03	177.0	7.043E+13	8.50E-01	5.20E-01	4.71E-04	6.59E+00	1.40E-01
95.00	6.880E-04	184.3	2.706E+13	5.40E-01	5.00E-01	3.93E-04	1.04E+01	1.30E-01
100.00	2.890E-04	190.7	1.098E+13	4.00E-01	4.00E-01	3.32E-04	1.71E+01	1.20E-01
105.00	1.300E-04	212.0	4.445E+12	3.40E-01	2.00E-01	2.84E-04	2.47E+01	1.10E-01
110.00	6.470E-05	241.6	1.941E+12	2.80E-01	5.00E-02	2.44E-04	3.36E+01	9.50E-02
115.00	3.600E-05	299.7	8.706E+11	2.40E-01	5.00E-03	2.12E-04	4.15E+01	6.00E-02
120.00	2.250E-05	380.0	4.225E+11	2.00E-01	5.00E-04	1.85E-04	5.00E+01	3.00E-02

Table 1b. Reference Atmospheric Model Profiles, Model 2. Midlatitude Summer

MODEL = 2 MIDLATITUDE SUMMER								
ALT (KM)	PRES (MB)	TEMP (K)	DENSITY (CM-3)	H2O (PPMV)	O3 (PPMV)	N2O (PPMV)	CO (PPMV)	CH4 (PPMV)
0.00	1.013E+03	294.2	2.496E+19	1.88E+04	3.02E-02	3.20E-01	1.50E-01	1.70E+00
1.00	9.020E+02	289.7	2.257E+19	1.38E+04	3.34E-02	3.20E-01	1.45E-01	1.70E+00
2.00	8.020E+02	285.2	2.038E+19	9.68E+03	3.69E-02	3.20E-01	1.40E-01	1.70E+00
3.00	7.100E+02	279.2	1.843E+19	5.98E+03	4.22E-02	3.20E-01	1.35E-01	1.70E+00
4.00	6.280E+02	273.2	1.666E+19	3.81E+03	4.82E-02	3.20E-01	1.31E-01	1.70E+00
5.00	5.540E+02	267.2	1.503E+19	2.23E+03	5.51E-02	3.20E-01	1.30E-01	1.69E+00
6.00	4.870E+02	261.2	1.351E+19	1.51E+03	6.41E-02	3.20E-01	1.29E-01	1.67E+00
7.00	4.260E+02	254.7	1.212E+19	1.02E+03	7.76E-02	3.20E-01	1.25E-01	1.65E+00
8.00	3.720E+02	248.2	1.086E+19	6.46E+02	9.13E-02	3.20E-01	1.19E-01	1.63E+00
9.00	3.240E+02	241.7	9.716E+18	4.13E+02	1.11E-01	3.16E-01	1.09E-01	1.62E+00
10.00	2.810E+02	235.3	8.656E+18	2.47E+02	1.30E-01	3.10E-01	9.96E-02	1.58E+00
11.00	2.430E+02	228.8	7.698E+18	9.56E+01	1.79E-01	2.99E-01	8.96E-02	1.54E+00
12.00	2.090E+02	222.3	6.814E+18	2.94E+01	2.23E-01	2.94E-01	7.81E-02	1.51E+00
13.00	1.790E+02	215.8	6.012E+18	8.00E+00	3.00E-01	2.86E-01	6.37E-02	1.48E+00
14.00	1.530E+02	215.7	5.141E+18	5.00E+00	4.40E-01	2.80E-01	5.03E-02	1.45E+00
15.00	1.300E+02	215.7	4.368E+18	3.40E+00	5.00E-01	2.72E-01	3.94E-02	1.42E+00
16.00	1.110E+02	215.7	3.730E+18	3.30E+00	6.00E-01	2.61E-01	3.07E-02	1.39E+00
17.00	9.500E+01	215.7	3.192E+18	3.20E+00	7.00E-01	2.42E-01	2.49E-02	1.36E+00
18.00	8.120E+01	216.8	2.715E+18	3.15E+00	1.00E+00	2.17E-01	1.97E-02	1.32E+00
19.00	6.950E+01	217.9	2.312E+18	3.20E+00	1.50E+00	1.84E-01	1.55E-02	1.28E+00
20.00	5.950E+01	219.2	1.967E+18	3.30E+00	2.00E+00	1.61E-01	1.33E-02	1.22E+00
21.00	5.100E+01	220.4	1.677E+18	3.45E+00	2.40E+00	1.32E-01	1.23E-02	1.15E+00
22.00	4.370E+01	221.6	1.429E+18	3.60E+00	2.90E+00	1.15E-01	1.23E-02	1.07E+00
23.00	3.760E+01	222.8	1.223E+18	3.85E+00	3.40E+00	1.04E-01	1.31E-02	9.73E-01
24.00	3.220E+01	223.9	1.042E+18	4.00E+00	4.00E+00	9.62E-02	1.40E-02	8.80E-01
25.00	2.770E+01	225.1	8.919E+17	4.20E+00	4.80E+00	8.96E-02	1.52E-02	7.89E-01
27.50	1.907E+01	228.5	6.050E+17	4.45E+00	6.00E+00	8.01E-02	1.72E-02	7.05E-01
30.00	1.320E+01	233.7	4.094E+17	4.70E+00	7.00E+00	6.70E-02	2.00E-02	6.32E-01
32.50	9.300E+00	239.0	2.820E+17	4.85E+00	8.10E+00	4.96E-02	2.27E-02	5.59E-01
35.00	6.520E+00	245.2	1.927E+17	4.95E+00	8.90E+00	3.70E-02	2.49E-02	5.01E-01
37.50	4.640E+00	251.3	1.338E+17	5.00E+00	8.70E+00	2.52E-02	2.72E-02	4.45E-01
40.00	3.330E+00	257.5	9.373E+16	5.10E+00	7.55E+00	1.74E-02	2.96E-02	3.92E-01
42.50	2.410E+00	263.7	6.624E+16	5.30E+00	5.90E+00	1.16E-02	3.14E-02	3.39E-01
45.00	1.760E+00	269.9	4.726E+16	5.45E+00	4.50E+00	7.67E-03	3.31E-02	2.87E-01
47.50	1.290E+00	275.2	3.398E+16	5.50E+00	3.50E+00	5.32E-03	3.49E-02	2.38E-01
50.00	9.510E-01	275.7	2.500E+16	5.50E+00	2.80E+00	3.22E-03*	3.65E-02	1.94E-01
55.00	5.150E-01	269.3	1.386E+16	5.35E+00	1.80E+00	2.03E-03	3.92E-02	1.57E-01
60.00	2.720E-01	257.1	7.668E+15	5.00E+00	1.30E+00	1.40E-03	4.67E-02	1.50E-01
65.00	1.390E-01	240.1	4.196E+15	4.40E+00	8.00E-01	1.02E-03	6.40E-02	1.50E-01
70.00	6.700E-02	218.1	2.227E+15	3.70E+00	4.00E-01	7.77E-04	1.18E-01	1.50E-01
75.00	3.000E-02	196.1	1.109E+15	2.95E+00	1.90E-01	6.26E-04	2.94E-01	1.50E-01
80.00	1.200E-02	174.1	4.996E+14	2.10E+00	2.00E-01	5.17E-04	6.82E-01	1.50E-01
85.00	4.480E-03	165.1	1.967E+14	1.33E+00	5.70E-01	4.35E-04	1.47E+00	1.50E-01
90.00	1.640E-03	165.0	7.204E+13	8.50E-01	7.50E-01	3.73E-04	2.85E+00	1.40E-01
95.00	6.250E-04	178.3	2.541E+13	5.40E-01	7.00E-01	3.24E-04	5.17E+00	1.30E-01
100.00	2.580E-04	190.5	9.816E+12	4.00E-01	4.00E-01	2.84E-04	1.01E+01	1.20E-01
105.00	1.170E-04	222.2	3.816E+12	3.40E-01	2.00E-01	2.52E-04	1.87E+01	1.10E-01
110.00	6.110E-05	262.4	1.688E+12	2.80E-01	5.00E-02	2.26E-04	2.86E+01	9.50E-02
115.00	3.560E-05	316.8	8.145E+11	2.40E-01	5.00E-03	2.04E-04	3.89E+01	6.00E-02
120.00	2.270E-05	380.0	4.330E+11	2.00E-01	5.00E-04	1.85E-04	5.00E+01	3.00E-02

Table 1c. Reference Atmospheric Model Profiles, Model 3. Midlatitude Winter

MODEL = 3 MIDLATITUDE WINTER								
ALT (KM)	PRES (MB)	TEMP (K)	DENSITY (CM-3)	H2O (PPMV)	O3 (PPMV)	N2O (PPMV)	CO (PPMV)	CH4 (PPMV)
0.00	1.018E+03	272.2	2.711E+19	4.32E+03	2.78E-02	3.20E-01	1.50E-01	1.70E+00
1.00	8.973E+02	268.7	2.420E+19	3.45E+03	2.80E-02	3.20E-01	1.45E-01	1.70E+00
2.00	7.897E+02	265.2	2.158E+19	2.79E+03	2.85E-02	3.20E-01	1.40E-01	1.70E+00
3.00	6.938E+02	261.7	1.922E+19	2.09E+03	3.20E-02	3.20E-01	1.35E-01	1.70E+00
4.00	6.081E+02	255.7	1.724E+19	1.28E+03	3.57E-02	3.20E-01	1.31E-01	1.70E+00
5.00	5.313E+02	249.7	1.542E+19	8.24E+02	4.72E-02	3.20E-01	1.30E-01	1.69E+00
6.00	4.627E+02	243.7	1.376E+19	5.10E+02	5.84E-02	3.20E-01	1.29E-01	1.67E+00
7.00	4.016E+02	237.7	1.225E+19	2.32E+02	7.89E-02	3.20E-01	1.25E-01	1.65E+00
8.00	3.473E+02	231.7	1.086E+19	1.08E+02	1.04E-01	3.20E-01	1.19E-01	1.63E+00
9.00	2.993E+02	225.7	9.612E+18	5.57E+01	1.57E-01	3.16E-01	1.09E-01	1.62E+00
10.00	2.568E+02	219.7	8.472E+18	2.96E+01	2.37E-01	3.10E-01	9.96E-02	1.58E+00
11.00	2.199E+02	219.2	7.271E+18	1.00E+01	3.62E-01	2.99E-01	8.96E-02	1.54E+00
12.00	1.882E+02	218.7	6.237E+18	6.00E+00	5.23E-01	2.94E-01	7.81E-02	1.51E+00
13.00	1.611E+02	218.2	5.351E+18	5.00E+00	7.04E-01	2.86E-01	6.37E-02	1.48E+00
14.00	1.378E+02	217.7	4.588E+18	4.80E+00	8.00E-01	2.80E-01	5.03E-02	1.45E+00
15.00	1.178E+02	217.2	3.931E+18	4.70E+00	9.00E-01	2.72E-01	3.94E-02	1.42E+00
16.00	1.007E+02	216.7	3.368E+18	4.60E+00	1.10E+00	2.61E-01	3.07E-02	1.39E+00
17.00	8.610E+01	216.2	2.886E+18	4.50E+00	1.40E+00	2.42E-01	2.49E-02	1.36E+00
18.00	7.360E+01	215.7	2.473E+18	4.50E+00	1.80E+00	2.17E-01	1.97E-02	1.32E+00
19.00	6.280E+01	215.2	2.115E+18	4.50E+00	2.30E+00	1.84E-01	1.55E-02	1.28E+00
20.00	5.370E+01	215.2	1.809E+18	4.50E+00	2.90E+00	1.62E-01	1.33E-02	1.22E+00
21.00	4.580E+01	215.2	1.543E+18	4.50E+00	3.50E+00	1.36E-01	1.23E-02	1.15E+00
22.00	3.910E+01	215.2	1.317E+18	4.53E+00	3.90E+00	1.23E-01	1.23E-02	1.07E+00
23.00	3.340E+01	215.2	1.125E+18	4.55E+00	4.30E+00	1.12E-01	1.31E-02	9.73E-01
24.00	2.860E+01	215.2	9.633E+17	4.60E+00	4.70E+00	1.05E-01	1.40E-02	8.80E-01
25.00	2.440E+01	215.2	8.218E+17	4.65E+00	5.10E+00	9.66E-02	1.50E-02	7.93E-01
27.50	1.646E+01	215.5	5.536E+17	4.70E+00	5.60E+00	8.69E-02	1.60E-02	7.13E-01
30.00	1.110E+01	217.4	3.701E+17	4.75E+00	6.10E+00	7.52E-02	1.71E-02	6.44E-01
32.50	7.560E+00	220.4	2.486E+17	4.80E+00	6.80E+00	6.13E-02	1.85E-02	5.75E-01
35.00	5.180E+00	227.9	1.647E+17	4.85E+00	7.10E+00	5.12E-02	2.00E-02	5.05E-01
37.50	3.600E+00	235.5	1.108E+17	4.90E+00	7.20E+00	3.97E-02	2.15E-02	4.48E-01
40.00	2.530E+00	243.2	7.540E+16	4.95E+00	6.90E+00	3.00E-02	2.33E-02	3.93E-01
42.50	1.800E+00	250.8	5.202E+16	5.00E+00	5.90E+00	2.08E-02	2.62E-02	3.40E-01
45.00	1.290E+00	258.5	3.617E+16	5.00E+00	4.60E+00	1.31E-02	3.06E-02	2.88E-01
47.50	9.400E-01	265.1	2.570E+16	5.00E+00	3.70E+00	8.07E-03	3.80E-02	2.39E-01
50.00	6.830E-01	265.7	1.863E+16	4.95E+00	2.75E+00	4.16E-03*	6.25E-02	1.94E-01
55.00	3.620E-01	260.6	1.007E+16	4.85E+00	1.70E+00	2.63E-03	1.48E-01	1.57E-01
60.00	1.880E-01	250.8	5.433E+15	4.50E+00	1.00E+00	1.81E-03	2.93E-01	1.50E-01
65.00	9.500E-02	240.9	2.858E+15	4.00E+00	5.50E-01	1.32E-03	5.59E-01	1.50E-01
70.00	4.700E-02	230.7	1.477E+15	3.30E+00	3.20E-01	1.01E-03	1.08E+00	1.50E-01
75.00	2.220E-02	220.4	7.301E+14	2.70E+00	2.50E-01	7.88E-04	1.90E+00	1.50E-01
80.00	1.030E-02	210.1	3.553E+14	2.00E+00	2.30E-01	6.33E-04	2.96E+00	1.50E-01
85.00	4.560E-03	199.8	1.654E+14	1.33E+00	5.50E-01	5.19E-04	4.53E+00	1.50E-01
90.00	1.980E-03	199.5	7.194E+13	8.50E-01	8.00E-01	4.33E-04	6.86E+00	1.40E-01
95.00	8.770E-04	208.3	3.052E+13	5.40E-01	8.00E-01	3.67E-04	1.05E+01	1.30E-01
100.00	4.074E-04	218.6	1.351E+13	4.00E-01	4.00E-01	3.14E-04	1.71E+01	1.20E-01
105.00	2.000E-04	237.1	6.114E+12	3.40E-01	2.00E-01	2.72E-04	2.47E+01	1.10E-01
110.00	1.057E-04	259.5	2.952E+12	2.80E-01	5.00E-02	2.37E-04	3.36E+01	9.50E-02
115.00	5.980E-05	293.0	1.479E+12	2.40E-01	5.00E-03	2.09E-04	4.15E+01	6.00E-02
120.00	3.600E-05	333.0	7.836E+11	2.00E-01	5.00E-04	1.85E-04	5.00E+01	3.00E-02

Table 1d. Reference Atmospheric Model Profiles, Model 4. Subarctic Summer

MODEL = 4 SUBARCTIC SUMMER								
ALT (KM)	PRES (MB)	TEMP (K)	DENSITY (CM-3)	H2O (PPMV)	O3 (PPMV)	N2O (PPMV)	CO (PPMV)	CH4 (PPMV)
0.00	1.010E+03	287.2	2.549E+19	1.19E+04	2.41E-02	3.10E-01	1.50E-01	1.70E+00
1.00	8.960E+02	281.7	2.305E+19	8.70E+03	2.94E-02	3.10E-01	1.45E-01	1.70E+00
2.00	7.929E+02	276.3	2.080E+19	6.75E+03	3.38E-02	3.10E-01	1.40E-01	1.70E+00
3.00	7.000E+02	270.9	1.873E+19	4.82E+03	3.89E-02	3.10E-01	1.35E-01	1.70E+00
4.00	6.160E+02	265.5	1.682E+19	3.38E+03	4.48E-02	3.08E-01	1.31E-01	1.70E+00
5.00	5.410E+02	260.1	1.508E+19	2.22E+03	5.33E-02	3.02E-01	1.30E-01	1.69E+00
6.00	4.740E+02	253.1	1.357E+19	1.33E+03	6.56E-02	2.91E-01	1.29E-01	1.67E+00
7.00	4.130E+02	246.1	1.216E+19	7.97E+02	7.74E-02	2.82E-01	1.25E-01	1.65E+00
8.00	3.590E+02	239.2	1.088E+19	4.00E+02	9.11E-02	2.76E-01	1.19E-01	1.63E+00
9.00	3.108E+02	232.2	9.701E+18	1.30E+02	1.42E-01	2.70E-01	1.09E-01	1.62E+00
10.00	2.677E+02	225.2	8.616E+18	4.24E+01	1.89E-01	2.65E-01	9.96E-02	1.58E+00
11.00	2.300E+02	225.2	7.402E+18	1.33E+01	3.05E-01	2.60E-01	8.98E-02	1.54E+00
12.00	1.977E+02	225.2	6.363E+18	6.00E+00	4.10E-01	2.55E-01	7.81E-02	1.51E+00
13.00	1.700E+02	225.2	5.471E+18	4.45E+00	5.00E-01	2.49E-01	6.37E-02	1.47E+00
14.00	1.460E+02	225.2	4.699E+18	4.00E+00	6.00E-01	2.43E-01	5.03E-02	1.43E+00
15.00	1.260E+02	225.2	4.055E+18	4.00E+00	7.00E-01	2.36E-01	3.94E-02	1.39E+00
16.00	1.080E+02	225.2	3.476E+18	4.00E+00	8.50E-01	2.28E-01	3.07E-02	1.34E+00
17.00	9.280E+01	225.2	2.987E+18	4.05E+00	1.00E+00	2.18E-01	2.49E-02	1.29E+00
18.00	7.980E+01	225.2	2.568E+18	4.30E+00	1.30E+00	2.04E-01	1.97E-02	1.23E+00
19.00	6.860E+01	225.2	2.208E+18	4.50E+00	1.70E+00	1.82E-01	1.55E-02	1.16E+00
20.00	5.900E+01	225.2	1.899E+18	4.60E+00	2.10E+00	1.57E-01	1.33E-02	1.07E+00
21.00	5.070E+01	225.2	1.632E+18	4.70E+00	2.70E+00	1.35E-01	1.23E-02	9.90E-01
22.00	4.360E+01	225.2	1.403E+18	4.80E+00	3.30E+00	1.22E-01	1.23E-02	9.17E-01
23.00	3.750E+01	225.2	1.207E+18	4.83E+00	3.70E+00	1.10E-01	1.31E-02	8.57E-01
24.00	3.228E+01	226.6	1.033E+18	4.85E+00	4.20E+00	9.89E-02	1.40E-02	8.01E-01
25.00	2.780E+01	228.1	8.834E+17	4.90E+00	4.50E+00	8.78E-02	1.51E-02	7.48E-01
27.50	1.923E+01	231.0	6.034E+17	4.95E+00	5.30E+00	7.33E-02	1.65E-02	6.96E-01
30.00	1.340E+01	235.1	4.131E+17	5.00E+00	5.70E+00	5.94E-02	1.81E-02	6.44E-01
32.50	9.400E+00	240.0	2.839E+17	5.00E+00	6.90E+00	4.15E-02	2.00E-02	5.89E-01
35.00	6.610E+00	247.2	1.938E+17	5.00E+00	7.70E+00	3.03E-02	2.18E-02	5.24E-01
37.50	4.720E+00	254.6	1.344E+17	5.00E+00	7.80E+00	1.95E-02	2.34E-02	4.51E-01
40.00	3.400E+00	262.1	9.402E+16	5.00E+00	7.00E+00	1.27E-02	2.50E-02	3.71E-01
42.50	2.480E+00	269.5	6.670E+16	5.00E+00	5.40E+00	9.00E-03	2.65E-02	2.99E-01
45.00	1.820E+00	273.6	4.821E+16	5.00E+00	4.20E+00	6.29E-03	2.81E-02	2.45E-01
47.50	1.340E+00	276.2	3.516E+16	5.00E+00	3.20E+00	4.56E-03	3.00E-02	2.00E-01
50.00	9.870E-01	277.2	2.581E+16	4.95E+00	2.50E+00	2.80E-03*	3.22E-02	1.66E-01
55.00	5.370E-01	274.0	1.421E+16	4.85E+00	1.70E+00	1.77E-03	3.65E-02	1.50E-01
60.00	2.880E-01	262.7	7.946E+15	4.50E+00	1.20E+00	1.21E-03	4.59E-02	1.50E-01
65.00	1.470E-01	239.7	4.445E+15	4.00E+00	8.00E-01	8.87E-04	6.38E-02	1.50E-01
70.00	7.100E-02	216.6	2.376E+15	3.30E+00	4.00E-01	6.76E-04	1.18E-01	1.50E-01
75.00	3.200E-02	193.6	1.198E+15	2.70E+00	2.00E-01	5.54E-04	3.03E-01	1.50E-01
80.00	1.250E-02	170.6	5.311E+14	2.00E+00	1.80E-01	4.65E-04	7.89E-01	1.50E-01
85.00	4.510E-03	161.7	2.022E+14	1.33E+00	6.50E-01	3.98E-04	1.82E+00	1.50E-01
90.00	1.610E-03	161.6	7.221E+13	8.50E-01	9.00E-01	3.46E-04	3.40E+00	1.40E-01
95.00	6.060E-04	176.8	2.484E+13	5.40E-01	8.00E-01	3.05E-04	5.92E+00	1.30E-01
100.00	2.480E-04	190.4	9.441E+12	4.00E-01	4.00E-01	2.71E-04	1.04E+01	1.20E-01
105.00	1.130E-04	226.0	3.624E+12	3.40E-01	2.00E-01	2.44E-04	1.88E+01	1.10E-01
110.00	6.000E-05	270.1	1.610E+12	2.80E-01	5.00E-02	2.21E-04	2.87E+01	9.50E-02
115.00	3.540E-05	322.7	7.951E+11	2.40E-01	5.00E-03	2.02E-04	3.89E+01	8.00E-02
120.00	2.260E-05	380.0	4.311E+11	2.00E-01	5.00E-04	1.85E-04	5.00E+01	3.00E-02

Table 1e. Reference Atmospheric Model Profiles, Model 5. Subarctic Winter

MODEL = 5 SUBARCTIC WINTER								
ALT (KM)	PRES (MB)	TEMP (K)	DENSITY (CM-3)	H2O (PPMV)	O3 (PPMV)	N2O (PPMV)	CO (PPMV)	CH4 (PPMV)
0.00	1.013E+03	257.2	2.858E+19	1.41E+03	1.80E-02	3.20E-01	1.50E-01	1.70E+00
1.00	8.878E+02	259.1	2.484E+19	1.62E+03	2.07E-02	3.20E-01	1.45E-01	1.70E+00
2.00	7.775E+02	255.9	2.202E+19	1.43E+03	2.34E-02	3.20E-01	1.40E-01	1.70E+00
3.00	6.798E+02	252.7	1.950E+19	1.17E+03	2.77E-02	3.20E-01	1.35E-01	1.70E+00
4.00	5.932E+02	247.7	1.736E+19	7.90E+02	3.25E-02	3.20E-01	1.31E-01	1.70E+00
5.00	5.158E+02	240.9	1.552E+19	4.31E+02	3.80E-02	3.20E-01	1.30E-01	1.69E+00
6.00	4.467E+02	234.1	1.383E+19	2.37E+02	4.45E-02	3.20E-01	1.29E-01	1.67E+00
7.00	3.853E+02	227.3	1.229E+19	1.47E+02	7.25E-02	3.20E-01	1.25E-01	1.65E+00
8.00	3.308E+02	220.6	1.087E+19	3.38E+01	1.04E-01	3.20E-01	1.19E-01	1.63E+00
9.00	2.829E+02	217.2	9.440E+18	2.98E+01	2.10E-01	3.16E-01	1.09E-01	1.62E+00
10.00	2.418E+02	217.2	8.069E+18	2.00E+01	3.00E-01	3.10E-01	9.96E-02	1.58E+00
11.00	2.067E+02	217.2	6.898E+18	1.00E+01	3.50E-01	2.99E-01	8.96E-02	1.54E+00
12.00	1.766E+02	217.2	5.893E+18	6.00E+00	4.00E-01	2.94E-01	7.81E-02	1.51E+00
13.00	1.510E+02	217.2	5.039E+18	4.45E+00	6.50E-01	2.86E-01	6.37E-02	1.47E+00
14.00	1.291E+02	217.2	4.308E+18	4.50E+00	9.00E-01	2.80E-01	5.03E-02	1.43E+00
15.00	1.103E+02	217.2	3.681E+18	4.55E+00	1.20E+00	2.72E-01	3.94E-02	1.39E+00
16.00	9.431E+01	216.6	3.156E+18	4.60E+00	1.50E+00	2.61E-01	3.07E-02	1.34E+00
17.00	8.058E+01	216.0	2.704E+18	4.65E+00	1.90E+00	2.42E-01	2.49E-02	1.29E+00
18.00	6.882E+01	215.4	2.316E+18	4.70E+00	2.45E+00	2.17E-01	1.97E-02	1.23E+00
19.00	5.875E+01	214.8	1.982E+18	4.75E+00	3.10E+00	1.84E-01	1.55E-02	1.16E+00
20.00	5.014E+01	214.2	1.697E+18	4.80E+00	3.70E+00	1.62E-01	1.33E-02	1.08E+00
21.00	4.277E+01	213.6	1.451E+18	4.85E+00	4.00E+00	1.36E-01	1.23E-02	1.01E+00
22.00	3.647E+01	213.0	1.241E+18	4.90E+00	4.20E+00	1.23E-01	1.23E-02	9.56E-01
23.00	3.109E+01	212.4	1.061E+18	4.95E+00	4.50E+00	1.12E-01	1.31E-02	9.01E-01
24.00	2.649E+01	211.8	9.065E+17	5.00E+00	4.60E+00	1.04E-01	1.40E-02	8.48E-01
25.00	2.256E+01	211.2	7.742E+17	5.00E+00	4.70E+00	9.57E-02	1.52E-02	7.96E-01
27.50	1.513E+01	213.6	5.134E+17	5.00E+00	4.90E+00	8.60E-02	1.72E-02	7.45E-01
30.00	1.020E+01	216.0	3.423E+17	5.00E+00	5.40E+00	7.31E-02	2.04E-02	6.94E-01
32.50	6.910E+00	218.5	2.292E+17	5.00E+00	5.90E+00	5.71E-02	2.49E-02	6.43E-01
35.00	4.701E+00	222.3	1.533E+17	5.00E+00	6.20E+00	4.67E-02	3.17E-02	5.88E-01
37.50	3.230E+00	228.5	1.025E+17	5.00E+00	6.25E+00	3.44E-02	4.43E-02	5.24E-01
40.00	2.243E+00	234.7	6.927E+16	5.00E+00	5.90E+00	2.47E-02	6.47E-02	4.51E-01
42.50	1.570E+00	240.8	4.726E+16	5.00E+00	5.10E+00	1.63E-02	1.04E-01	3.71E-01
45.00	1.113E+00	247.0	3.266E+16	5.00E+00	4.10E+00	1.07E-02	1.51E-01	3.00E-01
47.50	7.900E-01	253.2	2.261E+16	5.00E+00	3.00E+00	7.06E-03	2.16E-01	2.45E-01
50.00	5.719E-01	259.3	1.599E+16	4.95E+00	2.60E+00	3.97E-03*	3.14E-01	1.98E-01
55.00	2.990E-01	259.1	8.364E+15	4.85E+00	1.60E+00	2.51E-03	4.84E-01	1.59E-01
60.00	1.550E-01	250.9	4.478E+15	4.50E+00	9.50E-01	1.73E-03	7.15E-01	1.50E-01
65.00	7.900E-02	248.4	2.305E+15	4.00E+00	6.50E-01	1.26E-03	1.07E+00	1.50E-01
70.00	4.000E-02	245.4	1.181E+15	3.30E+00	5.00E-01	9.60E-04	1.52E+00	1.50E-01
75.00	2.000E-02	234.7	6.176E+14	2.70E+00	3.30E-01	7.55E-04	2.17E+00	1.50E-01
80.00	9.660E-03	223.9	3.127E+14	2.00E+00	1.30E-01	6.10E-04	3.06E+00	1.50E-01
85.00	4.500E-03	213.1	1.531E+14	1.33E+00	7.50E-01	5.02E-04	4.56E+00	1.50E-01
90.00	2.022E-03	202.3	7.244E+13	8.50E-01	8.00E-01	4.21E-04	6.88E+00	1.40E-01
95.00	9.070E-04	211.0	3.116E+13	5.40E-01	8.00E-01	3.58E-04	1.06E+01	1.30E-01
100.00	4.230E-04	218.5	1.403E+13	4.00E-01	4.00E-01	3.08E-04	1.71E+01	1.20E-01
105.00	2.070E-04	234.0	6.412E+12	3.40E-01	2.00E-01	2.68E-04	2.47E+01	1.10E-01
110.00	1.080E-04	252.6	3.099E+12	2.80E-01	5.00E-02	2.35E-04	3.36E+01	9.50E-02
115.00	6.000E-05	288.5	1.507E+12	2.40E-01	5.00E-03	2.08E-04	4.15E+01	6.00E-02
120.00	3.590E-05	333.0	7.814E+11	2.00E-01	5.00E-04	1.85E-04	5.00E+01	3.00E-02

Table 1f. Reference Atmospheric Model Profiles, Model 6. U. S. Standard

MODEL = 6 U. S. STANDARD, 1976

ALT (KM)	PRES (MB)	TEMP (K)	DENSITY (CM-3)	H2O (PPMV)	O3 (PPMV)	N2O (PPMV)	CO (PPMV)	CH4 (PPMV)
0.00	1.013E+03	288.2	2.548E+19	7.75E+03	2.66E-02	3.20E-01	1.50E-01	1.70E+00
1.00	8.988E+02	281.7	2.313E+19	6.07E+03	2.93E-02	3.20E-01	1.45E-01	1.70E+00
2.00	7.950E+02	275.2	2.094E+19	4.63E+03	3.24E-02	3.20E-01	1.40E-01	1.70E+00
3.00	7.012E+02	268.7	1.891E+19	3.18E+03	3.32E-02	3.20E-01	1.35E-01	1.70E+00
4.00	6.166E+02	262.2	1.704E+19	2.16E+03	3.39E-02	3.20E-01	1.31E-01	1.70E+00
5.00	5.405E+02	255.7	1.532E+19	1.40E+03	3.77E-02	3.20E-01	1.30E-01	1.70E+00
6.00	4.722E+02	249.2	1.373E+19	9.25E+02	4.11E-02	3.20E-01	1.29E-01	1.70E+00
7.00	4.111E+02	242.7	1.228E+19	5.72E+02	5.01E-02	3.20E-01	1.25E-01	1.70E+00
8.00	3.565E+02	236.2	1.094E+19	3.67E+02	5.97E-02	3.20E-01	1.19E-01	1.70E+00
9.00	3.080E+02	229.7	9.719E+18	1.58E+02	9.17E-02	3.20E-01	1.09E-01	1.69E+00
10.00	2.650E+02	223.3	8.602E+18	7.00E+01	1.31E-01	3.18E-01	9.96E-02	1.69E+00
11.00	2.270E+02	216.8	7.589E+18	3.61E+01	2.15E-01	3.14E-01	8.96E-02	1.68E+00
12.00	1.940E+02	216.7	6.489E+18	1.91E+01	3.10E-01	3.10E-01	7.81E-02	1.66E+00
13.00	1.658E+02	216.7	5.546E+18	1.09E+01	3.85E-01	3.05E-01	6.37E-02	1.65E+00
14.00	1.417E+02	216.7	4.739E+18	5.93E+00	5.03E-01	3.00E-01	5.03E-02	1.63E+00
15.00	1.211E+02	216.7	4.050E+18	5.00E+00	6.51E-01	2.94E-01	3.94E-02	1.61E+00
16.00	1.035E+02	216.7	3.462E+18	3.95E+00	8.70E-01	2.88E-01	3.07E-02	1.58E+00
17.00	8.850E+01	216.7	2.960E+18	3.85E+00	1.19E+00	2.78E-01	2.49E-02	1.55E+00
18.00	7.565E+01	216.7	2.530E+18	3.83E+00	1.59E+00	2.67E-01	1.97E-02	1.52E+00
19.00	6.467E+01	216.7	2.163E+18	3.85E+00	2.03E+00	2.53E-01	1.55E-02	1.48E+00
20.00	5.529E+01	216.7	1.849E+18	3.90E+00	2.58E+00	2.37E-01	1.33E-02	1.42E+00
21.00	4.729E+01	217.6	1.575E+18	3.98E+00	3.03E+00	2.19E-01	1.23E-02	1.36E+00
22.00	4.047E+01	218.6	1.342E+18	4.07E+00	3.65E+00	2.05E-01	1.23E-02	1.27E+00
23.00	3.467E+01	219.6	1.144E+18	4.20E+00	4.17E+00	1.97E-01	1.31E-02	1.19E+00
24.00	2.972E+01	220.6	9.765E+17	4.30E+00	4.63E+00	1.88E-01	1.40E-02	1.12E+00
25.00	2.549E+01	221.6	8.337E+17	4.43E+00	5.12E+00	1.76E-01	1.50E-02	1.06E+00
27.50	1.743E+01	224.0	5.640E+17	4.58E+00	5.80E+00	1.59E-01	1.60E-02	9.87E-01
30.00	1.197E+01	226.5	3.830E+17	4.73E+00	6.55E+00	1.42E-01	1.71E-02	9.14E-01
32.50	8.010E+00	230.0	2.524E+17	4.83E+00	7.37E+00	1.17E-01	1.85E-02	8.30E-01
35.00	5.746E+00	236.5	1.761E+17	4.90E+00	7.84E+00	9.28E-02	2.01E-02	7.46E-01
37.50	4.150E+00	242.9	1.238E+17	4.95E+00	7.80E+00	6.69E-02	2.22E-02	6.62E-01
40.00	2.871E+00	250.4	8.310E+16	5.03E+00	7.30E+00	4.51E-02	2.50E-02	5.64E-01
42.50	2.060E+00	257.3	5.803E+16	5.15E+00	6.20E+00	2.75E-02	2.82E-02	4.61E-01
45.00	1.491E+00	264.2	4.090E+16	5.23E+00	5.25E+00	1.59E-02	3.24E-02	3.63E-01
47.50	1.090E+00	270.6	2.920E+16	5.25E+00	4.10E+00	9.38E-03	3.72E-02	2.77E-01
50.00	7.978E-01	270.7	2.136E+16	5.23E+00	3.10E+00	4.75E-03*	4.60E-02	2.10E-01
55.00	4.250E-01	260.8	1.181E+16	5.10E+00	1.80E+00	3.00E-03	6.64E-02	1.65E-01
60.00	2.190E-01	247.0	6.426E+15	4.75E+00	1.10E+00	2.07E-03	1.07E-01	1.50E-01
65.00	1.090E-01	233.3	3.386E+15	4.20E+00	7.00E-01	1.51E-03	1.86E-01	1.50E-01
70.00	5.220E-02	219.6	1.723E+15	3.50E+00	3.00E-01	1.15E-03	3.06E-01	1.50E-01
75.00	2.400E-02	208.4	8.347E+14	2.83E+00	2.50E-01	8.89E-04	6.38E-01	1.50E-01
80.00	1.050E-02	198.6	3.832E+14	2.05E+00	3.00E-01	7.06E-04	1.50E+00	1.50E-01
85.00	4.460E-03	188.9	1.711E+14	1.33E+00	5.00E-01	5.72E-04	3.24E+00	1.50E-01
90.00	1.840E-03	186.9	7.136E+13	8.50E-01	7.00E-01	4.71E-04	5.84E+00	1.40E-01
95.00	7.600E-04	188.4	2.924E+13	5.40E-01	7.00E-01	3.93E-04	1.01E+01	1.30E-01
100.00	3.200E-04	195.1	1.189E+13	4.00E-01	4.00E-01	3.32E-04	1.69E+01	1.20E-01
105.00	1.450E-04	208.8	5.033E+12	3.40E-01	2.00E-01	2.84E-04	2.47E+01	1.10E-01
110.00	7.100E-05	240.0	2.144E+12	2.80E-01	5.00E 02	2.44E-04	3.36E+01	9.50E-02
115.00	4.010E-05	300.0	9.688E+11	2.40E-01	5.00E-03	2.12E-04	4.15E+01	6.00E-02
120.00	2.540E-05	360.0	5.114E+11	2.00E-01	5.00E-04	1.85E-04	5.00E+01	3.00E-02

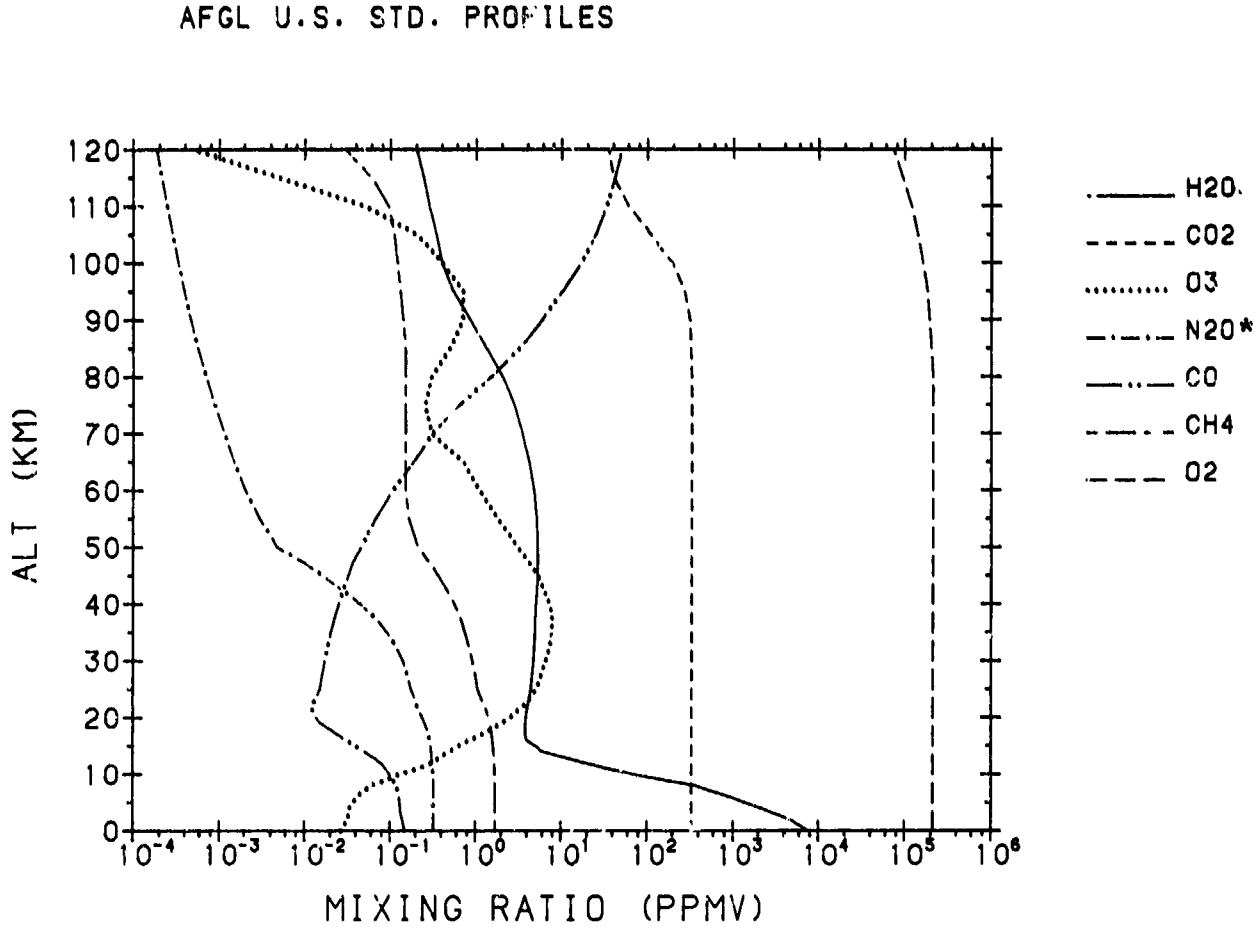

Figure 1. U.S. Standard Model Atmosphere Profiles for the mixing ratios of the major radiating atmospheric gases. This corresponds to Model 6 in Table 1; see text.

[(*) indicates extrapolation adopted for that species; see tabular data]

Table 2. Constituent Profiles (ppmv):

Molecules 1-7 are Model 6 (U.S. Standard) compatible and are repeated here because they duplicate the AFGL Line Parameter and Trace Gas numbering scheme. In addition, CO_2 and O_2 are only defined by a single profile so have not been included in Table 1.

Molecules 8-28 are provided as single representative profiles. Their natural variability can be very different from the selected profile.

[(*) indicates subsequent extrapolation adopted for that species]

Table 2a. Constituent Profiles (ppmv), H_2O, CO_2, O_3, N_2O, CO, CH_4, O_2

	1 H2O	2 CO2	3 O3	4 N2O	5 CO	6 CH4	7 O2
(KM)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)
0.0	7.75E+03	3.30E+02	2.66E-02	3.20E-01	1.50E-01	1.70E+00	2.09E+05
1.0	6.07E+03	3.30E+02	2.93E-02	3.20E-01	1.45E-01	1.70E+00	2.09E+05
2.0	4.63E+03	3.30E+02	3.24E-02	3.20E-01	1.40E-01	1.70E+00	2.09E+05
3.0	3.18E+03	3.30E+02	3.32E-02	3.20E-01	1.35E-01	1.70E+00	2.09E+05
4.0	2.16E+03	3.30E+02	3.39E-02	3.20E-01	1.31E-01	1.70E+00	2.09E+05
5.0	1.40E+03	3.30E+02	3.77E-02	3.20E-01	1.30E-01	1.70E+00	2.09E+05
6.0	9.25E+02	3.30E+02	4.11E-02	3.20E-01	1.29E-01	1.70E+00	2.09E+05
7.0	5.72E+02	3.30E+02	5.01E-02	3.20E-01	1.25E-01	1.70E+00	2.09E+05
8.0	3.67E+02	3.30E+02	5.97E-02	3.20E-01	1.19E-01	1.70E+00	2.09E+05
9.0	1.58E+02	3.30E+02	9.17E-02	3.20E-01	1.09E-01	1.69E+00	2.09E+05
10.0	7.00E+01	3.30E+02	1.31E-01	3.18E-01	9.96E-02	1.69E+00	2.09E+05
11.0	3.61E+01	3.30E+02	2.15E-01	3.14E-01	8.96E-02	1.68E+00	2.09E+05
12.0	1.91E+01	3.30E+02	3.10E-01	3.10E-01	7.81E-02	1.66E+00	2.09E+05
13.0	1.09E+01	3.30E+02	3.85E-01	3.05E-01	6.37E-02	1.65E+00	2.09E+05
14.0	5.93E+00	3.30E+02	5.03E-01	3.00E-01	5.03E-02	1.63E+00	2.09E+05
15.0	5.00E+00	3.30E+02	6.51E-01	2.94E-01	3.94E-02	1.61E+00	2.09E+05
16.0	3.95E+00	3.30E+02	8.70E-01	2.88E-01	3.07E-02	1.58E+00	2.09E+05
17.0	3.85E+00	3.30E+02	1.19E+00	2.78E-01	2.49E-02	1.55E+00	2.09E+05
18.0	3.83E+00	3.30E+02	1.59E+00	2.67E-01	1.97E-02	1.52E+00	2.09E+05
19.0	3.85E+00	3.30E+02	2.03E+00	2.53E-01	1.55E-02	1.48E+00	2.09E+05
20.0	3.90E+00	3.30E+02	2.58E+00	2.37E-01	1.33E-02	1.42E+00	2.09E+05
21.0	3.98E+00	3.30E+02	3.03E+00	2.19E-01	1.23E-02	1.36E+00	2.09E+05
22.0	4.07E+00	3.30E+02	3.65E+00	2.05E-01	1.23E-02	1.27E+00	2.09E+05
23.0	4.20E+00	3.30E+02	4.17E+00	1.97E-01	1.31E-02	1.19E+00	2.09E+05
24.0	4.30E+00	3.30E+02	4.63E+00	1.88E-01	1.40E-02	1.12E+00	2.09E+05
25.0	4.43E+00	3.30E+02	5.12E+00	1.76E-01	1.50E-02	1.06E+00	2.09E+05
27.5	4.58E+00	3.30E+02	5.80E+00	1.59E-01	1.60E-02	9.87E-01	2.09E+05
30.0	4.73E+00	3.30E+02	6.55E+00	1.42E-01	1.71E-02	9.14E-01	2.09E+05
32.5	4.83E+00	3.30E+02	7.37E+00	1.17E-01	1.85E-02	8.30E-01	2.09E+05
35.0	4.90E+00	3.30E+02	7.84E+00	9.28E-02	2.01E-02	7.46E-01	2.09E+05
37.5	4.95E+00	3.30E+02	7.80E+00	6.89E-02	2.22E-02	6.62E-01	2.09E+05
40.0	5.03E+00	3.30E+02	7.30E+00	4.51E-02	2.50E-02	5.64E-01	2.09E+05
42.5	5.15E+00	3.30E+02	6.20E+00	2.75E-02	2.82E-02	4.61E-01	2.09E+05
45.0	5.23E+00	3.30E+02	5.25E+00	1.59E-02	3.24E-02	3.63E-01	2.09E+05
47.5	5.25E+00	3.30E+02	4.10E+00	9.38E-03	3.72E-02	2.77E-01	2.09E+05
50.0	5.23E+00	3.30E+02	3.10E+00	4.75E-03*	4.60E-02	2.10E-01	2.09E+05
55.0	5.10E+00	3.30E+02	1.80E+00	3.00E-03	6.64E-02	1.65E-01	2.09E+05
60.0	4.75E+00	3.30E+02	1.10E+00	2.07E-03	1.07E-01	1.50E-01	2.09E+05
65.0	4.20E+00	3.30E+02	7.00E-01	1.51E-03	1.86E-01	1.50E-01	2.09E+05
70.0	3.50E+00	3.30E+02	3.00E-01	1.15E-03	3.06E-01	1.50E-01	2.09E+05
75.0	2.83E+00	3.30E+02	2.50E-01	8.89E-04	6.38E-01	1.50E-01	2.09E+05
80.0	2.05E+00	3.28E+02	3.00E-01	7.06E-04	1.50E+00	1.50E-01	2.09E+05
85.0	1.33E+00	3.20E+02	5.00E-01	5.72E-04	3.24E+00	1.50E-01	2.00E+05
90.0	8.50E-01	3.10E+02	7.00E-01	4.71E-04	5.84E+00	1.40E-01	1.90E+05
95.0	5.40E-01	2.70E+02	7.00E-01	3.93E-04	1.01E+01	1.30E-01	1.80E+05
100.0	4.00E-01	1.95E+02	4.00E-01	3.32E-04	1.69E+01	1.20E-01	1.60E+05
105.0	3.40E-01	1.10E+02	2.00E-01	2.84E-04	2.47E+01	1.10E-01	1.40E+05
110.0	2.80E-01	6.00E+01	5.00E-02	2.44E-04	3.36E+01	9.50E-02	1.20E+05
115.0	2.40E-01	4.00E+01	5.00E-03	2.12E-04	4.15E+01	6.00E-02	9.40E+04
120.0	2.00E-01	3.50E+01	5.00E-04	1.85E-04	5.00E+01	3.00E-02	7.25E+04

Table 2b. Constituent Profiles (ppmv), NO, SO_2, NO_2, NH_3, HNO_3, OH, HF

	8 NO	9 SO2	10 NO2	11 NH3	12 HNO3	13 OH	14 HF
(KM)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)
0.0	3.00E-04	3.00E-04	2.30E-05	5.00E-04	5.00E-05	4.40E-08	1.00E-08
1.0	3.00E-04	2.74E-04	2.30E-05	5.00E-04	5.96E-05	4.40E-08	1.00E-08
2.0	3.00E-04	2.36E-04	2.30E-05	4.63E-04	6.93E-05	4.40E-08	1.23E-08
3.0	3.00E-04	1.90E-04	2.30E-05	3.80E-04	7.91E-05	4.40E-08	1.97E-08
4.0	3.00E-04	1.46E-04	2.30E-05	2.88E-04	8.87E-05	4.40E-08	3.18E-08
5.0	3.00E-04	1.18E-04	2.30E-05	2.04E-04	9.75E-05	4.40E-08	5.63E-08
6.0	3.00E-04	9.71E-05	2.30E-05	1.46E-04	1.11E-04	4.40E-08	9.18E-08
7.0	3.00E-04	8.30E-05	2.30E-05	9.88E-05	1.26E-04	4.41E-08	1.53E-07
8.0	3.00E-04	7.21E-05	2.30E-05	6.48E-05	1.39E-04	4.45E-08	2.41E-07
9.0	3.00E-04	6.56E-05	2.32E-05	3.77E-05	1.53E-04	4.56E-08	4.04E-07
10.0	3.00E-04	6.08E-05	2.38E-05	2.03E-05	1.74E-04	4.68E-08	6.57E-07
11.0	3.00E-04	5.79E-05	2.62E-05	1.09E-05	2.02E-04	4.80E-08	1.20E-06
12.0	3.00E-04	5.60E-05	3.15E-05	6.30E-06	2.41E-04	4.94E-08	1.96E-06
13.0	2.99E-04	5.59E-05	4.45E-05	3.12E-06	2.76E-04	5.19E-08	3.12E-06
14.0	2.95E-04	5.64E-05	7.48E-05	1.11E-06	3.33E-04	5.65E-08	4.62E-06
15.0	2.83E-04	5.75E-05	1.71E-04	4.47E-07	4.52E-04	6.75E-08	7.09E-06
16.0	2.68E-04	5.75E-05	3.19E-04	2.11E-07	7.37E-04	8.25E-08	1.05E-05
17.0	2.52E-04	5.37E-05	5.19E-04	1.10E-07	1.31E-03	1.04E-07	1.69E-05
18.0	2.40E-04	4.78E-05	7.71E-04	6.70E-08	2.11E-03	1.30E-07	2.57E-05
19.0	2.44E-04	3.97E-05	1.06E-03	3.97E-08	3.17E-03	1.64E-07	4.02E-05
20.0	2.55E-04	3.19E-05	1.39E-03	2.41E-08	4.20E-03	2.16E-07	5.77E-05
21.0	2.77E-04	2.67E-05	1.76E-03	1.92E-08	4.94E-03	3.40E-07	7.77E-05
22.0	3.07E-04	2.28E-05	2.16E-03	1.72E-08	5.46E-03	5.09E-07	9.90E-05
23.0	3.60E-04	2.07E-05	2.58E-03	1.59E-08	5.74E-03	7.59E-07	1.23E-04
24.0	4.51E-04	1.90E-05	3.06E-03	1.44E-08	5.84E-03	1.16E-06	1.50E-04
25.0	6.85E-04	1.75E-05	3.74E-03	1.23E-08	5.61E-03	2.18E-06	1.82E-04
27.5	1.28E-03	1.54E-05	4.81E-03	9.37E-09	4.82E-03	5.00E-06	2.30E-04
30.0	2.45E-03	1.34E-05	6.16E-03	6.35E-09	3.74E-03	1.17E-05	2.83E-04
32.5	4.53E-03	1.21E-05	7.21E-03	3.68E-09	2.59E-03	3.40E-05	3.20E-04
35.0	7.14E-03	1.16E-05	7.28E-03	1.82E-09	1.64E-03	8.35E-05	3.48E-04
37.5	9.34E-03	1.21E-05	6.26E-03	9.26E-10	9.68E-04	1.70E-04	3.72E-04
40.0	1.12E-02	1.36E-05	4.03E-03	2.94E-10*	5.33E-04	2.85E-04	3.95E-04
42.5	1.19E-02	1.65E-05	2.17E-03	8.72E-11	2.52E-04	4.06E-04	4.10E-04
45.0	1.17E-02	2.10E-05	1.15E-03	2.98E-11	1.21E-04	5.11E-04	4.21E-04
47.5	1.10E-02	2.77E-05	6.66E-04	1.30E-11	7.70E-05	5.79E-04	4.24E-04
50.0	1.03E-02	3.56E-05	4.43E-04*	7.13E-12	5.55E-05*	6.75E-04	4.25E-04*
55.0	1.01E-02	4.59E-05	3.39E-04	4.80E-12	4.45E-05	9.53E-04	4.25E-04
60.0	1.01E-02	5.15E-05	2.85E-04	3.66E-12	3.84E-05	1.78E-03	4.25E-04
65.0	1.03E-02	5.11E-05	2.53E-04	3.00E-12	3.49E-05	3.74E-03	4.25E-04
70.0	1.15E-02	4.32E-05	2.31E-04	2.57E-12	3.27E-05	7.19E-03	4.25E-04
75.0	1.61E-02	2.83E-05	2.15E-04	2.27E-12	3.12E-05	1.12E-02	4.25E-04
80.0	2.68E-02	1.33E-05	2.02E-04	2.04E-12	3.01E-05	1.13E-02	4.25E-04
85.0	7.01E-02	5.56E-06	1.92E-04	1.85E-12	2.92E-05	6.10E-03	4.25E-04
90.0	2.13E-01	2.24E-06	1.83E-04	1.71E-12	2.84E-05	1.51E-03	4.25E-04
95.0	7.12E-01	8.96E-07	1.76E-04	1.59E-12	2.78E-05	2.42E-04	4.25E-04
100.0	2.08E+00	3.58E-07	1.70E-04	1.48E-12	2.73E-05	4.47E-05	4.25E-04
105.0	4.50E+00	1.43E-07	1.64E-04	1.40E-12	2.68E-05	1.77E-05	4.25E-04
110.0	7.98E+00	5.73E-08	1.59E-04	1.32E-12	2.64E-05	1.19E-05	4.25E-04
115.0	1.00E+01	2.29E-08	1.55E-04	1.25E-12	2.60E-05	1.35E-05	4.25E-04
120.0	1.00E+01	9.17E-09	1.51E-04	1.19E-12	2.57E-05	2.20E-05	4.25E-04

Table 2c. Constituent Profiles (ppmv), HCl, HBr, HI, ClO, OCS, H_2CO, HOCl

	15 HCL	16 HBR	17 HI	18 CLO	19 OCS	20 H2CO	21 HOCL
(KM)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)
0.0	1.00E-03	1.70E-06	3.00E-06*	1.00E-08	6.00E-04	2.40E-03	7.70E-06
1.0	7.49E-04	1.70E-06	3.00E-06	1.00E-08	5.90E-04	1.07E-03	1.06E-05
2.0	5.61E-04	1.70E-06	3.00E-06	1.00E-08	5.80E-04	4.04E-04	1.22E-05
3.0	4.22E-04	1.70E-06	3.00E-06	1.00E-08	5.70E-04	2.27E-04	1.14E-05
4.0	3.19E-04	1.70E-06	3.00E-06	1.00E-08	5.62E-04	1.40E-04	9.80E-06
5.0	2.39E-04	1.70E-06	3.00E-06	1.00E-08	5.55E-04	1.00E-04	8.01E-06
6.0	1.79E-04	1.70E-06	3.00E-06	1.00E-08	5.48E-04	7.44E-05	6.42E-06
7.0	1.32E-04	1.70E-06	3.00E-06	1.00E-08	5.40E-04	6.04E-05	5.42E-06
8.0	9.96E-05	1.70E-06	3.00E-06	1.01E-08	5.32E-04	5.01E-05	4.70E-06
9.0	7.48E-05	1.70E-06	3.00E-06	1.05E-08	5.25E-04	4.22E-05	4.41E-06
10.0	5.68E-05	1.70E-06	3.00E-06	1.21E-08	5.18E-04	3.63E-05	4.34E-06
11.0	4.59E-05	1.70E-06	3.00E-06	1.87E-08	5.09E-04	3.43E-05	4.65E-06
12.0	4.36E-05	1.70E-06	3.00E-06	3.18E-08	4.98E-04	3.39E-05	5.01E-06
13.0	6.51E-05	1.70E-06	3.00E-06	5.61E-08	4.82E-04	3.50E-05	5.22E-06
14.0	1.01E-04	1.70E-06	3.00E-06	9.99E-08	4.60E-04	3.62E-05	5.60E-06
15.0	1.63E-04	1.70E-06	3.00E-06	1.78E-07	4.26E-04	3.62E-05	6.86E-06
16.0	2.37E-04	1.70E-06	3.00E-06	3.16E-07	3.88E-04	3.58E-05	8.77E-06
17.0	3.13E-04	1.70E-06	3.00E-06	5.65E-07	3.48E-04	3.50E-05	1.20E-05
18.0	3.85E-04	1.70E-06	3.00E-06	1.04E-06	3.09E-04	3.42E-05	1.63E-05
19.0	4.42E-04	1.70E-06	3.00E-06	2.04E-06	2.74E-04	3.39E-05	2.26E-05
20.0	4.89E-04	1.70E-06	3.00E-06	4.64E-06	2.41E-04	3.43E-05	3.07E-05
21.0	5.22E-04	1.70E-06	3.00E-06	8.15E-06	2.14E-04	3.68E-05	4.29E-05
22.0	5.49E-04	1.70E-06	3.00E-06	1.07E-05	1.88E-04	4.03E-05	5.76E-05
23.0	5.75E-04	1.70E-06	3.00E-06	1.52E-05	1.64E-04	4.50E-05	7.65E-05
24.0	6.04E-04	1.70E-06	3.00E-06	2.24E-05	1.37E-04	5.06E-05	9.92E-05
25.0	6.51E-04	1.71E-06	3.00E-06	3.97E-05	1.08E-04	5.82E-05	1.31E-04
27.5	7.51E-04	1.76E-06	3.00E-06	8.48E-05	6.70E-05	7.21E-05	1.84E-04
30.0	9.88E-04	1.90E-06	3.00E-06	1.85E-04	2.96E-05	8.73E-05	2.45E-04
32.5	1.28E-03	2.26E-06	3.00E-06	3.57E-04	1.21E-05	1.01E-04	2.96E-04
35.0	1.57E-03	2.82E-06	3.00E-06	5.08E-04	4.31E-06	1.11E-04	3.21E-04
37.5	1.69E-03	3.69E-06	3.00E-06	6.07E-04	1.60E-06	1.13E-04	3.04E-04
40.0	1.74E-03	4.91E-06	3.00E-06	5.95E-04	6.71E-07	1.03E-04	2.48E-04
42.5	1.76E-03	6.13E-06	3.00E-06	4.33E-04	4.35E-07	7.95E-05	1.64E-04
45.0	1.79E-03	6.85E-06	3.00E-06	2.51E-04	3.34E-07	4.82E-05	9.74E-05
47.5	1.80E-03	7.08E-06	3.00E-06	1.56E-04	2.80E-07	1.63E-05	4.92E-05
50.0	1.80E-03*	7.14E-06*	3.00E-06	1.04E-04*	2.47E-07*	5.10E-06*	2.53E-05*
55.0	1.80E-03	7.15E-06	3.00E-06	7.69E-05	2.28E-07	2.00E-06	1.50E-05
60.0	1.80E-03	7.15E-06	3.00E-06	6.30E-05	2.16E-07	1.05E-06	1.05E-05
65.0	1.80E-03	7.15E-06	3.00E-06	5.52E-05	2.08E-07	6.86E-07	8.34E-06
70.0	1.80E-03	7.15E-06	3.00E-06	5.04E-05	2.03E-07	5.14E-07	7.11E-06
75.0	1.80E-03	7.15E-06	3.00E-06	4.72E-05	1.98E-07	4.16E-07	6.33E-06
80.0	1.80E-03	7.15E-06	3.00E-06	4.49E-05	1.95E-07	3.53E-07	5.78E-06
85.0	1.80E-03	7.15E-06	3.00E-06	4.30E-05	1.92E-07	3.09E-07	5.37E-06
90.0	1.80E-03	7.15E-06	3.00E-06	4.16E-05	1.89E-07	2.76E-07	5.05E-06
95.0	1.80E-03	7.15E-06	3.00E-06	4.03E-05	1.87E-07	2.50E-07	4.78E-06
100.0	1.80E-03	7.15E-06	3.00E-06	3.93E-05	1.85E-07	2.30E-07	4.56E-06
105.0	1.80E-03	7.15E-06	3.00E-06	3.83E-05	1.83E-07	2.13E-07	4.37E-06
110.0	1.80E-03	7.15E-06	3.00E-06	3.75E-05	1.81E-07	1.98E-07	4.21E-06
115.0	1.80E-03	7.15E-06	3.00E-06	3.68E-05	1.80E-07	1.86E-07	4.06E-06
120.0	1.80E-03	7.15E-06	3.00E-06	3.61E-05	1.78E-07	1.75E-07	3.93E-06

Table 2d. Constituent Profiles (ppmv), N_2, HCN, CH_3Cl, H_2O_2, C_2H_2, C_2H_6, PH_3

	22 N2	23 HCN	24 CH3CL	25 H2O2	26 C2H2	27 C2H6	28 PH3
(KM)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)
0.0	7.81E+05	1.70E-04	7.00E-04	2.00E-04	3.00E-04	2.00E-03	1.00E-14*
1.0	7.81E+05	1.65E-04	6.70E-04	1.95E-04	1.72E-04	2.00E-03	1.00E-14
2.0	7.81E+05	1.63E-04	6.43E-04	1.92E-04	9.57E-05	2.00E-03	1.00E-14
3.0	7.81E+05	1.61E-04	6.22E-04	1.89E-04	6.74E-05	2.00E-03	1.00E-14
4.0	7.81E+05	1.60E-04	6.07E-04	1.84E-04	5.07E-05	1.98E-03	1.00E-14
5.0	7.81E+05	1.60E-04	6.02E-04	1.77E-04	3.99E-05	1.95E-03	1.00E-14
6.0	7.81E+05	1.60E-04	6.00E-04	1.66E-04	3.19E-05	1.90E-03	1.00E-14
7.0	7.81E+05	1.60E-04	6.00E-04	1.49E-04	2.80E-05	1.85E-03	1.00E-14
8.0	7.81E+05	1.60E-04	5.98E-04	1.23E-04	2.55E-05	1.79E-03	1.00E-14
9.0	7.81E+05	1.60E-04	5.94E-04	9.09E-05	2.40E-05	1.72E-03	1.00E-14
10.0	7.81E+05	1.60E-04	5.88E-04	5.79E-05	2.27E-05	1.58E-03	1.00E-14
11.0	7.81E+05	1.60E-04	5.79E-04	3.43E-05	2.08E-05	1.30E-03	1.00E-14
12.0	7.81E+05	1.60E-04	5.66E-04	1.95E-05	1.76E-05	9.86E-04	1.00E-14
13.0	7.81E+05	1.59E-04	5.48E-04	1.08E-05	1.23E-05	7.22E-04	1.00E-14
14.0	7.81E+05	1.57E-04	5.28E-04	6.59E-06	7.32E-06	4.96E-04	1.00E-14
15.0	7.81E+05	1.55E-04	5.03E-04	4.20E-06	4.52E-06	3.35E-04	1.00E-14
16.0	7.81E+05	1.52E-04	4.77E-04	2.94E-06	2.59E-06	2.14E-04	1.00E-14
17.0	7.81E+05	1.49E-04	4.49E-04	2.30E-06	1.55E-06	1.49E-04	1.00E-14
18.0	7.81E+05	1.45E-04	4.21E-04	2.24E-06	8.63E-07	1.05E-04	1.00E-14
19.0	7.81E+05	1.41E-04	3.95E-04	2.68E-06	5.30E-07	7.96E-05	1.00E-14
20.0	7.81E+05	1.37E-04	3.69E-04	3.68E-06	3.10E-07	6.01E-05	1.00E-14
21.0	7.81E+05	1.34E-04	3.43E-04	5.62E-06	1.89E-07	4.57E-05	1.00E-14
22.0	7.81E+05	1.30E-04	3.17E-04	1.03E-05	1.04E-07	3.40E-05	1.00E-14
23.0	7.81E+05	1.25E-04	2.86E-04	1.97E-05	5.75E-08	2.60E-05	1.00E-14
24.0	7.81E+05	1.19E-04	2.48E-04	3.70E-05	2.23E-08	1.89E-05	1.00E-14
25.0	7.81E+05	1.13E-04	1.91E-04	6.20E-05	8.51E-09	1.22E-05	1.00E-14
27.5	7.81E+05	1.05E-04	1.10E-04	1.03E-04	4.09E-09	5.74E-06	1.00E-14
30.0	7.81E+05	9.73E-05	4.72E-05	1.36E-04	2.52E-09	2.14E-06	1.00E-14
32.5	7.81E+05	9.04E-05	1.79E-05	1.36E-04	1.86E-09	8.49E-07	1.00E-14
35.0	7.81E+05	8.46E-05	7.35E-06	1.13E-04	1.52E-09	3.42E-07	1.00E-14
37.5	7.81E+05	8.02E-05	3.03E-06	8.51E-05	1.32E-09	1.34E-07	1.00E-14
40.0	7.81E+05	7.63E-05	1.32E-06	6.37E-05	1.18E-09	5.39E-08*	1.00E-14
42.5	7.81E+05	7.30E-05	8.69E-07	5.17E-05	1.08E-09	2.25E-08	1.00E-14
45.0	7.81E+05	7.00E-05	6.68E-07	4.44E-05	9.97E-10	1.04E-08	1.00E-14
47.5	7.81E+05	6.70E-05	5.60E-07	3.80E-05	9.34E-10	6.57E-09	1.00E-14
50.0	7.81E+05	6.43E-05*	4.94E-07*	3.48E-05	8.83E-10*	4.74E-09	1.00E-14
55.0	7.81E+05	6.21E-05	4.56E-07	3.62E-05	8.43E-10	3.79E-09	1.00E-14
60.0	7.81E+05	6.02E-05	4.32E-07	5.25E-05	8.10E-10	3.28E-09	1.00E-14
65.0	7.81E+05	5.88E-05	4.17E-07	1.26E-04	7.83E-10	2.98E-09	1.00E-14
70.0	7.81E+05	5.75E-05	4.05E-07	3.77E-04	7.60E-10	2.79E-09	1.00E-14
75.0	7.81E+05	5.62E-05	3.96E-07	1.12E-03	7.40E-10	2.66E-09	1.00E-14
80.0	7.81E+05	5.50E-05	3.89E-07	2.00E-03	7.23E-10	2.56E-09	1.00E-14
85.0	7.81E+05	5.37E-05	3.83E-07	1.68E-03	7.07E-10	2.49E-09	1.00E-14
90.0	7.80E+05	5.25E-05	3.78E-07	4.31E-04	6.94E-10	2.43E-09	1.00E-14
95.0	7.79E+05	5.12E-05	3.73E-07	4.98E-05	6.81E-10	2.37E-09	1.00E-14
100.0	7.77E+05	5.00E-05	3.69E-07	6.76E-06	6.70E-10	2.33E-09	1.00E-14
105.0	7.74E+05	4.87E-05	3.66E-07	8.38E-07	6.59E-10	2.29E-09	1.00E-14
110.0	7.70E+05	4.75E-05	3.62E-07	9.56E-08	6.49E-10	2.25E-09	1.00E-14
115.0	7.65E+05	4.62E-05	3.59E-07	1.00E-08	6.40E-10	2.22E-09	1.00E-14
120.0	7.60E+05	4.50E-05	3.56E-07	1.00E-09	6.32E-10	2.19E-09	1.00E-14

The altitude increments for both Table 1 and Table 2 are 1km between 0 and 25km, 2.5km between 25 and 50km, and 5km between 50 and 120km. These increments (and the subset of reference atmospheres themselves) have been chosen for their compatability with existing profiles in other radiation models (particularly LOWTRAN6[12a, 12b]), facilitating validation and intercomparison tests. The units are: altitude in (km), temperature in (K), pressure in (mb), and mixing ratios in (ppmv). In addition to this document, this profile set is available from AFGL/OPI≠ in computer-accessible formats, either as tables or FORTRAN data statements appropriate for direct incorporation into computer simulations (e.g. FASCOD2[13]).

A two-part bibliography appears in Appendix B. The first portion is divided by subject: (a) radiance-transmittance models, (b) other constituent compilations and/or photochemical models, (c) reference atmosphere (temperature-pressure) compilations and (d) individual constituents. Each species is followed by the set of journal references which contributed either directly or indirectly to the tabulated profiles. These are generally sequenced according to their influence with secondary sources provided for estimating natural variability and/or uncertainty. For instance, the water vapor profiles incorporate the LOWTRAN6[12] values in the tropopause, satellite measurements (LIMS)[8] in the stratosphere, and photochemical estimates throughout the mesosphere and lower thermosphere[14, 15]. The particular tabulated values are unique to this compilation, having undergone smoothing, interpolation, and averaging. Similarly, the tropospheric ozone profiles from LOWTRAN have been combined with a composite climatology[9] based on satellite measurements of the stratosphere (SBUV[16], LIMS[17]) and

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≠ AFGL/OPI
Hanscom Air Force Base, MA 01731

12a. Kneizys, F.X., Shettle, E.P., Gallery, W.O., Chetwynd, J.H., Abreu, L.W., Selby, J.E.A., Fenn, R.W., and McClatchey, R.A. (1980), Atmospheric Transmittance/Radiance: Computer Code LOWTRAN5, AFGL-TR-80-0067. (NTIS AD A088215).

12b. Kneizys, F.X., Shettle, E.P., Gallery, W.O., Chetwynd, J.H., Abreu, L.W., Selby, J.E.A., Clough, S.A. and Fenn, R.W. (1983), Atmospheric Transmittance/Radiance: Computer Code LOWTRAN6, AFGL-TR-83-0187, (NTIS AD A137796).

13. Clough, S.A., Kneizys, F.X., Shettle, E.P., Anderson, G.P., (1986), Atmospheric radiance and transmittance: FASCOD2, Proc. of the Sixth Conference on Atmospheric Radiation, Williamsburg, VA., American Meteorological Society, Boston, MA., 141-144.

14. Allen, M., Lunine, J.I. and Yung, U.L. (1984) The vertical distribution of ozone in the mesophere and lower thermosphere, J. Geophys. Res; 89, 4841-4872.

15. Garcia, R.R. and Solomon, S. (1983) A numerical model of the zonally averaged dynamical and chemical structure of the middle atmosphere, J. Geophys. Res; 88, 1379-1400.

16. McPeters, R.D., Heath, D.F. and Bhartia, P.K. (1984) Average ozone profiles for 1979 from the Numbus 7 SBUV instrument, J. Geophys. Res; 89, 5199-5214.

17. Remsberg, E.E., Russell III, J.M., Gille, J.C., Gordley, L.L., Baily, P.L., Planet, W.G. and Harries, J.E. (1984a) The validation of Nimbus 7 LIMS measurements of ozone, J. Geophys. Res; 89, 5161-5178.

mesosphere (SME[18]); however, in the thermosphere all six ozone profiles are identical, based on a single in situ rocket determination (ALADDIN[19, 20]). The N_2O and CH_4 profiles follow the Smith[3] compilation in the tropopause and rely on satellite-derived latitudinal distributions in the stratosphere[10]. Above the stratopause the CH_4 profile is photochemically determined[14, 15] while N_2O has been extrapolated (see subsequent discussion). The second part of the bibliography is an alphabetical listing of all referenced materials; those publications that can be associated with particular molecules are so identified.

3. ERROR ESTIMATES/VARIABILITY

The practical accuracies of these tabulated values vary with species and altitude. At their best they offer approximately 10-30% relative consistency for U.S. Standard Atmosphere conditions throughout the troposphere and stratosphere; exceptions include PH_3 which is unmeasured in the earth's atmosphere. The mesospheric and thermospheric profiles are much less certain and, in fact, are only defined for temperature, pressure, and the following constituents: H_2O, CO_2, O_3, CO, CH_4, O_2, NO, SO_2, OH, and H_2O_2. Mixing ratios for the remaining species have been extrapolated from measurements (usually near the stratopause) using a logarithmically decreasing mixing ratio scale height; the onset of such profile extrapolations is marked by asterisks (*) in the tables and figures. This, of course, leads to unsupported estimates of abundance in the upper atmosphere. [The adopted logarithmic extrapolation scheme is a compromise between using either (a) constant or (b) constantly decreasing mixing ratios. The former introduces erroneous relative changes between extrapolated species. The latter, while obviously connoting the lack of data, introduces an abrupt discontinuity into the profiles.] The mixing ratios of all extrapolated species are, in any case, very small.

4. LIMITATIONS

Representative profiles do not necessarily resemble in situ environments, leading to constraints on their general applicability. WMO and COSPAR will release new sets of

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18. Thomas, R.J., Barth, C.A. and Solomon, S. (1984) Seasonal variations of O_3 in the upper mesosphere and gravity waves, Geophys. Res. Letts., 11, 673-676.
19. Weeks, L.H., Good, R.E., Randhawa, J.S. and Trinks, A. (1978) Ozone measurements in the stratosphere, mesosphere, and lower thermosphere during Aladdin 74, J. Geophys. Res; 83, 978-982.
20. Allen, M., Private Communication.

standard temperature-density profiles in 1986 which provide significant enhancements to the NASA, 1966 Supplements and CIRA, 1972 Reference Atmospheres[21]. (A subset of the CIRA, 1972 profiles is available in this format.) However, a more detailed climatology does not ensure adequate simulation of observed variability. Particularly in disturbed winter conditions, dynamic wave activity can bring about rapid changes in temperature and pressure, which can then propagate from the troposphere into and through the stratosphere.

In addition to any tropospheric meteorologically-driven changes in temperature, the water vapor and anthropogenic pollutants (CO, CO_2, O_3, nitrogen-oxygen compounds, etc) exhibit factors of 100 or more local variability. Dynamic perturbations are less extreme in the stratosphere; however, horizontal gradients on local, latitudinal or seasonal scales often exceed factors of 2-10. In the mesophere and lower thermosphere, in addition to the extrapolated data, natural excursions brought about by responses to dynamic and solar influences can be substantial. Calculated radiances or transmittances which rely upon default choices represent only a reasonable set of possibilities; they do not replicate actual measurement conditions. When detailed comparisons between theoretical radiance/transmittance calculations and actual data are required, supporting sources (radiosondes, thermosondes, in situ measurements) are recommended.

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21. CIRA 1972, (1972) Ed. A.C. Strickland, Akademie-Verlag, Berlin, 450 pp.

References

1. NASA (1966), U.S. Standard Atmosphere Supplements, 1966, U.S. Government Printing Office, Washington, D.C.

2. NASA (1976), U.S. Standard Atmosphere Supplements, 1976, U.S. Government Printing Office, Washington, D.C.

3. Smith, M.A.H. (1982) Compilation of atmospheric gas concentration profiles from 0-50km, NASA Tech Mem 83289, 70 pp.

4a. W.M.O. (1982) The Stratosphere 1981: Theory and Measurements, Report No. 11, NASA, Greenbelt, MD.

4b. W.M.O. (1986) Atmospheric Ozone 1985: Assessment of Our Understanding of the Processes Controlling its Present Distribution and Change, WMO Report No. 16, W.M.O., Geneva, Switzerland.

5. Brasseur, G. and Solomon, S. (1984) Aeronomy of the Middle Atmosphere, D. Reidel Publishing Co, Dordrecht, Holland, Chapter 5: Composition & Chemistry, 440 pp.

6. Rothman, L.S., Goldman, A., Gillis, J.R., Gamache, R.R., Pickett, H.M., Poynter, R.L., Husson, N. and Chedin, A. (1983b), AFGL trace gas compilation: 1982 version, Appl. Opt., 22, 1616-1627.

7. Rothman, L.S., Gamache, R.R., Barbe, A., Goldman, A., Gillis, H.R., Brown, L.A., Toth, R.A., Flaud, J.-M. and Camy-Peyret, C. (1983a), AFGL atmospheric absorption line parameters compilation: 1982 edition, Appl. Opt., 22, 2247-2256.

8. Russell III, J.M., Gille, J.C., Remsberg, E.E., Gordley, L.L., Bailey, P.L., Fischer, H., Girard, A., Drayon, S.R., Evans, W.F.J. and Harries, J.E. (1984b) Validation of water vapor results measured by the LIMS experiment on Nimbus 7, J. Geophys. Res; 89, 5115-5120.

9. Keating G.M. and Young D.F. (1985) Interim reference ozone models for the middle atmosphere, Interim COSPAR Reference Atmosphere for Altitudes 20-120km, in preparation.

10. Jones, R.L. and Pyle, J.A. (1984) Observations of CH_4 and N_2O by the Nimbus 7 SAMS: A comparison with in situ data and two-dimensional numerical model calculations, J. Geophys. Res; 89, 5263-5379.

11. Solomon, S., Garcia, R.R., Olivero, J.J., Bevilacqua, R.M., Schwartz, P.R., Clancy, R.T. and Mahleman, D.O. (1985) Photochemistry and transport of CO in the middle atmosphere, J. Atmos. Sci., 42, 1072-1083.

12a. Kneizys, F.X., Shettle, E.P., Gallery, W.O., Chetwynd, J.H., Abreu, L.W., Selby, J.E.A., Fenn, R.W., and McClatchey, R.A. (1980), Atmospheric Transmittance/Radiance: Computer Code LOWTRAN5, AFGL-TR-80-0067, (NTIS AD A088215).

12b. Kneizys, F.X., Shettle, E.P., Gallery, W.O., Chetwynd, J.H., Abreu, L.W., Selby, J.E.A., Clough, S.A. and Fenn, R.W. (1983), Atmospheric Transmittance/Radiance: Computer Code LOWTRAN6, AFGL-TR-83-0187, (NTIS AD A137796).

13. Clough, S.A., Kneizys, F.X., Shettle, E.P., Anderson, G.P., (1986) Atmospheric radiance and transmittance: FASCOD2, Proc. of the Sixth Conference on Atmospheric Radiation, Williamsburg, VA., American Meteorological Society, Boston, MA., 141-144.

14. Allen, M., Lunine, J.I. and Yung, Y.L. (1984) The vertical distribution of ozone in the mesosphere and lower thermosphere, J. Geophys. Res; 89, 4841-4872.

15. Garcia, R.R. and Solomon, S. (1983) A numerical model of the zonally averaged dynamical and chemical structure of the middle atmosphere, J. Geophys. Res; 88, 1379-1400.

16. McPeters, R.D., Heath, D.F. and Bhartia, P.K. (1984) Average ozone profiles for 1979 from the Numbus 7 SBUV instrument, J. Geophys. Res; 89, 5199-5214.

17. Remsberg, E.E., Russell III, J.M., Gille, J.C., Gordley, L.L., Bailey, P.L., Planet, W.G. and Harries, J.E. (1984a) The validation of Nimbus 7 LIMS measurements of ozone, J. Geophys. Res; 89, 5161-5178.

18. Thomas, R.J., Barth, C.A. and Solomon, S. (1984) Seasonal variations of O_3 in the upper mesosphere and gravity waves, Geophys. Res. Letts., 11, 673-676.

19. Weeks, L.H., Good, R.E., Randhawa, J.S. and Trinks, A. (1978) Ozone measurements in the stratosphere, mesosphere, and lower thermosphere during Aladdin 74, J. Geophys. Res; 83, 978-982.

20. Allen, M., Private Communication.

21. CIRA 1972, (1972) Ed. A.C. Strickland, Akademie-Verlag, Berlin, 450 pp.

Appendix A

Graphical representation for all tabular data; see the text for description.

Part I: Reference Atmospheric Model Profiles:

Part II: Constituent Profiles (U.S. Standard Atm. ONLY)

Appendix A: Part I

Reference Atmospheric Model Profiles

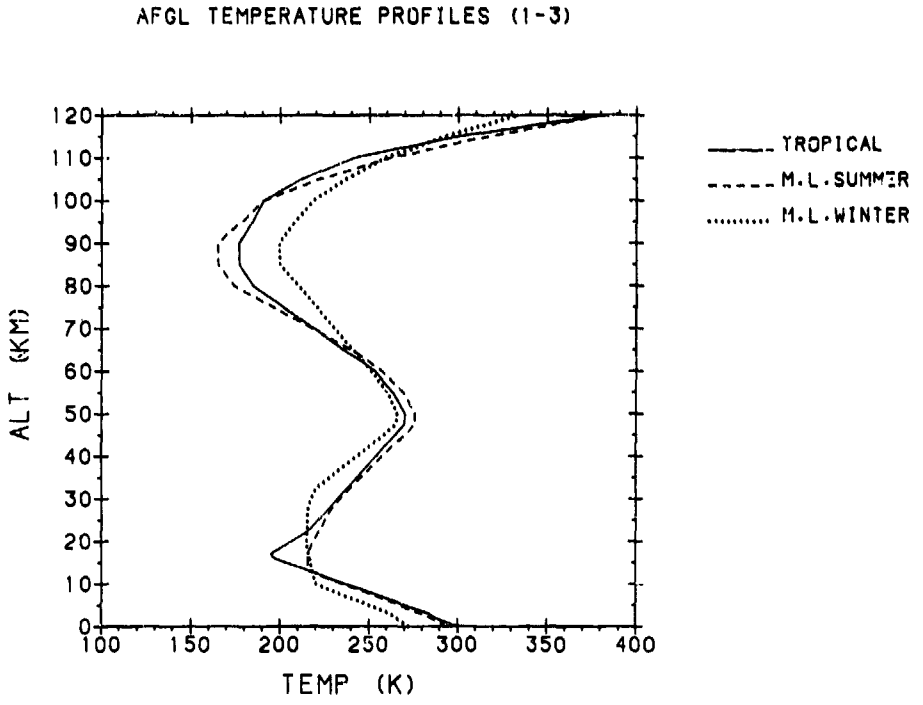

Figure A1. Temperature Profiles (1-3)

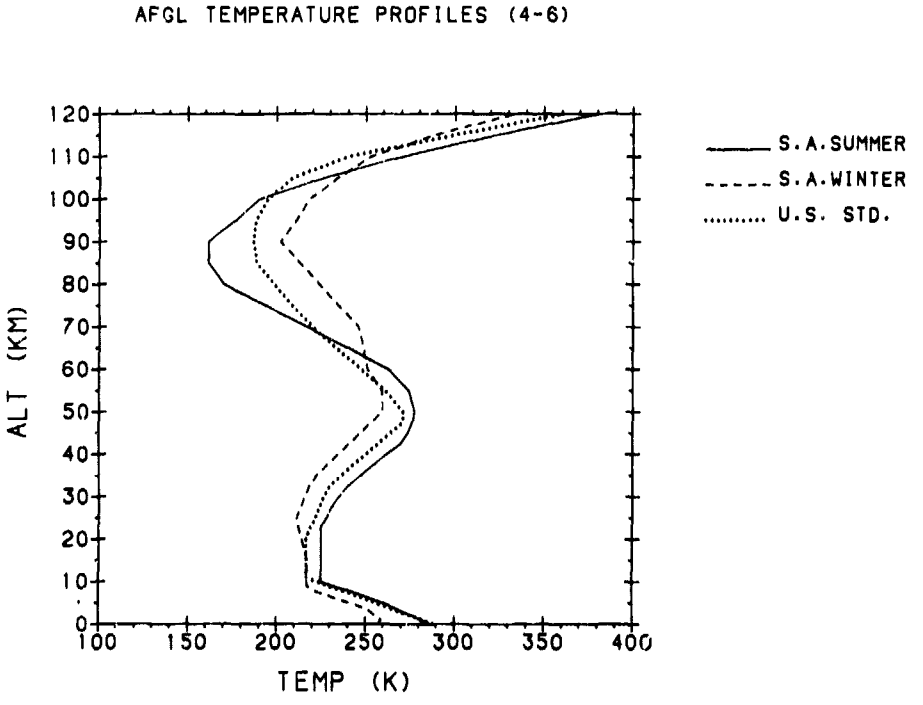

Figure A2. Temperature Profiles (4-6)

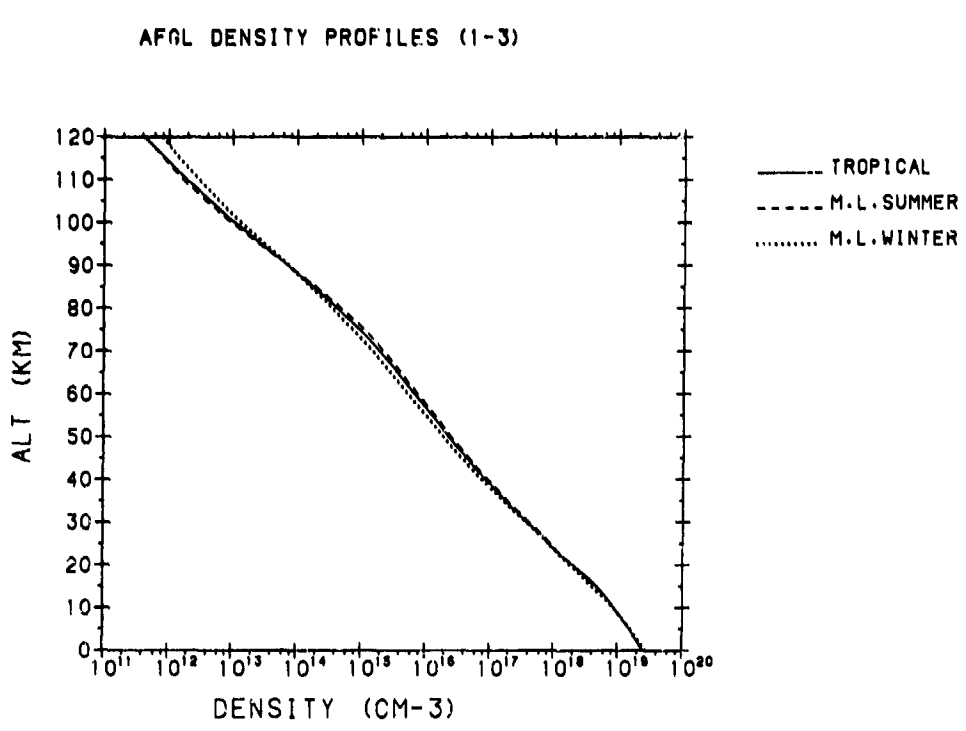

Figure A3. Density Profiles (1-3)

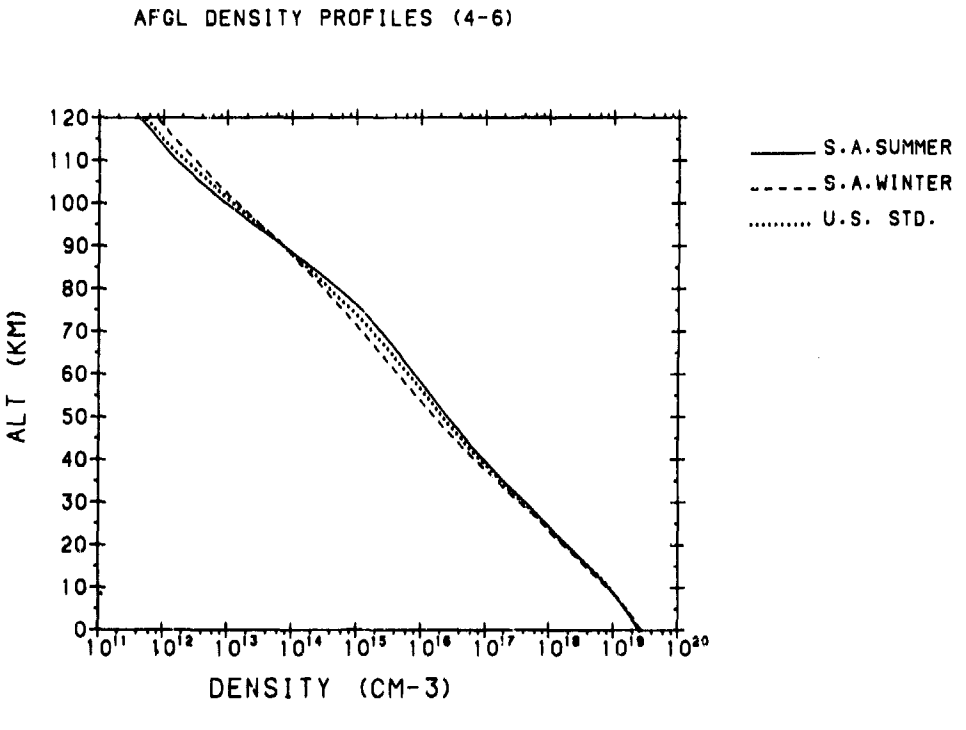

Figure A4. Density Profiles (4-6)

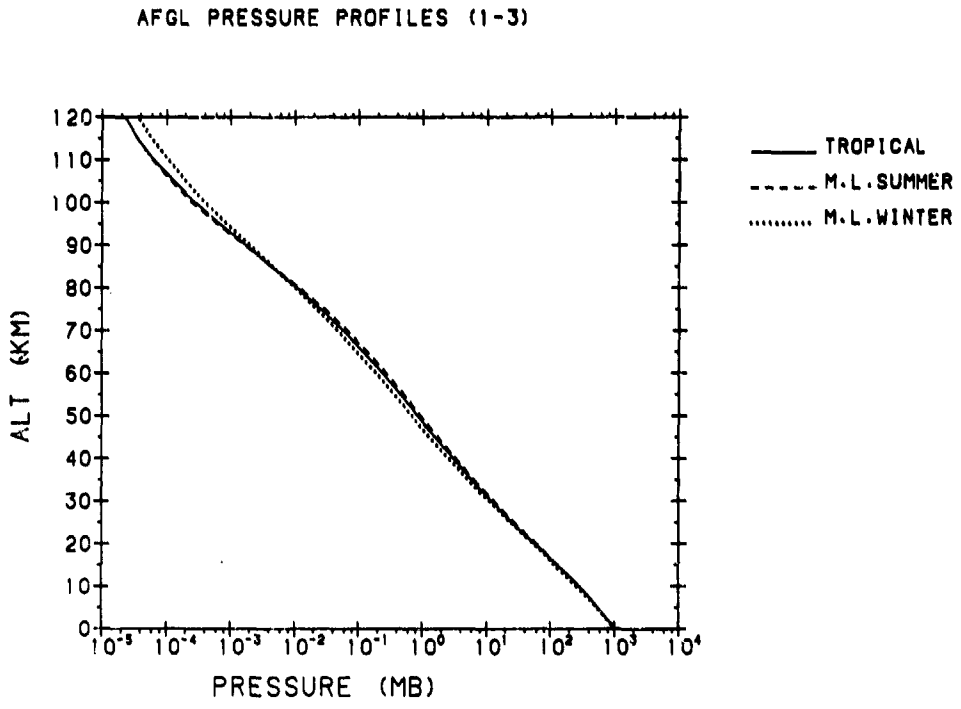

Figure A5. Pressure Profiles (1-3)

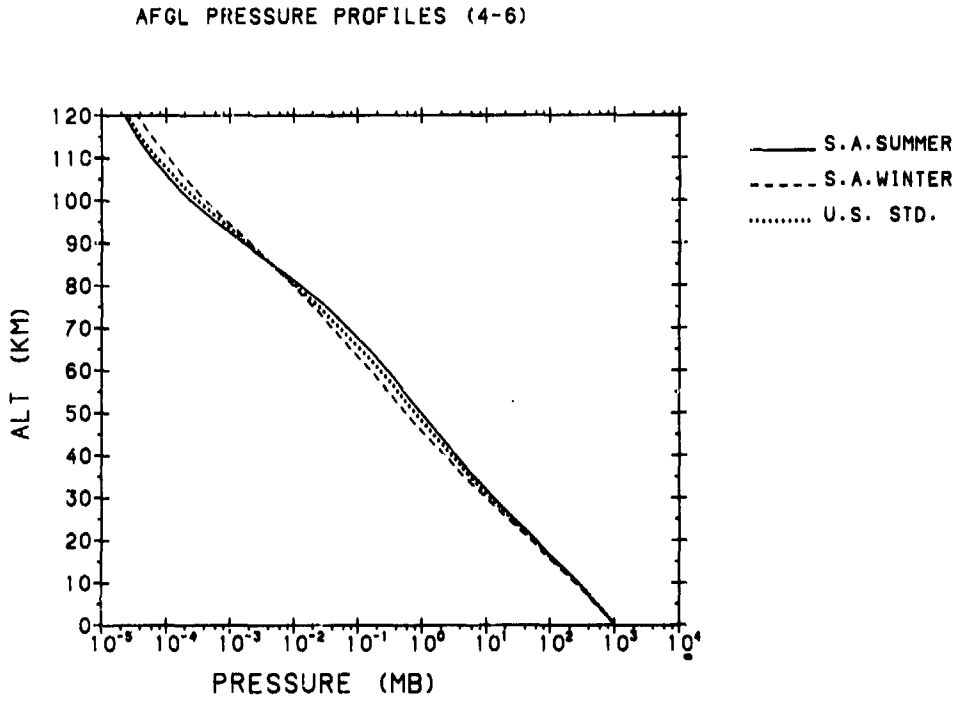

Figure A6. Pressure Profiles (4-6)

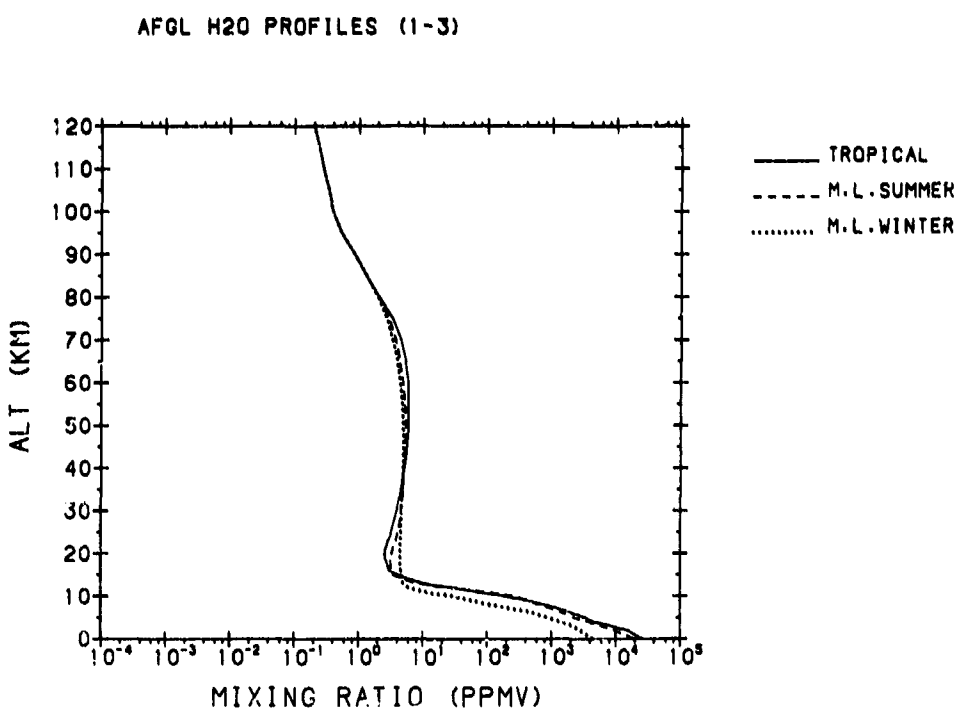

Figure A7. H_2O Mixing Ratios (1-3)

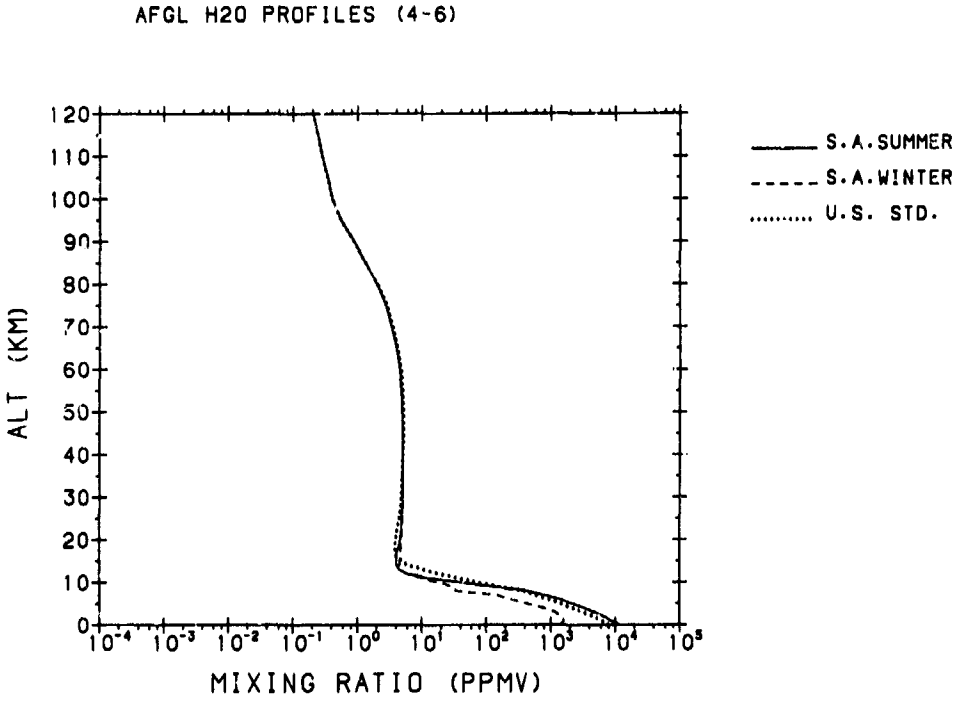

Figure A8. H_2O Mixing Ratios (4-6)

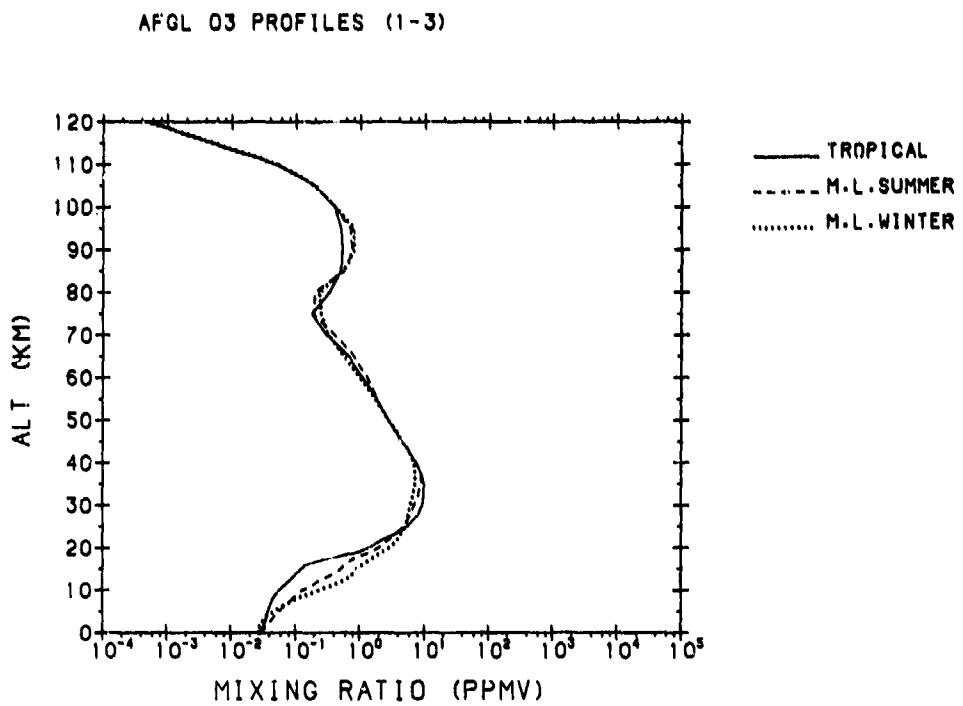

Figure A9. O_3 (1-3)

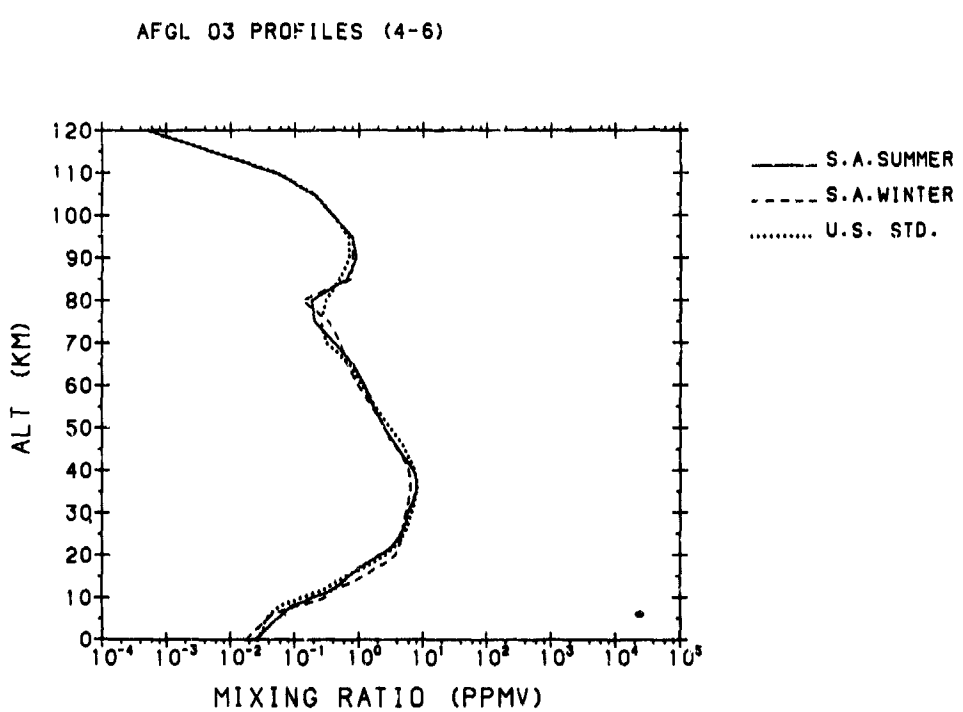

Figure A10. O_3 (4-6)

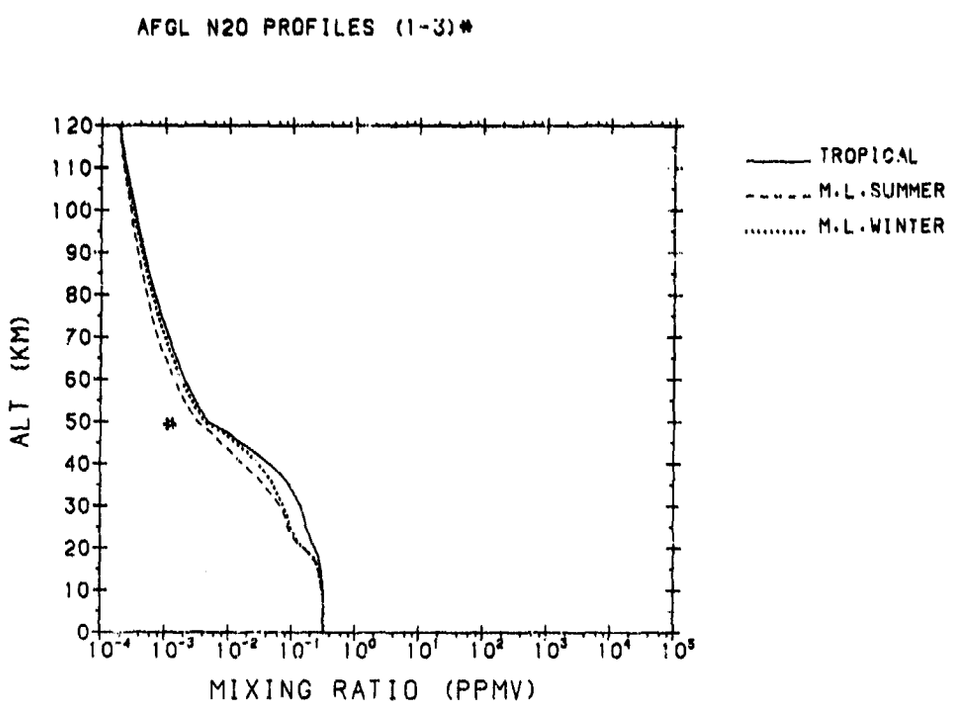

Figure A11. N_2O (1-3)

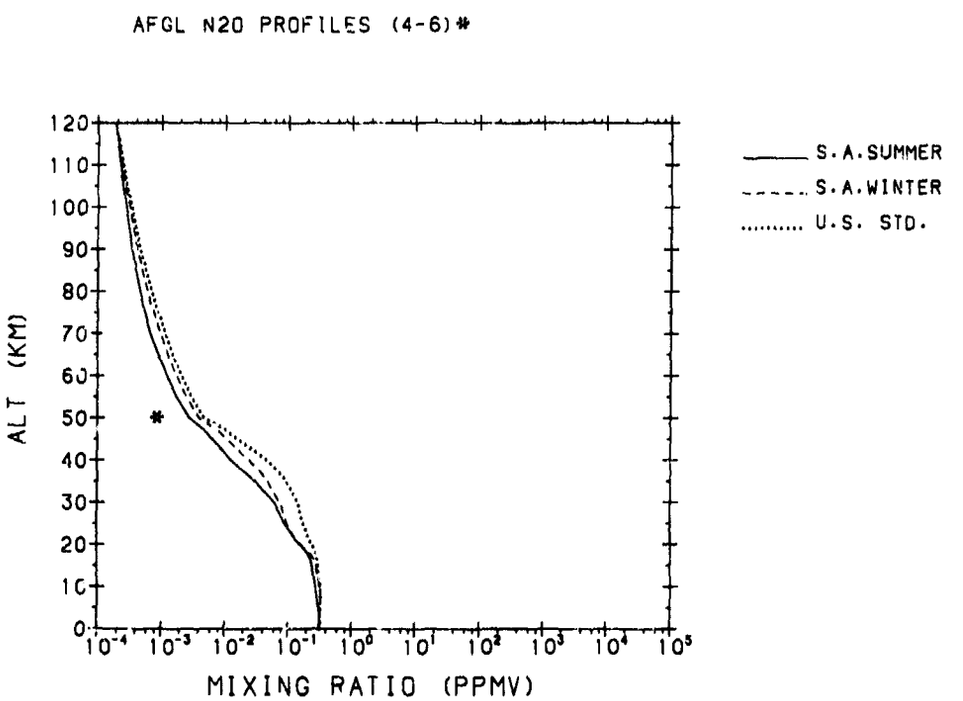

Figure A12. N_2O (4-6)

[(*) indicates extrapolation adopted for that species]

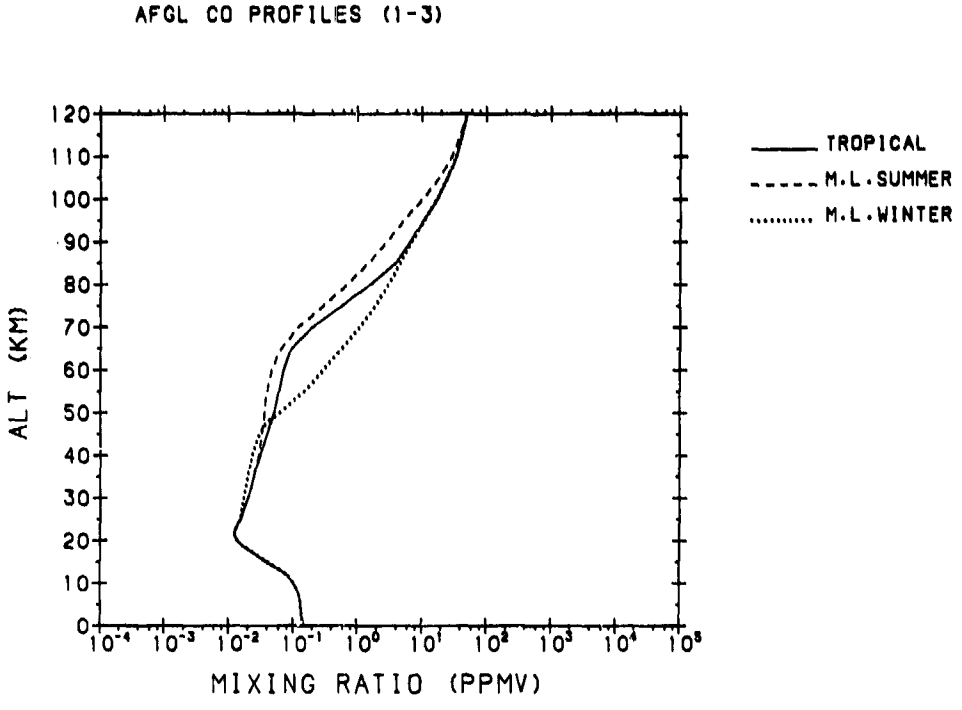

Figure A13. CO (1-3)

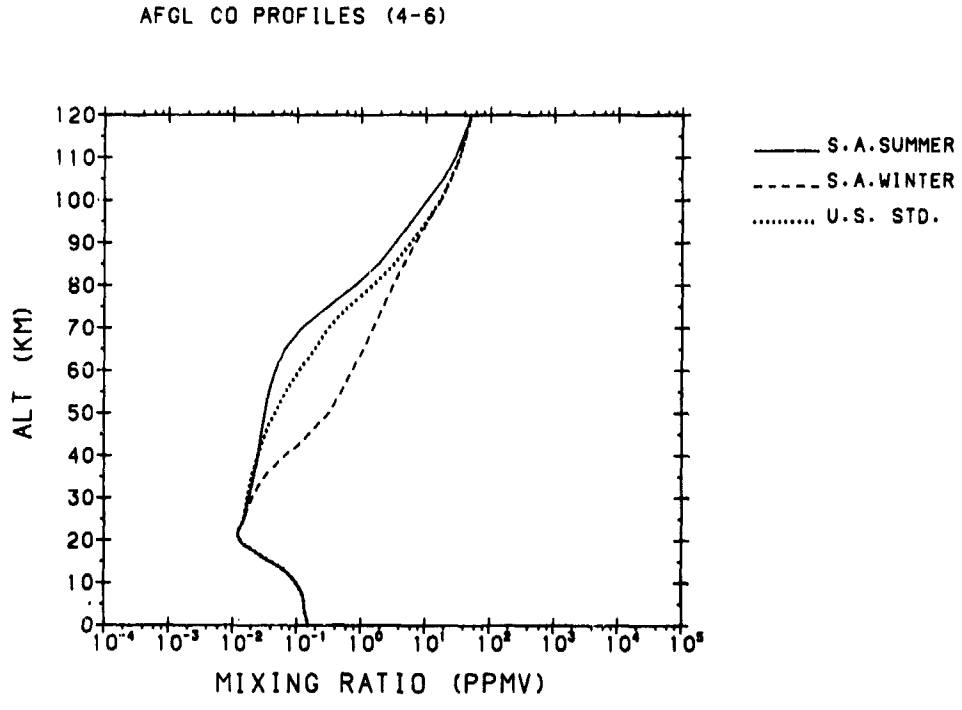

Figure A14. CO (4-6)

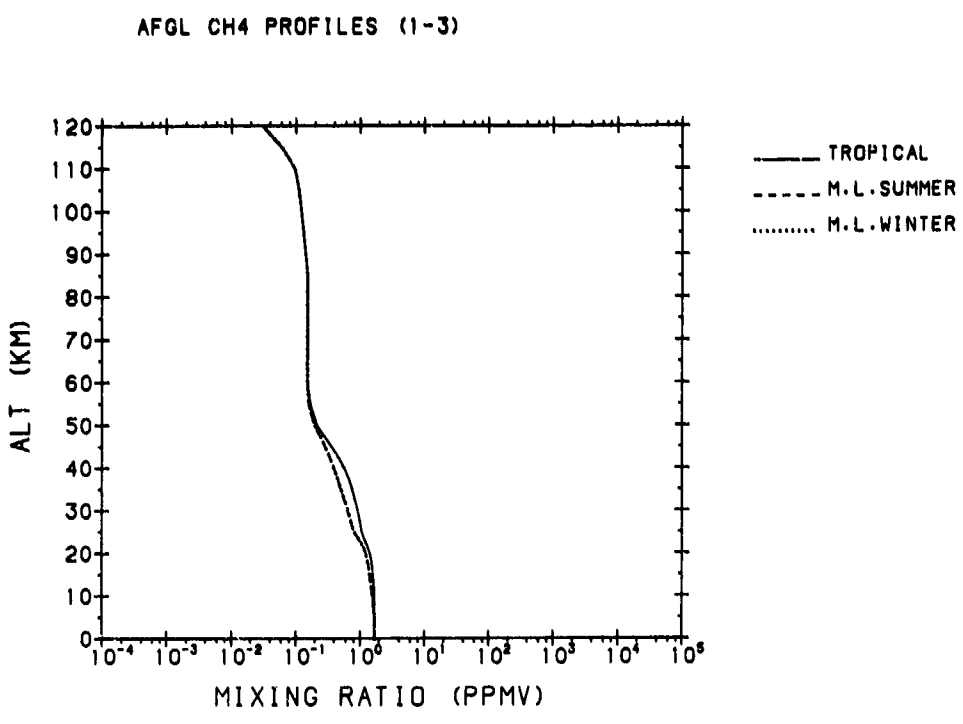

Figure A15. CH_4 (1-3)

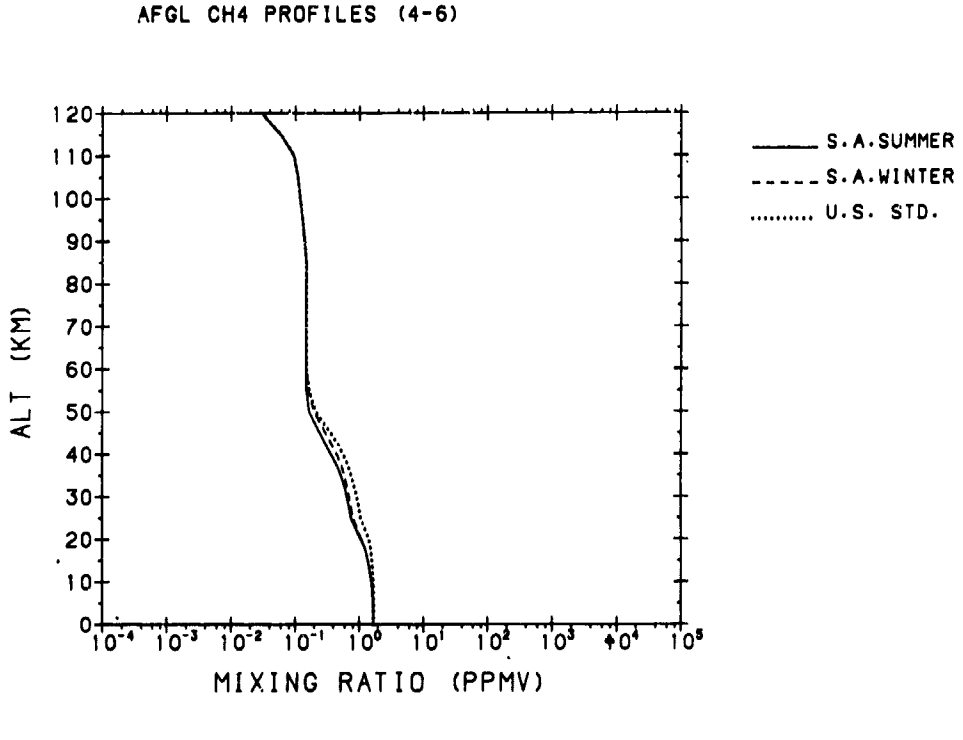

Figure A16. CH_4 (4-6)

Appendix A: Part II

Constituent Profiles (U.S. Standard Atmosphere ONLY)

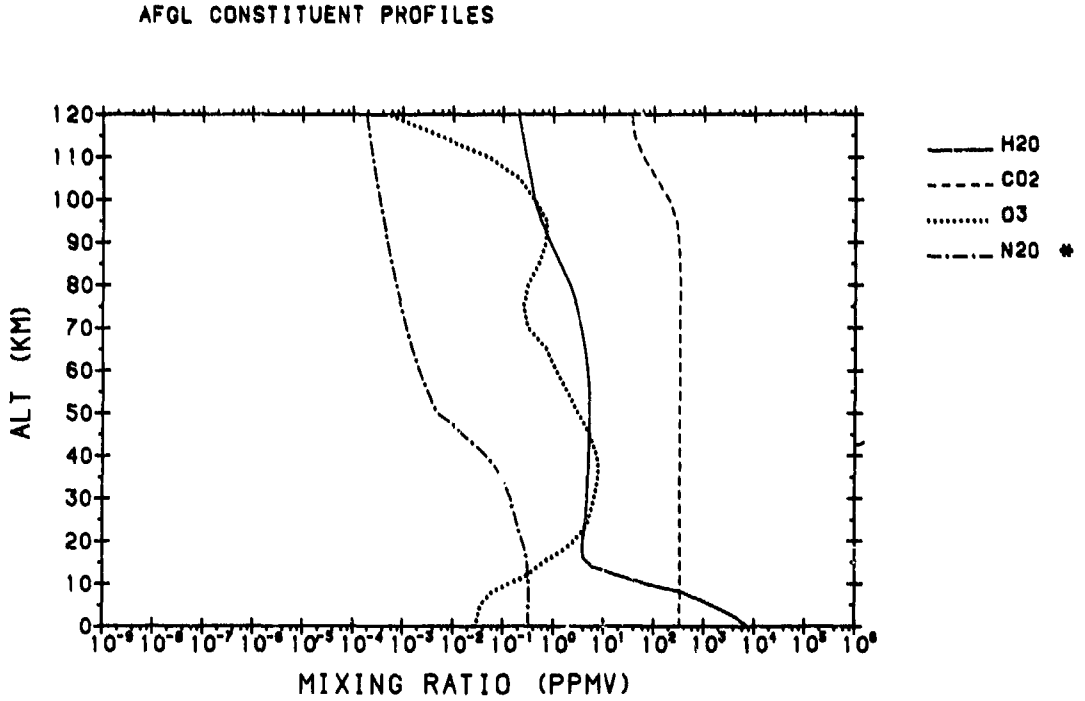

Figure A17. H_2O, CO_2, O_3, N_2O

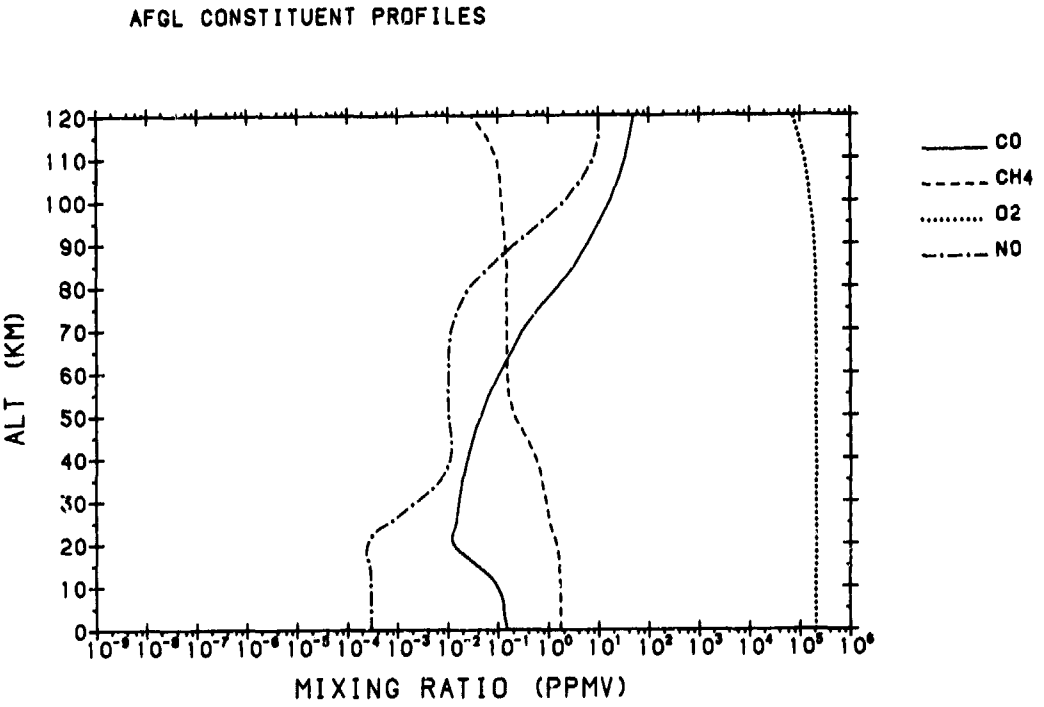

Figure A18. CO, CH_4, O_2, NO

[(*) indicates extrapolation adopted for that species, see tabular data]

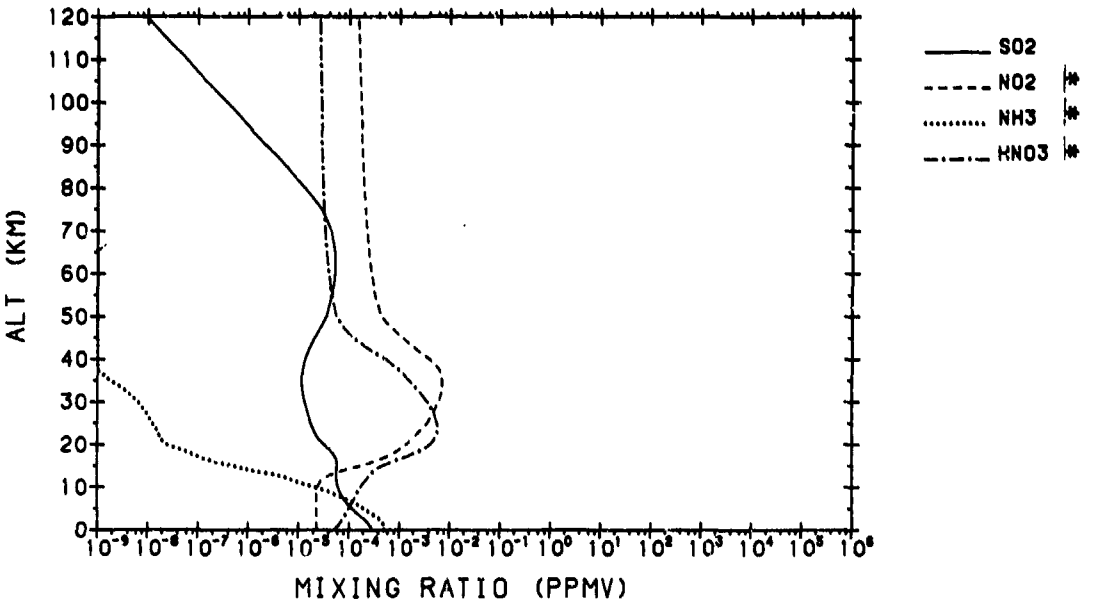

Figure A19. SO_2, NO_2, NH_3, HNO_3

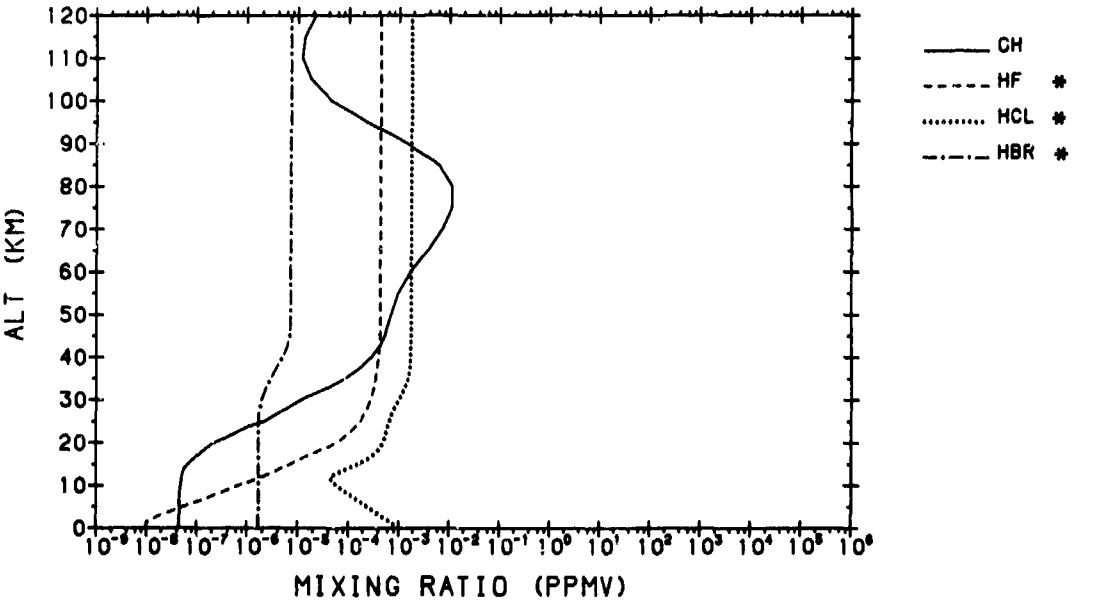

Figure A20. OH, HF, HCl, HBR

[(*) indicates extrapolation adopted for that species, see tabular data]

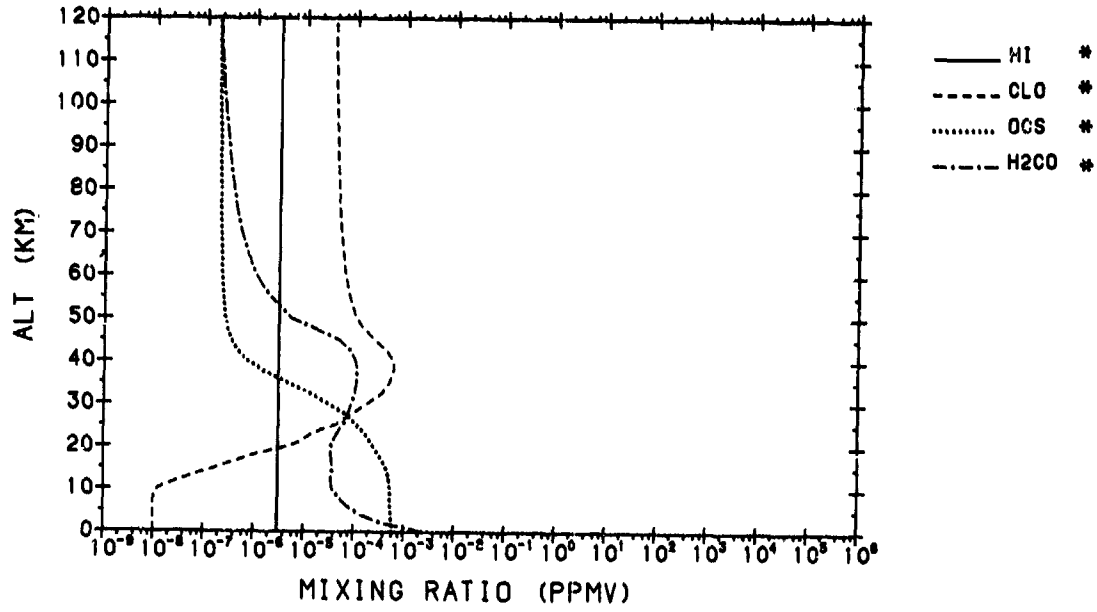

Figure A21. HI, ClO, OCS, H_2CO

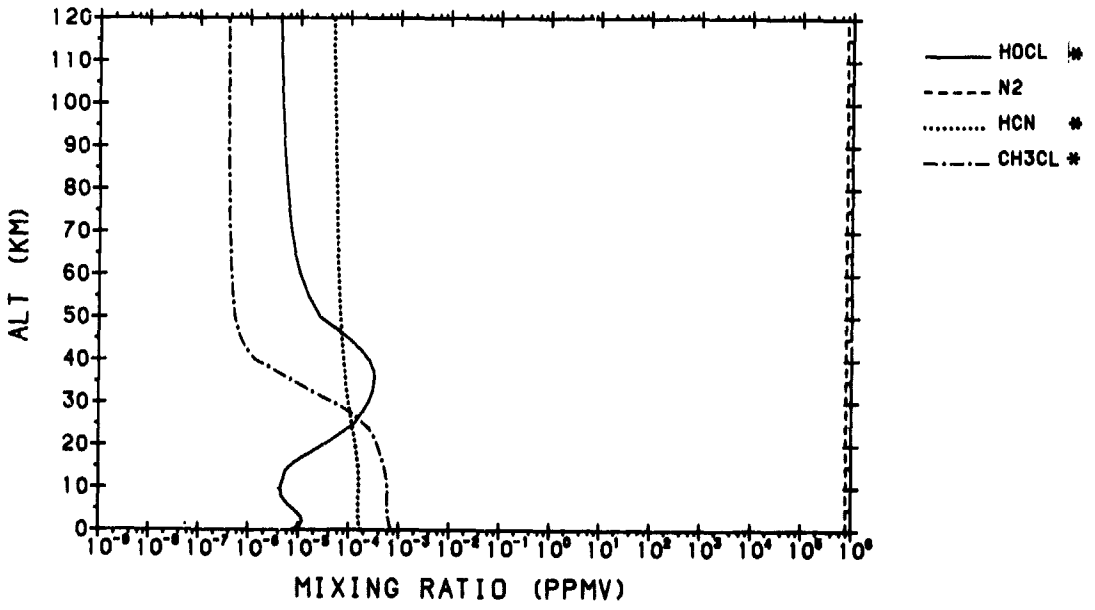

Figure A22. HOCl, N_2, HCN, CH_3Cl

[(*) indicates extrapolation adopted for that species, see tabular data]

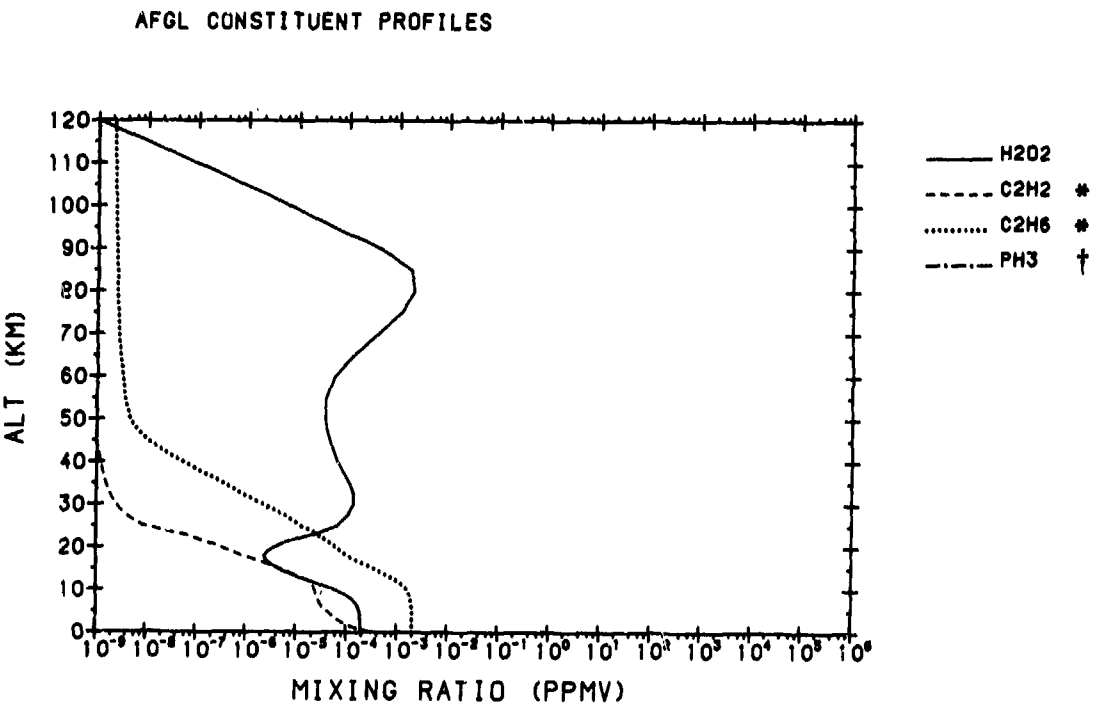

Figure A23. H_2O_2, C_2H_2, C_2H_6, PH_3†

[(*) indicates extrapolation adopted for that species, see tabular data]
[(†) mixing ratio for PH_3 is $1x10^{-14}$ PPMV]

Appendix B

Bibliography

The tabulated profiles (see text) are, in most cases, derived from more than one literature source. This bibliography provides a list of all references considered when formulating these profiles and is provided as an aide to evaluating species variability, measurement techniques, and/or modeling efforts. In general the final profiles have undergone merging, editing, smoothing, interpolation, and often extrapolation. They can not, therefore, be directly attributed to single sources.

Part I of the Bibliography lists the source data by author and year, separated into four categories: (A) Radiance-Transmittance Models and Line Parameters; (B) Literature Reviews and/or Photochemical Models; (C) Atmospheric Temperature/Pressure Profiles; and (D) Constituent Profiles. The order in which the references appear may reflect their impact upon the adopted profile (see text).

Part II provides the actual alphabetized references with appropriate species identification for cross indexing.

Part I: Subject Listing

A. Radiance-Transmittance Models and Line Parameters

Clough, et al., 1981; Clough, et al., 1985;
Kneizys, et al., 1980; Kneizys, et al., 1983;
Rothman, et al., 1983a; Rothman, et al., 1983b.

B. Literature Reviews/Photochemical Models

Allen, et al., 1984. (subsequently referred to as A)
Brasseur and Solomon, 1984. (referred to as BS)
Crutzen and Gidel, 1983. (referred to as CG)
Garcia and Solomon, 1983. (referred to as GS)
Logan, et al., 1981. (referred to as L)
Smith, 1982. (referred to as Sm)
WMO, 1982. (referred to as WMO)
WMO, 1986.

C. Atmospheric Temperature/Pressure Profiles

NASA, 1966.
CIRA, 1972.
NASA, 1976.

D. Constituent Profiles

[All] (Sm); (WMO); (BS)

[H_2O] Kneizys, et al., 1980; Remsberg, et al., 1984b; Farmer, et al., 1980; Girard and Louisnard, 1984; Grossman, et al., 1985; Lippens, et al., 1984; Louisnard, et al., 1983; Russell, et al., 1984b; Stordal, et al., 1985; Weinreb, et al., 1984; Degges and Nadile, in press; Philbrick, private communication; (A); (GS); (L); (Sm); (WMO).

[CO_2] Farmer, et al., 1980; Komhyre, et al., 1985; Lippens, et al., 1984; (Sm); (WMO).

[O_3] Keating and Young, in press; Bojkov, in press; Fishman, 1985; Girard and Louisnard, 1984; Louisnard, et al., 1983; McPeters, et al., 1984; Remsberg, et al., 1984a; Seiler and Fishman, 1981; (A); (BS); (CG); (GS); (L); (Sm); (WMO).

[N_2O] Jones and Pyle, 1984; Farmer, et al., 1980; Guthrie, et al., 1984; Louisnard, et al., 1983; Rinsland, et al., 1982a; Stordal, et al., 1985; (BS); (Sm); (WMO).

[CO] Solomon, et al., 1985; Bevilacqua, et al., 1985; Clancy, et al., 1982; Farmer, et al., 1980; Fishman, 1985; Lippens, et al., 1984; Louisnard, et al., 1983; Seiler and Fishman, 1981; Wattenbach, et al., 1984; (A), (BS); (CG); (L); (Sm); (WMO).

[CH_4]	Jones and Pyle, 1984; Farmer, et al., 1980; Louisnard, et al., 1983; Stordal, et al., 1985; (BS); (CG); (Sm); (WMO).
[O_2]	NASA, 1976., Allen, private communication; Philbrick, private communication; (A), (BS); (CG); (Sm); (WMO).
[NO]	Grossman, et al., 1985; Hameed and Stewart, 1983; Laurent, et al., 1985; Logan, 1983; Louisnard, et al., 1983; Philbrick, private communication; Rinsland, et al., 1984; (BS); (CG); (L); (Sm); (WMO).
[SO_2]	Chatfield and Crutzen, 1984; Turco, et al., 1979; (BS); (CG); (Sm); (WMO).
[NO_2]	Hameed and Stewart, 1983; Laurent, et al., 1985; Logan, 1983; Louisnard, et al., 1993; Naudet, et al., 1980; Russell, et al., 1984a; Russell, et al., 1984c; Solomon, et al., 1984; Weis, et al., 1984; (BS); (CG); (L); (Sm); (WMO).
[NH_3]	Arijs, et al., 1982; Farmer and Dawson, 1982; Oelhaf, et al., 1983; (BS); (Sm); (WMO).
[HNO_3]	Gille, et al., 1984; Girard and Louisnard, 1984; Goldman, et al., 1984; Logan, 1983; Weinreb, et al., 1984; (BS); (Sm); (WMO).
[OH]	Chatfield and Crutzen, 1984; Hameed and Stewart, 1983; Herman and McQuillan, 1985; Philbrick, private communication; Solomon, et al., 1982; (BS); (CG); (L); (Sm); (WMO).
[HF]	Farmer, et al., 1980; Mankin and Coffey, 1983; (BS); (Sm); (WMO).
[HCl]	Farmer, et al., 1980; Herman and McQuillan, 1985; Mankin and Coffey, 1983.
[HBr]	(BS); (Sm); (WMO).
[HI]	(BS); (Sm); (WMO).
[ClO]	Herman and McQuillan, 1985; Weinstock, et al., 1981; (BS); (Sm); (WMO).
[OCS]	Louisnard, et al., 1983; Turco, et al., 1979; (BS); (Sm); (WMO).
[H_2CO]	(BS); (Sm); (WMO).
[HOCl]	Herman and McQuillan, 1985; (BS); (Sm); (WMO).
[N_2]	(BS); (Sm); (WMO).
[HCN]	Rinsland, et al., 1982; Smith and Rinsland, 1985; (BS); (Sm); (WMO).
[CH_2Cl]	(CG), (L), (Sm), (WMO).
[H_2O_2]	Chatfield and Crutzen, 1984; (BS); (Sm); (WMO).
[C_2H_2]	Brewer, et al., 1983; Goldman, et al., 1981; Rasmussen, et al., 1983; (BS); (Sm); (WMO).
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