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# Atmospheric Transmission of Laser Radiation: Computer Code LASER

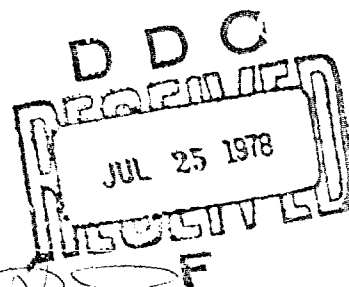
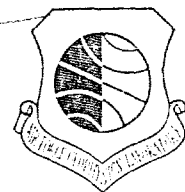
R. A. McCLATCHEY  
A. P. D'AGATI

31 Jan 1978

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HANSCOM AFB, MASSACHUSETTS 01731

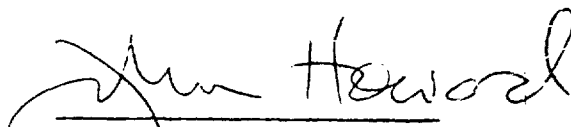
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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br>A computer code called LASER has been developed and documented and will be made available to interested users. LASER is a version of HITRAN which computes the monochromatic extinction coefficients for both molecular and particulate components of the atmosphere and provides results for a series of atmospheric models from sea level to 100 km in altitude. A detailed description of the calculations leading to these extinction coefficient charts is → next page |                       |                                                                                        |

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20. Abstract (Continued)

provided, and charts are provided for a number of specific laser frequencies in order to bring up to date previously published results. In addition, high spectral resolution atmospheric transmission spectra have been provided covering the regions of CO<sub>2</sub>, CO, and DF laser emission. These plotted spectra represent an up-to-date version of previously published material.

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## Atmospheric Transmission of Laser Radiation: Computer Code LASER

### 1. INTRODUCTION

Several years ago, the development of lasers as sources of coherent, monochromatic radiation led to the need for understanding the propagation characteristics of the atmosphere at high spectral resolution. Fortunately, a wealth of basic experimental and theoretical work existed in the scientific literature and was already in the process of being compiled to form a data base<sup>1</sup> essential to the development of atmospheric transmission models pertinent to laser propagation. This data compilation is essential to address the problem of molecular absorption by discrete absorption lines of atmospheric molecules. Absorption line widths of such atmospheric molecules are typically of the order of  $0.1 \text{ cm}^{-1}$  at one atmosphere pressure, and decrease with pressure. Thus, a computational spectral resolution of better than  $0.1 \text{ cm}^{-1}$  is required.

Although discrete absorption lines form the most highly frequency-dependent portion of the atmospheric extinction coefficient, it is necessary, in addition, to consider extinction due to scattering by the molecules composing the atmosphere and extinction due to both scattering and absorption by aerosols (particulates) in

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(Received for publication 31 January 1978)

1. McClatchey, R.A., Benedict, W.S., Clough, S.A. et al. (1974) AFCRL Atmospheric Absorption Line Parameters Compilation, AFCRL-TR-73-0096.

the atmosphere. These four extinction coefficients add to form the total extinction coefficient as indicated in Eq. (1)

$$\gamma = k_m + \sigma_m + k_a + \sigma_a \quad (1)$$

where  $k_m$ ,  $\sigma_m$ ,  $k_a$ ,  $\sigma_a$  are extinction coefficients due to molecular absorption, molecular scattering, aerosol absorption, and aerosol scattering, respectively. With the exception of molecular absorption, the remaining extinction mechanisms all result in rather slowly varying functions of frequency and so can be dealt with somewhat differently from the molecular absorption effects.

A series of reports<sup>2,3,4</sup> was published in an effort to provide the extinction coefficients expressed in Eq. (1) for a number of different atmospheric paths and for a large number of different laser emission lines. In addition to providing specific extinction coefficient information, high resolution spectra were published covering the entire spectral region from 0.76 to 31.25  $\mu\text{m}$ ,<sup>5</sup> using a version of the AFGL HITRAN computer code. This combination of extinction coefficients for specific atmospheric models and high resolution spectra has gone a long way to provide the systems analyst with some idea of the atmospheric extinction effects on any laser system in this spectral region.

However, there still appears to be a need for the user of this material to be able to consider laser frequencies other than those specific ones for which results were published and to consider alternative atmospheric models. The ability to interpolate within and to extrapolate beyond the published results is admittedly difficult and in some cases not very accurate. Therefore, we are using this report as a means of making available a computer code which can be used to generate extinction coefficients for the propagation of laser radiation through the atmosphere. As a result of modifications to all elements (except molecular scattering) of the extinction coefficients, we are providing a limited number of revised extinction charts for some of the same laser lines previously published. In view of the high interest in the propagation through the atmosphere of several laser systems, we are publishing revised high resolution spectra in the regions from 3.3 to 4.2  $\mu\text{m}$ , 4.6 to 5.3  $\mu\text{m}$ , and 7.1 to 13.5  $\mu\text{m}$ . We have made every effort to

2. McClatchey, R.A. (1970) Atmospheric Attenuation of CO Laser Radiation, AFCRL-71-0370, ERP 359.
3. McClatchey, R.A., and Selby, J.E.A. (1972a) Atmospheric Attenuation of HF and DF Laser Radiation, AFCRL-72-0312, ERP 400.
4. McClatchey, R.A., and Selby, J.E.A. (1972b) Atmospheric Transmittance, 7-30  $\mu\text{m}$ : Attenuation of CO<sub>2</sub> Laser Radiation, AFCRL-72-0611, ERP 419.
5. McClatchey, R.A., and Selby, J.E.A. (1974) Atmospheric Attenuation of Laser Radiation from 0.76 to 31.25  $\mu\text{m}$ , AFCRL-TR-74-0003, ERP 460.

simplify and document the computer code, LASER, contained in Appendix A. This code is a special version of our AFGL HITRAN code specifically applicable to monochromatic, laser extinction coefficient calculations.\*

## 2. MOLECULAR EXTINCTION

As indicated in the foregoing section, the process of molecular absorption by discrete absorption lines produces absorption coefficients that vary rapidly with frequency. In addition to this process, there are absorption processes that give rise to more smoothly varying absorption coefficients. Some examples are the "continuum" absorption by water vapor of particular significance in the atmospheric "windows" between 3 and 5  $\mu\text{m}$  and also between 8 and 14  $\mu\text{m}$ . We also have a slowly varying absorption caused by the nitrogen molecule ( $\text{N}_2$ ) between about 3 and 4  $\mu\text{m}$ . Let us indicate the form of the molecular scattering (Rayleigh) function used in our calculations, before considering these absorption effects. The extinction coefficient due to molecular scattering is given by Eq. (2) where  $p$  and  $T$  are the pressure (mb) and temperature (k) of the atmospheric path and  $\nu$  is the frequency in wavenumbers ( $\text{cm}^{-1}$ ).

$$\sigma_m = 9.807 \times 10^{-20} \left( \frac{273}{T} \right) \left( \frac{p}{1013} \right) \nu^{4.0117} \text{ (km}^{-1}\text{)} \quad (2)$$

This expression was obtained as a best fit to molecular scattering coefficients published by Penndorf<sup>6</sup> and is shown in Figure 1. In our model, it is necessary to integrate the density ( $p/T$ ) through the atmospheric layer in question in order to represent more accurately the changing density with height. Due to the small variations in molecular scattering for different atmospheric models, the LASER program provides results for only one of the six standard input model atmospheres (see Appendix B).

During the past seven years since our first publication of laser transmission models, there have been numerous improvements in the molecular data base which forms the foundation of these calculations. We cannot possibly specify each of these improvements, but we have tried to keep the scientific community posted

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\* A card deck for this computer program can be obtained by writing to the National Climatic Center, Federal Building, Asheville, N.C. 28301 for a charge of \$20.00. The AFGL Atmospheric Absorption Line Parameters data tape required as input data can also be obtained from the same address for a charge of \$60.00.

6. Penndorf, R. (1956) Luminous and Spectral Reflectance as Well as Colors of Natural Objects, Geophysical Research Paper No. 44, AFCRC-TR-56-203.

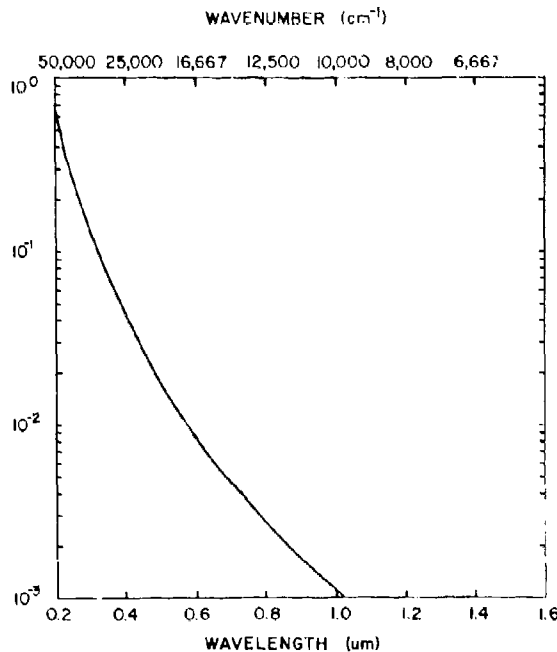


Figure 1. Molecular Scattering Coefficients at STP

through meetings and publications in the open literature.<sup>7,8</sup> The results of these improvements have been incorporated on the AFGL Atmospheric Absorption Line Parameters Compilation and made available through the National Climatic Center (see Section 1). Some substantial modifications to previous results arising from absorption line modifications have been made in the region between 3 and 4 micrometers as a result of improvements in HDO and methane line parameters. These improvements are reflected in some of the results included in this report.

There has been considerable controversy during the past two years regarding the water vapor "continuum" absorption, particularly in the 8 to 14-μm region, but also in the 3 to 5-μm region. As of this writing, existing laboratory measurements have been analyzed thoroughly; the resulting coefficients described here have been included in all results and in Appendix B where the LASER computer code is presented.

7. Rothman, L. S., and McClatchey, R. A. (1976) Updating of the AFCRL Atmospheric Absorption Line Parameters Compilation, Applied Opt. 15:2616.
8. Rothman, L. S. (1977) Atmospheric Optics, OSA Technical Group Meeting, Tucson, 19 October 1976, Applied Opt. 16(No. 2):277.

The absorption coefficient per precipital centimeter of water vapor is given in Eq. (3).

$$k_m \begin{matrix} (v, T) \\ \text{(Cont.)} \end{matrix} = C_s(v, T) P_s + C_N(v, T) P_N \quad (3)$$

where  $C_s(v, T)$  is a self-broadening coefficient due to collisions of water molecules with other water molecules;  $C_N(v, T)$  is a nitrogen broadening coefficient due to collisions of water molecules with air (primarily nitrogen) molecules;  $P_s$  is the partial pressure (in atmospheres) of water vapor, and  $P_N$  is the partial pressure of the remainder of the atmosphere (primarily nitrogen). It is necessary to establish the  $C_s$  and the  $C_N$  quantities and their frequency and temperature dependence in both the 8 to 14- and 3 to 5- $\mu$ m regions.

(i) The 8 to 14 micrometer continuum<sup>7,8</sup>

$$C_s(v, T) = C_s(v, 296) \exp \left( 1800 \left( \frac{1}{T} - \frac{1}{296} \right) \right)$$

where  $C_s(v, 296) = 4.18 + 5578 \exp(-7.87 \times 10^{-3} v)(\text{pr. cm})^{-1} \text{atm}^{-1}$  and  $C_N(v, T) = 0.002 \times C_s(v, 296)(\text{pr. cm})^{-1} \text{atm}^{-1}$ .

(ii) The 3.5-4.2 micrometer continuum<sup>8</sup>

$$C_s(v, T) = C_s(v, 296) \exp \left( 1350 \left( \frac{1}{T} - \frac{1}{296} \right) \right) (\text{pr. cm})^{-1} \text{atm}^{-1}$$

$$C_N(v, T) = 0.12 \times C_s(v, T)$$

where the  $C_s(v, 296)$  values are given in Table 1.

Table 1. Self-Broadening Absorption Coefficients for Water Vapor Continuum (3.3-4.2  $\mu$ m)

| $v$ ( $\text{cm}^{-1}$ ) | $(C_s(v, 296)(\text{pr. cm}^{-1})(\text{atm}^{-1}))$ | $v$  | $C_s(v, 296)(\text{pr. cm}^{-1})(\text{atm}^{-1})$ |
|--------------------------|------------------------------------------------------|------|----------------------------------------------------|
| 2350                     | 0.230                                                | 2700 | 0.120                                              |
| 2400                     | 0.187                                                | 2750 | 0.147                                              |
| 2450                     | 0.147                                                | 2800 | 0.174                                              |
| 2500                     | 0.117                                                | 2850 | 0.200                                              |
| 2550                     | 0.097                                                | 2900 | 0.240                                              |
| 2600                     | 0.087                                                | 2950 | 0.280                                              |
| 2650                     | 0.100                                                | 3000 | 0.330                                              |

Using these continuum functions and the atmospheric models described in Section 4, we have Figure 2 drawn to show the relative effects of the water vapor continuum at 4 and 10  $\mu\text{m}$ .

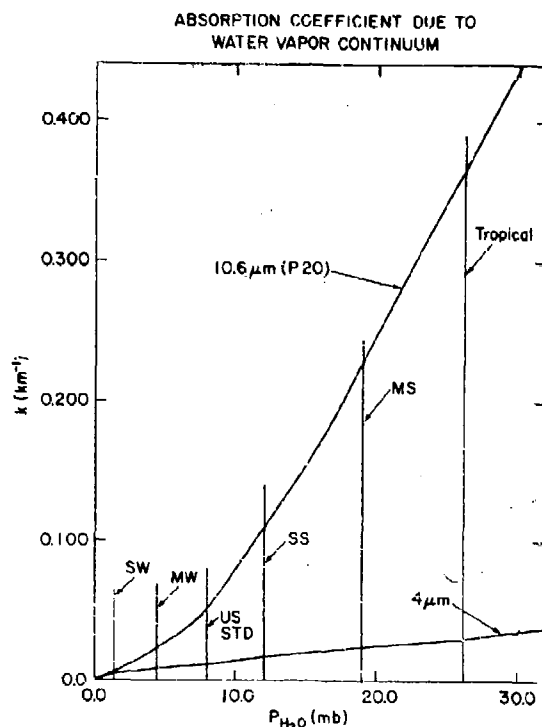


Figure 2. Absorption Coefficient Due to Water Vapor Continuum for Standard Meteorological models: MS = Midlatitude Summer; SS = Subarctic Summer; US STD = U.S. Standard Atmosphere, 1962; MW = Midlatitude Winter; SW = Subarctic Winter (see Table 5)

In addition to the more or less continuous absorption due to water vapor as described, there is another quasi-continuous absorption feature due to molecular absorption by the nitrogen molecule centered near 4.3  $\mu\text{m}$  ( $2350\text{ cm}^{-1}$ ). In the spectral region from  $2400\text{ cm}^{-1}$  to about  $2800\text{ cm}^{-1}$ , this absorption feature is of particular importance to laser transmission, as it tends to provide a background transmission level for paths in the lower atmosphere regardless of the presence or absence of absorption lines and regardless of how dry the atmosphere may be. It is of little importance at frequencies smaller than  $2400\text{ cm}^{-1}$  due to the overwhelming absorption by atmospheric carbon dioxide. Figure 3 represents the

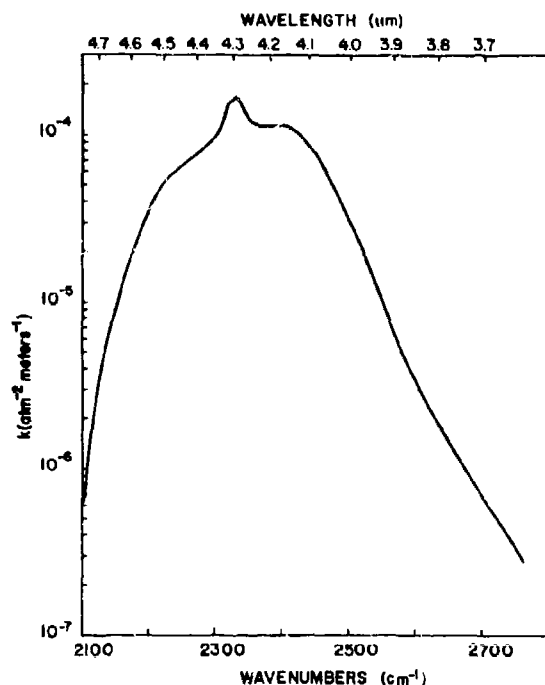


Figure 3. Absorption Coefficient Due to the Pressure-Induced Nitrogen Band at 4.3  $\mu\text{m}$

absorption coefficient as a function of frequency for this nitrogen absorption as contained in the LASER computer program in Appendix B.

In addition to these "continuum absorption" features, there is another issue accounting for much of the uncertainty due to molecular absorption in laser extinction computations. The problem is related to an accurate description of absorption line wings beyond 10 or 20  $\text{cm}^{-1}$  from absorption line centers. Indeed, in some cases uncertainties begin to arise within only a few wavenumbers of the centers of absorption lines. In our calculations and in the LASER program, we have truncated all line wings at 20  $\text{cm}^{-1}$  from line centers. In the lower atmosphere, all lines have been assumed to follow the Lorentz line profile, except that carbon dioxide lines have been modified by multiplication by the  $\chi$  factor given in Table 2. This factor arises from analysis of measurements made by Burch et al.<sup>9</sup> Measurements of Long et al.<sup>10</sup> and others provide evidence that water vapor lines should

9. Burch, D.E. (1970) Semiannual Technical Report, Investigation of the Absorption of Infrared Radiation by Atmospheric Gases, U-4784.

10. Long, R.K., Mills, F.S., and Trusty, G.L. (1973) Experimental Absorption Coefficients for Eleven CO Laser Lines, RADC-TR-73.

Table 2. The " $\chi$ " Factor Modification to the Lorentz Line Profile for CO<sub>2</sub> Lines

| $\nu - \nu_0$ | $\chi$ | $\nu - \nu_0$ | $\chi$ |
|---------------|--------|---------------|--------|
| 0             | 1.0    | 1.5           | 0.50   |
| 0.5           | 1.0    | 2.0           | 0.41   |
| 0.6           | 0.96   | 2.5           | 0.34   |
| 0.7           | 0.89   | 3.0           | 0.31   |
| 0.8           | 0.82   | 5.0           | 0.29   |
| 0.9           | 0.77   | 8.0           | 0.23   |
| 1.0           | 0.70   | 10.0          | 0.19   |
| 1.2           | 0.60   | 15.0          | 0.00   |

be represented by some "super-Lorentz" function, but as of the present, this remains one of the major unresolved problems of molecular spectroscopy. In any event, in regions where extinction coefficients are small, the contributions of line wings will be small and the empirically derived continua described here will dominate the molecular absorption between absorption lines. In spectral regions where line wings are more significant, the total extinction will be large, so the uncertainty in extinction coefficient will increase. However, in most cases, the existence of large extinction coefficients for atmospheric propagation will reduce the interest in developing systems operating at these wavelengths in the first place.

In the interest of developing a consistent set of AFGL Atmospheric Transmission Models, the continuum absorption for water vapor and nitrogen described in the preceding paragraphs is identical to the continuum models used in the most recent LOWTRAN model (LOWTRAN 3B).<sup>11</sup> This is possible in the case of the continuum absorption as it is fundamentally described by slowly varying (low resolution) functions.

### 3. AEROSOL EXTINCTION

Aerosols produce yet another rather continuous or slowly varying set of extinction coefficients throughout the visible and infrared spectral regions. Although there are some spectral features associated with aerosol extinction, this

11. Selby, J. E. A., Shettle, E. P. and McClatchey, R. A. (1976) Atmospheric Transmittance from 0.25 to 28.5  $\mu$ m: Supplement LOWTRAN 3B (1976), AFGL-TR-76-0258, ERP 587.

interaction of radiation with solid particles always generates smoother spectral features than those resulting from gaseous absorption.

Throughout most of the visible and near infrared, it is the scattering coefficient due to aerosols which is most significant. At longer wavelengths, absorption by aerosols contributes significantly to the total extinction as well.

In general, it is necessary to know (or measure) two different quantities in order to describe adequately the aerosol extinction in the atmosphere: We must know the complex index of refraction of the particles; and we must know the particle size distribution (that is, the number of particles within a given size range for all particle sizes that might affect the extinction of radiation of the wavelength in question). A knowledge of these two quantities is sufficient if the assumption of spherical particles is valid. We also must know these two quantities as a function of position along the atmospheric path in question. Even if we can assume horizontal homogeneity, we must define the vertical variation of these quantities for anything other than a horizontal path. Given this information and assuming spherical particles, we can apply Mie theory calculations to the aerosol models and aerosol scattering and absorption coefficients can be computed.

The difficulty is that we usually do not have the necessary aerosol measurements available for the atmospheric path in question. In fact, generally, we don't have any kind of statistical base of aerosol measurements available for a given site. So, we need to develop some reasonable models based on all available measurements and then learn when these might be valid for an arbitrary atmospheric path.

Efforts have been made to do just this and much of the experimental data and analysis leading to such models can be examined in two reports by Shettle and Fenn.<sup>12, 13</sup> A description of some of these models is also available in the LOWTRAN 3B report.

In the development of the LASER computer code, a subset of the aerosol models described in the three references has been used and will be described here. The extinction coefficients (scattering and absorption separately) used in the LASER program are given in Table 3 for each of the following models: Rural, Urban, Maritime, Tropospheric, Background Stratospheric, Aged Volcanic and Meteoric Dust. The first three of these models are intended to be strictly boundary layer models and may be applied only to the lowest 1 to 2 km. The third (Tropospheric) model may also be applied to the boundary layer under extremely clear continental conditions. The Background Stratospheric and Aged Volcanic provide a range of

12. Shettle, E.P., and Fenn, R.W. (1976) Models of the Atmospheric Aerosols and Their Optical Properties, AGARD Conference Proceedings No. 183, Optical Propagation in the Atmosphere, pp. 2.1-2.16.

13. Shettle, E.P., and Fenn, R.W. (1978) Models of the Atmospheric Aerosols and Their Optical Properties (to be published).

Table 3a. Attenuation Coefficients Resulting from Aerosol Extinction - Rural  
(Normalized to an Extinction Coefficient =  $1.00 \text{ km}^{-1}$  at a Wavelength =  $0.55 \mu\text{M}$ )

|        |           |           |           |
|--------|-----------|-----------|-----------|
| .200   | 2.419E+00 | 1.916E+00 | 5.829E-01 |
| .250   | 2.087E+00 | 1.856E+00 | 2.317E-01 |
| .300   | 1.806E+00 | 1.673E+00 | 1.335E-01 |
| .337   | 1.634E+00 | 1.537E+00 | 9.620E-02 |
| .400   | 1.394E+00 | 1.311E+00 | 8.337E-02 |
| .488   | 1.139E+00 | 1.068E+00 | 7.050E-02 |
| .515   | 1.076E+00 | 1.008E+00 | 6.748E-02 |
| .550   | 1.000E+00 | 9.387E-01 | 6.928E-02 |
| .633   | 8.516E-01 | 7.900E-01 | 6.159E-02 |
| .694   | 7.636E-01 | 7.023E-01 | 6.129E-02 |
| .860   | 5.792E-01 | 5.122E-01 | 6.694E-02 |
| 1.060  | 4.480E-01 | 3.802E-01 | 6.775E-02 |
| 1.300  | 3.322E-01 | 2.697E-01 | 6.247E-02 |
| 1.536  | 2.648E-01 | 2.057E-01 | 5.907E-02 |
| 1.800  | 1.978E-01 | 1.535E-01 | 4.432E-02 |
| 2.000  | 1.588E-01 | 1.312E-01 | 2.763E-02 |
| 2.250  | 1.429E-01 | 1.140E-01 | 2.894E-02 |
| 2.500  | 1.309E-01 | 1.016E-01 | 2.932E-02 |
| 2.700  | 1.439E-01 | 7.835E-02 | 6.559E-02 |
| 3.000  | 1.203E-01 | 8.330E-02 | 3.696E-02 |
| 3.200  | 1.139E-01 | 9.339E-02 | 2.046E-02 |
| 3.392  | 1.123E-01 | 9.251E-02 | 1.979E-02 |
| 3.500  | 1.118E-01 | 9.598E-02 | 1.583E-02 |
| 3.750  | 1.075E-01 | 9.394E-02 | 1.357E-02 |
| 4.000  | 1.047E-01 | 9.001E-02 | 1.465E-02 |
| 4.500  | 1.023E-01 | 8.011E-02 | 2.219E-02 |
| 5.000  | 9.705E-02 | 7.672E-02 | 2.033E-02 |
| 5.500  | 9.359E-02 | 6.904E-02 | 2.455E-02 |
| 6.000  | 8.791E-02 | 5.870E-02 | 2.921E-02 |
| 6.200  | 8.809E-02 | 5.696E-02 | 3.113E-02 |
| 6.500  | 8.842E-02 | 5.488E-02 | 3.354E-02 |
| 7.200  | 9.929E-02 | 5.216E-02 | 4.713E-02 |
| 7.900  | 6.978E-02 | 3.074E-02 | 3.904E-02 |
| 8.200  | 6.450E-02 | 1.340E-02 | 5.110E-02 |
| 8.500  | 1.126E-01 | 3.319E-02 | 7.937E-02 |
| 8.700  | 1.262E-01 | 5.497E-02 | 7.125E-02 |
| 9.000  | 1.237E-01 | 5.719E-02 | 7.649E-02 |
| 9.200  | 1.401E-01 | 5.289E-02 | 8.719E-02 |
| 9.500  | 1.184E-01 | 5.477E-02 | 6.358E-02 |
| 9.800  | 1.104E-01 | 5.774E-02 | 5.266E-02 |
| 10.000 | 1.085E-01 | 5.722E-02 | 5.123E-02 |
| 10.591 | 1.005E-01 | 5.749E-02 | 4.391E-02 |
| 11.000 | 9.579E-02 | 5.972E-02 | 3.607E-02 |
| 11.500 | 9.207E-02 | 5.823E-02 | 3.184E-02 |
| 12.500 | 8.539E-02 | 5.370E-02 | 3.269E-02 |
| 13.000 | 8.474E-02 | 5.164E-02 | 3.310E-02 |
| 14.000 | 8.140E-02 | 4.733E-02 | 3.407E-02 |
| 14.800 | 7.781E-02 | 3.926E-02 | 3.855E-02 |
| 15.000 | 8.654E-02 | 3.376E-02 | 5.278E-02 |
| 15.400 | 8.760E-02 | 4.353E-02 | 4.407E-02 |
| 17.200 | 9.369E-02 | 4.512E-02 | 4.857E-02 |
| 18.000 | 8.82E-02  | 4.495E-02 | 4.387E-02 |
| 18.500 | 8.562E-02 | 4.276E-02 | 4.286E-02 |
| 20.000 | 9.032E-02 | 4.175E-02 | 4.857E-02 |
| 21.300 | 8.747E-02 | 3.988E-02 | 4.959E-02 |
| 22.500 | 8.739E-02 | 3.683E-02 | 4.856E-02 |
| 25.000 | 8.242E-02 | 3.505E-02 | 4.737E-02 |
| 27.900 | 7.508E-02 | 3.099E-02 | 4.713E-02 |
| 30.000 | 7.624E-02 | 2.807E-02 | 4.817E-02 |
| 35.000 | 7.486E-02 | 2.601E-02 | 4.885E-02 |
| 40.000 | 7.283E-02 | 2.311E-02 | 4.972E-02 |

Table 3b. Attenuation Coefficients Resulting from Aerosol Extinction - Urban  
(Normalized to an Extinction Coefficient =  $1.00 \text{ km}^{-1}$  at a Wavelength =  $0.55 \mu\text{m}$ )

|        |           |           |           |
|--------|-----------|-----------|-----------|
| .200   | 1.64E+00  | 1.287E+00 | 6.767E-01 |
| .250   | 1.798E+00 | 1.251E+00 | 5.474E-01 |
| .300   | 1.633E+00 | 1.154E+00 | 4.792E-01 |
| .337   | 1.507E+00 | 1.065E+00 | 4.417E-01 |
| .400   | 1.321E+00 | 9.171E-01 | 4.036E-01 |
| .488   | 1.116E+00 | 7.567E-01 | 3.591E-01 |
| .515   | 1.065E+00 | 7.167E-01 | 3.482E-01 |
| .550   | 1.000E+00 | 6.657E-01 | 3.343E-01 |
| .633   | 8.732E-01 | 5.706E-01 | 3.027E-01 |
| .694   | 7.976E-01 | 5.110E-01 | 2.866E-01 |
| .860   | 6.374E-01 | 3.828E-01 | 2.545E-01 |
| 1.060  | 5.152E-01 | 2.896E-01 | 2.256E-01 |
| 1.300  | 4.095E-01 | 2.131E-01 | 1.964E-01 |
| 1.536  | 3.423E-01 | 1.670E-01 | 1.753E-01 |
| 1.800  | 2.826E-01 | 1.302E-01 | 1.524E-01 |
| 2.000  | 2.468E-01 | 1.129E-01 | 1.339E-01 |
| 2.250  | 2.224E-01 | 9.833E-02 | 1.240E-01 |
| 2.500  | 2.032E-01 | 8.758E-02 | 1.157E-01 |
| 2.700  | 2.016E-01 | 7.286E-02 | 1.288E-01 |
| 3.000  | 1.796E-01 | 7.209E-02 | 1.075E-01 |
| 3.200  | 1.692E-01 | 7.572E-02 | 9.346E-02 |
| 3.392  | 1.635E-01 | 7.383E-02 | 8.966E-02 |
| 3.500  | 1.611E-01 | 7.500E-02 | 8.610E-02 |
| 3.750  | 1.532E-01 | 7.256E-02 | 8.063E-02 |
| 4.000  | 1.468E-01 | 6.939E-02 | 7.739E-02 |
| 4.500  | 1.369E-01 | 6.220E-02 | 7.474E-02 |
| 5.000  | 1.272E-01 | 5.900E-02 | 6.824E-02 |
| 5.500  | 1.200E-01 | 5.386E-02 | 6.613E-02 |
| 6.000  | 1.124E-01 | 4.767E-02 | 6.472E-02 |
| 6.200  | 1.113E-01 | 4.634E-02 | 6.492E-02 |
| 6.500  | 1.089E-01 | 4.496E-02 | 6.393E-02 |
| 7.200  | 1.106E-01 | 4.271E-02 | 6.784E-02 |
| 7.900  | 9.148E-02 | 3.118E-02 | 6.030E-02 |
| 8.200  | 8.759E-02 | 2.199E-02 | 6.560E-02 |
| 8.500  | 1.112E-01 | 3.205E-02 | 7.916E-02 |
| 8.700  | 1.173E-01 | 4.318E-02 | 7.416E-02 |
| 9.000  | 1.202E-01 | 4.414E-02 | 7.610E-02 |
| 9.200  | 1.227E-01 | 4.181E-02 | 8.090E-02 |
| 9.500  | 1.106E-01 | 4.262E-02 | 6.802E-02 |
| 9.800  | 1.056E-01 | 4.400E-02 | 6.161E-02 |
| 10.000 | 1.040E-01 | 4.365E-02 | 6.037E-02 |
| 10.591 | 9.843E-02 | 4.350E-02 | 5.493E-02 |
| 11.000 | 9.488E-02 | 4.448E-02 | 5.040E-02 |
| 11.500 | 9.192E-02 | 4.350E-02 | 4.842E-02 |
| 12.500 | 8.687E-02 | 4.083E-02 | 4.604E-02 |
| 13.000 | 8.523E-02 | 3.961E-02 | 4.562E-02 |
| 14.000 | 8.189E-02 | 3.713E-02 | 4.476E-02 |
| 14.800 | 7.896E-02 | 3.275E-02 | 4.621E-02 |
| 15.000 | 8.321E-02 | 2.985E-02 | 5.336E-02 |
| 16.400 | 8.208E-02 | 3.457E-02 | 4.751E-02 |
| 17.200 | 8.435E-02 | 3.524E-02 | 4.911E-02 |
| 18.000 | 8.094E-02 | 3.499E-02 | 4.595E-02 |
| 18.500 | 7.881E-02 | 3.376E-02 | 4.505E-02 |
| 20.000 | 7.989E-02 | 3.298E-02 | 4.691E-02 |
| 21.300 | 7.846E-02 | 3.174E-02 | 4.672E-02 |
| 22.500 | 7.651E-02 | 3.099E-02 | 4.552E-02 |
| 25.000 | 7.235E-02 | 2.861E-02 | 4.374E-02 |
| 27.900 | 6.847E-02 | 2.601E-02 | 4.246E-02 |
| 30.000 | 6.648E-02 | 2.422E-02 | 4.226E-02 |
| 35.000 | 6.360E-02 | 2.248E-02 | 4.112E-02 |
| 40.000 | 6.065E-02 | 2.037E-02 | 4.028E-02 |

Table 3c. Attenuation Coefficients Resulting from Aerosol Extinction - Maritime  
(Normalized to an Extinction Coefficient =  $1.00 \text{ km}^{-1}$  at a Wavelength =  $0.55 \mu\text{m}$ )

|        |           |           |           |
|--------|-----------|-----------|-----------|
| .200   | 1.318E+00 | 1.188E+00 | 1.300E-01 |
| .250   | 1.235E+00 | 1.181E+00 | 5.471E-02 |
| .300   | 1.170E+00 | 1.142E+00 | 2.800E-02 |
| .337   | 1.134E+00 | 1.115E+00 | 1.858E-02 |
| .400   | 1.078E+00 | 1.063E+00 | 1.536E-02 |
| .488   | 1.026E+00 | 1.014E+00 | 1.271E-02 |
| .515   | 1.009E+00 | 9.975E-01 | 1.147E-02 |
| .550   | 1.000E+00 | 9.882E-01 | 1.179E-02 |
| .633   | 9.655E-01 | 9.556E-01 | 3.960E-03 |
| .694   | 9.454E-01 | 9.396E-01 | 9.790E-03 |
| .860   | 9.121E-01 | 9.013E-01 | 1.084E-02 |
| 1.060  | 8.803E-01 | 8.682E-01 | 1.210E-02 |
| 1.360  | 8.406E-01 | 8.288E-01 | 1.178E-02 |
| 1.536  | 8.071E-01 | 7.951E-01 | 1.207E-02 |
| 1.800  | 7.626E-01 | 7.534E-01 | 9.180E-03 |
| 2.000  | 7.297E-01 | 7.159E-01 | 1.380E-02 |
| 2.250  | 6.878E-01 | 6.772E-01 | 1.062E-02 |
| 2.500  | 6.305E-01 | 6.093E-01 | 2.125E-02 |
| 2.700  | 5.813E-01 | 4.399E-01 | 9.134E-02 |
| 3.000  | 6.599E-01 | 3.271E-01 | 3.328E-01 |
| 3.200  | 6.092E-01 | 4.594E-01 | 2.208E-01 |
| 3.392  | 6.471E-01 | 5.670E-01 | 8.004E-02 |
| 3.500  | 6.269E-01 | 5.849E-01 | 4.164E-02 |
| 3.750  | 5.817E-01 | 5.645E-01 | 1.718E-02 |
| 4.000  | 5.487E-01 | 5.289E-01 | 1.985E-02 |
| 4.500  | 4.945E-01 | 4.520E-01 | 4.247E-02 |
| 5.000  | 4.438E-01 | 4.072E-01 | 3.660E-02 |
| 5.500  | 3.752E-01 | 3.431E-01 | 3.207E-02 |
| 6.000  | 3.471E-01 | 1.984E-01 | 1.488E-01 |
| 6.200  | 4.334E-01 | 2.886E-01 | 1.448E-01 |
| 6.500  | 3.618E-01 | 2.879E-01 | 7.387E-02 |
| 7.200  | 3.011E-01 | 2.415E-01 | 5.965E-02 |
| 7.900  | 2.572E-01 | 1.988E-01 | 5.840E-02 |
| 8.200  | 2.506E-01 | 1.869E-01 | 6.368E-02 |
| 8.500  | 2.560E-01 | 1.848E-01 | 7.119E-02 |
| 8.700  | 2.701E-01 | 1.996E-01 | 7.851E-02 |
| 9.000  | 2.663E-01 | 1.955E-01 | 7.085E-02 |
| 9.200  | 2.507E-01 | 1.786E-01 | 7.218E-02 |
| 9.500  | 2.248E-01 | 1.609E-01 | 6.397E-02 |
| 9.800  | 2.061E-01 | 1.439E-01 | 6.222E-02 |
| 10.000 | 1.931E-01 | 1.307E-01 | 6.245E-02 |
| 10.591 | 1.634E-01 | 9.447E-02 | 6.893E-02 |
| 11.000 | 1.563E-01 | 7.216E-02 | 8.415E-02 |
| 11.500 | 1.618E-01 | 5.652E-02 | 1.052E-01 |
| 12.500 | 1.952E-01 | 4.523E-02 | 1.490E-01 |
| 13.000 | 2.114E-01 | 4.841E-02 | 1.629E-01 |
| 14.000 | 2.334E-01 | 5.448E-02 | 1.789E-01 |
| 14.800 | 2.412E-01 | 5.001E-02 | 1.832E-01 |
| 15.000 | 2.461E-01 | 5.950E-02 | 1.866E-01 |
| 16.400 | 2.545E-01 | 6.689E-02 | 1.876E-01 |
| 17.200 | 2.608E-01 | 7.504E-02 | 1.858E-01 |
| 18.000 | 2.556E-01 | 7.611E-02 | 1.795E-01 |
| 18.500 | 2.501E-01 | 7.484E-02 | 1.752E-01 |
| 20.000 | 2.309E-01 | 7.033E-02 | 1.606E-01 |
| 21.300 | 2.160E-01 | 6.514E-02 | 1.509E-01 |
| 22.500 | 2.045E-01 | 6.128E-02 | 1.433E-01 |
| 25.000 | 1.836E-01 | 5.367E-02 | 1.299E-01 |
| 27.900 | 1.659E-01 | 4.611E-02 | 1.198E-01 |
| 30.000 | 1.532E-01 | 4.085E-02 | 1.123E-01 |
| 35.000 | 1.419E-01 | 3.006E-02 | 1.119E-01 |
| 40.000 | 1.590E-01 | 2.533E-02 | 1.336E-01 |

Table 3d. Attenuation Coefficients Resulting from Aerosol Extinction—Tropospheric  
(Normalized to an Extinction Coefficient =  $1.00 \text{ km}^{-1}$  at a Wavelength =  $0.55 \mu\text{m}$ )

|        |           |           |           |
|--------|-----------|-----------|-----------|
| .200   | 2.545E+00 | 2.036E+00 | 5.090E-01 |
| .250   | 2.184E+00 | 1.966E+00 | 2.184E-01 |
| .300   | 1.878E+00 | 1.766E+00 | 1.119E-01 |
| .337   | 1.690E+00 | 1.616E+00 | 7.429E-02 |
| .400   | 1.429E+00 | 1.368E+00 | 6.144E-02 |
| .488   | 1.151E+00 | 1.102E+00 | 4.844E-02 |
| .515   | 1.082E+00 | 1.037E+00 | 4.589E-02 |
| .550   | 1.000E+00 | 9.528E-01 | 4.716E-02 |
| .633   | 8.381E-01 | 7.983E-01 | 3.985E-02 |
| .694   | 7.419E-01 | 7.028E-01 | 3.916E-02 |
| .860   | 5.403E-01 | 4.971E-01 | 4.326E-02 |
| 1.060  | 3.965E-01 | 3.532E-01 | 4.336E-02 |
| 1.300  | 2.693E-01 | 2.313E-01 | 3.796E-02 |
| 1.536  | 1.948E-01 | 1.603E-01 | 3.451E-02 |
| 1.800  | 1.210E-01 | 9.904E-02 | 2.200E-02 |
| 2.000  | 7.853E-02 | 6.761E-02 | 1.092E-02 |
| 2.250  | 6.151E-02 | 5.005E-02 | 1.146E-02 |
| 2.500  | 4.954E-02 | 3.797E-02 | 1.157E-02 |
| 2.700  | 6.541E-02 | 2.650E-02 | 3.891E-02 |
| 3.000  | 3.983E-02 | 2.394E-02 | 1.589E-02 |
| 3.200  | 3.927E-02 | 2.350E-02 | 6.770E-03 |
| 3.392  | 2.781E-02 | 2.133E-02 | 6.480E-03 |
| 3.500  | 2.657E-02 | 2.174E-02 | 4.830E-03 |
| 3.750  | 2.240E-02 | 1.838E-02 | 4.020E-03 |
| 4.000  | 1.998E-02 | 1.564E-02 | 4.340E-03 |
| 4.500  | 1.860E-02 | 1.159E-02 | 7.010E-03 |
| 5.000  | 1.472E-02 | 8.490E-03 | 6.230E-03 |
| 5.500  | 1.416E-02 | 6.110E-03 | 8.050E-03 |
| 6.000  | 1.481E-02 | 4.010E-03 | 1.080E-02 |
| 6.200  | 1.562E-02 | 3.930E-03 | 1.169E-02 |
| 6.500  | 1.559E-02 | 3.830E-03 | 1.276E-02 |
| 7.200  | 2.330E-02 | 2.940E-03 | 2.036E-02 |
| 7.900  | 1.956E-02 | 5.500E-04 | 1.801E-02 |
| 8.200  | 2.046E-02 | 1.700E-04 | 2.929E-02 |
| 8.500  | 4.168E-02 | 1.210E-03 | 4.847E-02 |
| 8.700  | 4.204E-02 | 7.850E-03 | 3.419E-02 |
| 9.000  | 4.597E-02 | 8.470E-03 | 3.750E-02 |
| 9.200  | 5.432E-02 | 6.200E-03 | 4.812E-02 |
| 9.500  | 3.184E-02 | 4.840E-03 | 2.700E-02 |
| 9.800  | 2.889E-02 | 4.230E-03 | 1.966E-02 |
| 10.000 | 2.270E-02 | 3.750E-03 | 1.895E-02 |
| 10.591 | 1.720E-02 | 2.750E-03 | 1.445E-02 |
| 11.000 | 1.343E-02 | 2.350E-03 | 1.102E-02 |
| 11.500 | 1.212E-02 | 1.850E-03 | 1.027E-02 |
| 12.500 | 1.119E-02 | 1.220E-03 | 9.970E-03 |
| 13.000 | 1.140E-02 | 1.040E-03 | 1.036E-02 |
| 14.000 | 1.151E-02 | 7.500E-04 | 1.076E-02 |
| 14.800 | 1.438E-02 | 4.900E-04 | 1.389E-02 |
| 15.000 | 2.420E-02 | 4.600E-04 | 2.374E-02 |
| 16.400 | 1.556E-02 | 6.800E-04 | 1.488E-02 |
| 17.200 | 1.670E-02 | 9.200E-04 | 1.578E-02 |
| 18.000 | 1.396E-02 | 7.200E-04 | 1.324E-02 |
| 18.500 | 1.401E-02 | 5.600E-04 | 1.345E-02 |
| 20.000 | 1.591E-02 | 6.100E-04 | 1.530E-02 |
| 21.300 | 1.565E-02 | 4.900E-04 | 1.616E-02 |
| 22.500 | 1.593E-02 | 4.000E-04 | 1.553E-02 |
| 25.000 | 1.581E-02 | 2.600E-04 | 1.555E-02 |
| 27.900 | 1.625E-02 | 1.700E-04 | 1.608E-02 |
| 30.000 | 1.744E-02 | 1.200E-04 | 1.732E-02 |
| 35.000 | 1.739E-02 | 9.000E-05 | 1.730E-02 |
| 40.000 | 1.13E-02  | 6.000E-05 | 1.907E-02 |

Table 3e. Attenuation Coefficients Resulting from Aerosol Extinction - Background Stratospheric (Normalized to an Extinction Coefficient =  $1.00 \text{ km}^{-1}$  at a Wavelength =  $0.55 \text{ } \mu\text{m}$ )

|        |           |           |           |
|--------|-----------|-----------|-----------|
| .200   | 1.487E+00 | 1.487E+00 | 0.        |
| .250   | 1.553E+00 | 1.553E+00 | 0.        |
| .300   | 1.555E+00 | 1.555E+00 | 0.        |
| .337   | 1.515E+00 | 1.515E+00 | 0.        |
| .400   | 1.376E+00 | 1.376E+00 | 0.        |
| .488   | 1.150E+00 | 1.150E+00 | 0.        |
| .515   | 1.087E+00 | 1.087E+00 | 0.        |
| .550   | 1.000E+00 | 1.000E+00 | 0.        |
| .633   | 8.224E-01 | 8.224E-01 | 0.        |
| .694   | 7.063E-01 | 7.063E-01 | 0.        |
| .860   | 4.685E-01 | 4.685E-01 | 0.        |
| 1.060  | 2.886E-01 | 2.886E-01 | 0.        |
| 1.300  | 1.642E-01 | 1.642E-01 | 2.000E-05 |
| 1.536  | 9.992E-02 | 9.972E-02 | 2.000E-04 |
| 1.800  | 5.881E-02 | 5.817E-02 | 6.400E-04 |
| 2.000  | 4.183E-02 | 4.055E-02 | 1.280E-03 |
| 2.250  | 2.727E-02 | 2.570E-02 | 1.570E-03 |
| 2.500  | 1.849E-02 | 1.560E-02 | 2.890E-03 |
| 2.700  | 1.334E-02 | 9.310E-03 | 4.030E-03 |
| 3.000  | 6.510E-02 | 6.320E-03 | 5.878E-02 |
| 3.200  | 8.271E-02 | 6.000E-03 | 7.671E-02 |
| 3.392  | 8.227E-02 | 6.270E-03 | 8.300E-02 |
| 3.500  | 8.540E-02 | 6.230E-03 | 7.917E-02 |
| 3.750  | 6.525E-02 | 5.100E-03 | 6.019E-02 |
| 4.000  | 5.794E-02 | 4.030E-03 | 5.391E-02 |
| 4.500  | 4.764E-02 | 2.420E-03 | 4.522E-02 |
| 5.000  | 4.277E-02 | 1.450E-03 | 4.132E-02 |
| 5.500  | 5.807E-02 | 1.030E-03 | 5.704E-02 |
| 6.000  | 5.368E-02 | 1.050E-03 | 5.263E-02 |
| 6.200  | 4.392E-02 | 8.800E-04 | 4.304E-02 |
| 6.500  | 3.338E-02 | 5.500E-04 | 3.283E-02 |
| 7.200  | 4.456E-02 | 1.900E-04 | 4.437E-02 |
| 7.900  | 1.187E-01 | 5.000E-04 | 1.182E-01 |
| 8.200  | 1.471E-01 | 7.700E-04 | 1.463E-01 |
| 8.500  | 1.457E-01 | 9.500E-04 | 1.448E-01 |
| 8.700  | 1.274E-01 | 9.600E-04 | 1.264E-01 |
| 9.000  | 9.289E-02 | 7.260E-04 | 9.217E-02 |
| 9.200  | 8.780E-02 | 5.800E-04 | 8.722E-02 |
| 9.500  | 1.006E-01 | 7.100E-04 | 9.987E-02 |
| 9.800  | 7.323E-02 | 6.700E-04 | 7.256E-02 |
| 10.000 | 5.020E-02 | 4.900E-04 | 4.971E-02 |
| 10.591 | 4.068E-02 | 2.700E-04 | 4.041E-02 |
| 11.000 | 5.736E-02 | 2.600E-04 | 5.710E-02 |
| 11.500 | 3.575E-02 | 2.600E-04 | 3.549E-02 |
| 12.500 | 1.975E-02 | 1.300E-04 | 1.962E-02 |
| 13.000 | 1.940E-02 | 1.000E-04 | 1.930E-02 |
| 14.000 | 1.867E-02 | 7.000E-05 | 1.860E-02 |
| 14.800 | 1.795E-02 | 5.000E-05 | 1.890E-02 |
| 15.000 | 1.953E-02 | 5.000E-05 | 1.948E-02 |
| 16.400 | 3.665E-02 | 4.000E-05 | 3.661E-02 |
| 17.200 | 4.152E-02 | 5.000E-05 | 4.147E-02 |
| 18.000 | 2.326E-02 | 5.000E-05 | 2.321E-02 |
| 18.500 | 1.714E-02 | 4.000E-05 | 1.710E-02 |
| 20.000 | 1.345E-02 | 2.000E-05 | 1.343E-02 |
| 21.300 | 1.519E-02 | 2.000E-05 | 1.617E-02 |
| 22.500 | 1.532E-02 | 2.000E-05 | 1.530E-02 |
| 25.000 | 8.370E-03 | 1.000E-05 | 8.360E-03 |
| 27.900 | 6.810E-03 | 1.000E-05 | 6.800E-03 |
| 30.000 | 6.330E-03 | 1.000E-05 | 6.320E-03 |
| 35.000 | 5.800E-03 | 0.        | 5.800E-03 |
| 40.000 | 5.920E-03 | 0.        | 5.920E-03 |

Table 3f. Attenuation Coefficients Resulting from Aerosol Extinction - Aged Volcanic (Normalized to an Extinction Coefficient =  $1.00 \text{ km}^{-1}$  at a Wavelength =  $0.55 \mu\text{m}$ )

|        |           |           |           |
|--------|-----------|-----------|-----------|
| .200   | 1.149F+00 | 7.006E-01 | 4.482E-01 |
| .250   | 1.183E+00 | 9.009E-01 | 2.818E-01 |
| .300   | 1.192F+00 | 1.079E+00 | 1.126E-01 |
| .337   | 1.180E+00 | 1.095E+00 | 6.497E-02 |
| .400   | 1.140F+00 | 1.068E+00 | 7.244E-02 |
| .480   | 1.063F+00 | 1.003E+00 | 5.962E-02 |
| .515   | 1.036E+00 | 9.799E-01 | 5.651E-02 |
| .550   | 1.000F+00 | 9.473E-01 | 5.271E-02 |
| .633   | 9.129E-01 | 8.676E-01 | 4.532E-02 |
| .694   | 8.487E-01 | 8.079E-01 | 4.084E-02 |
| .860   | 6.987E-01 | 6.570E-01 | 3.178E-02 |
| 1.060  | 5.302E-01 | 5.057E-01 | 2.452E-02 |
| 1.300  | 3.881E-01 | 3.693E-01 | 1.881E-02 |
| 1.536  | 2.797E-01 | 2.640E-01 | 1.490E-02 |
| 1.800  | 1.968E-01 | 1.849E-01 | 1.191E-02 |
| 2.000  | 1.456E-01 | 1.353E-01 | 1.019E-02 |
| 2.250  | 1.107E-01 | 1.021E-01 | 8.670E-03 |
| 2.500  | 8.635E-02 | 7.792E-02 | 8.430E-03 |
| 2.700  | 7.185E-02 | 6.343E-02 | 8.420E-03 |
| 3.000  | 6.075E-02 | 5.126E-02 | 9.490E-03 |
| 3.200  | 5.198E-02 | 4.262E-02 | 9.360E-03 |
| 3.392  | 4.504E-02 | 3.761E-02 | 7.430E-03 |
| 3.500  | 4.089E-02 | 3.435E-02 | 6.540E-03 |
| 3.750  | 3.401E-02 | 2.913E-02 | 4.880E-03 |
| 4.000  | 2.743E-02 | 2.394E-02 | 3.490E-03 |
| 4.500  | 2.094E-02 | 1.775E-02 | 3.190E-03 |
| 5.000  | 1.539E-02 | 1.204E-02 | 3.350E-03 |
| 5.500  | 1.265E-02 | 8.690E-03 | 3.960E-03 |
| 6.000  | 1.021E-02 | 5.700E-03 | 4.510E-03 |
| 6.200  | 9.920E-03 | 4.670E-03 | 5.250E-03 |
| 6.500  | 1.043E-02 | 3.780E-03 | 6.650E-03 |
| 7.200  | 1.362E-02 | 2.500E-03 | 1.112E-02 |
| 7.900  | 1.788E-02 | 1.360E-03 | 1.652E-02 |
| 8.200  | 2.279E-02 | 9.900E-04 | 2.180E-02 |
| 8.500  | 2.475E-02 | 2.570E-03 | 2.218E-02 |
| 8.700  | 2.919E-02 | 4.810E-03 | 2.438E-02 |
| 9.000  | 3.108E-02 | 6.020E-03 | 2.506E-02 |
| 9.200  | 3.231E-02 | 5.730E-03 | 2.658E-02 |
| 9.500  | 3.389E-02 | 5.180E-03 | 2.871E-02 |
| 9.800  | 3.454E-02 | 4.750E-03 | 2.979E-02 |
| 10.000 | 3.458E-02 | 4.490E-03 | 3.009E-02 |
| 10.591 | 3.181E-02 | 3.220E-03 | 2.859E-02 |
| 11.000 | 2.771E-02 | 2.600E-03 | 2.511E-02 |
| 11.500 | 2.473E-02 | 1.910E-03 | 2.282E-02 |
| 12.500 | 1.713E-02 | 9.000E-04 | 1.623E-02 |
| 13.000 | 1.601E-02 | 7.100E-04 | 1.530E-02 |
| 14.000 | 1.493E-02 | 4.600E-04 | 1.447E-02 |
| 14.860 | 1.565E-02 | 3.300E-04 | 1.532E-02 |
| 15.000 | 1.667E-02 | 3.200E-04 | 1.635E-02 |
| 16.400 | 1.648E-02 | 2.800E-04 | 1.620E-02 |
| 17.200 | 1.735E-02 | 2.900E-04 | 1.706E-02 |
| 18.000 | 1.857E-02 | 3.100E-04 | 1.826E-02 |
| 18.500 | 1.772E-02 | 3.100E-04 | 1.741E-02 |
| 20.000 | 1.416E-02 | 2.600E-04 | 1.390E-02 |
| 21.300 | 1.077E-02 | 2.300E-04 | 1.054E-02 |
| 22.500 | 1.124E-02 | 2.000E-04 | 1.104E-02 |
| 25.000 | 1.052E-02 | 1.400E-04 | 1.038E-02 |
| 27.900 | 1.080E-02 | 8.000E-05 | 1.072E-02 |
| 30.000 | 1.130E-02 | 6.000E-05 | 1.124E-02 |
| 35.000 | 1.195E-02 | 3.000E-05 | 1.192E-02 |
| 40.000 | 1.330E-02 | 2.000E-05 | 1.328E-02 |

Table 3g. Attenuation Coefficients Resulting from Aerosol Extinction - Meteoric Dust (Normalized to an Extinction Coefficient =  $1.00 \text{ km}^{-1}$  at a Wavelength =  $0.55 \mu\text{m}$ )

|        |           |           |           |
|--------|-----------|-----------|-----------|
| .200   | 1.050E+00 | 1.050E+00 | 6.300E-04 |
| .250   | 1.058E+00 | 1.057E+00 | 9.900E-04 |
| .300   | 1.059E+00 | 1.057E+00 | 1.570E-03 |
| .337   | 1.053E+00 | 1.051E+00 | 1.810E-03 |
| .400   | 1.043E+00 | 1.041E+00 | 2.600E-03 |
| .488   | 1.020E+00 | 1.016E+00 | 3.870E-03 |
| .515   | 1.012E+00 | 1.007E+00 | 4.310E-03 |
| .550   | 1.000E+00 | 9.949E-01 | 5.060E-03 |
| .633   | 9.723E-01 | 9.657E-01 | 6.640E-03 |
| .694   | 9.495E-01 | 9.416E-01 | 7.930E-03 |
| .860   | 8.877E-01 | 8.756E-01 | 1.212E-02 |
| 1.060  | 8.146E-01 | 7.963E-01 | 1.827E-02 |
| 1.300  | 7.329E-01 | 7.057E-01 | 2.716E-02 |
| 1.536  | 6.605E-01 | 6.233E-01 | 3.725E-02 |
| 1.800  | 5.889E-01 | 5.390E-01 | 4.998E-02 |
| 2.000  | 5.438E-01 | 4.822E-01 | 6.161E-02 |
| 2.250  | 4.914E-01 | 4.160E-01 | 7.539E-02 |
| 2.500  | 4.468E-01 | 3.574E-01 | 8.943E-02 |
| 2.700  | 4.167E-01 | 3.162E-01 | 1.005E-01 |
| 3.000  | 3.806E-01 | 2.645E-01 | 1.161E-01 |
| 3.200  | 3.621E-01 | 2.367E-01 | 1.254E-01 |
| 3.392  | 3.478E-01 | 2.147E-01 | 1.331E-01 |
| 3.500  | 3.410E-01 | 2.042E-01 | 1.368E-01 |
| 3.750  | 3.280E-01 | 1.845E-01 | 1.435E-01 |
| 4.000  | 3.172E-01 | 1.700E-01 | 1.472E-01 |
| 4.500  | 2.972E-01 | 1.509E-01 | 1.463E-01 |
| 5.000  | 2.751E-01 | 1.378E-01 | 1.373E-01 |
| 5.500  | 2.508E-01 | 1.262E-01 | 1.246E-01 |
| 6.000  | 2.262E-01 | 1.144E-01 | 1.118E-01 |
| 6.200  | 2.166E-01 | 1.094E-01 | 1.071E-01 |
| 6.500  | 2.025E-01 | 1.018E-01 | 1.008E-01 |
| 7.200  | 1.727E-01 | 8.264E-02 | 9.004E-02 |
| 7.900  | 1.491E-01 | 6.170E-02 | 8.737E-02 |
| 8.200  | 1.424E-01 | 5.237E-02 | 8.999E-02 |
| 8.500  | 1.394E-01 | 4.326E-02 | 9.618E-02 |
| 8.700  | 1.408E-01 | 3.775E-02 | 1.031E-01 |
| 9.000  | 1.506E-01 | 3.151E-02 | 1.191E-01 |
| 9.200  | 1.640E-01 | 2.962E-02 | 1.344E-01 |
| 9.500  | 1.944E-01 | 3.129E-02 | 1.631E-01 |
| 9.800  | 2.252E-01 | 3.697E-02 | 1.882E-01 |
| 10.000 | 2.361E-01 | 4.059E-02 | 1.955E-01 |
| 10.591 | 2.448E-01 | 4.385E-02 | 2.010E-01 |
| 11.000 | 2.779E-01 | 5.296E-02 | 2.250E-01 |
| 11.500 | 2.507E-01 | 6.657E-02 | 1.842E-01 |
| 12.500 | 1.527E-01 | 5.990E-02 | 9.282E-02 |
| 13.000 | 1.316E-01 | 5.084E-02 | 8.076E-02 |
| 14.000 | 1.144E-01 | 3.968E-02 | 7.476E-02 |
| 14.800 | 9.603E-02 | 2.937E-02 | 6.666E-02 |
| 15.000 | 9.456E-02 | 2.633E-02 | 6.823E-02 |
| 16.400 | 1.458E-01 | 2.245E-02 | 1.233E-01 |
| 17.200 | 1.237E-01 | 1.822E-02 | 1.055E-01 |
| 18.000 | 1.560E-01 | 1.767E-02 | 1.383E-01 |
| 18.500 | 1.835E-01 | 2.167E-02 | 1.618E-01 |
| 20.000 | 1.684E-01 | 2.886E-02 | 1.315E-01 |
| 21.300 | 1.219E-01 | 2.356E-02 | 9.836E-02 |
| 22.500 | 1.227E-01 | 1.847E-02 | 1.043E-01 |
| 25.000 | 1.292E-01 | 2.339E-02 | 1.058E-01 |
| 27.900 | 9.600E-02 | 1.851E-02 | 7.749E-02 |
| 30.000 | 8.541E-02 | 1.783E-02 | 6.758E-02 |
| 35.000 | 5.055E-02 | 1.360E-02 | 3.695E-02 |
| 40.000 | 4.109E-02 | 8.640E-03 | 3.245E-02 |

extinction for the stratosphere. Currently, conditions are similar to the Background Stratospheric, although the eruption of new major volcanos could change this. The volcanic stratospheric model should be used to represent the stratosphere during the late 1960's and early 1970's. The meteoric dust model is intended to be used only above 30 km.

The question of when to apply the three boundary layer models remains somewhat ambiguous and requires some judgment. Some rules-of-thumb follow: (1) Relatively clear, continental air having a trajectory from relatively unpolluted land areas should usually be represented by the Rural model. (2) The Urban model should be used not only in urban areas under rather stagnant, stable weather conditions, but may also be used in regions where the trajectory of the prevailing air mass indicates an urban origin. (3) The Maritime model should be used not only over the oceans, but also over land areas where the trajectory is obviously maritime.

The LASER program has been set up using the Rural model in the lowest 2 km, but results for a sea-level path are also provided for any input laser wavelength for the Urban, Maritime, and Tropospheric models.

Table 4 has been constructed based on extinction coefficient and number density measurements of aerosols as a function of altitude. This table constitutes a series of scaling factors which, when multiplied by the scattering and absorption coefficients of Table 3, give the scattering and absorption coefficients as a function of altitude. The work of Shettle and Fenn<sup>12, 13</sup> provide many more models than could be accommodated in the LASER code, so here we have limited these to a "Clear" and a "Hazy" model which at sea level relates to a meteorological range of 50 km and 5 km, respectively. Aside from the options available for the boundary layer, the LASER program divides the atmosphere in the vertical into four general regions and uses the extinction coefficients in the "Clear" and "Hazy" atmospheric aerosol models as indicated in Table 4. If the extinction coefficient for other than 50- or 5-km meteorological range is required, a linear interpolation will provide a reasonable estimate.

Table 4. Scaling Factors Representing Vertical Distributions of Aerosol Extinction

| Height | Clear    | Hazy     |                                                                                                                        |
|--------|----------|----------|------------------------------------------------------------------------------------------------------------------------|
| 0.0    | 6.95E-2  | 7.57E-1  | Uses Rural Extinction Coefficients                                                                                     |
| 1.0    | 2.58E-2  | 7.57E-1  |                                                                                                                        |
| 2.0    | 9.70E-3  | 6.21E-2  |                                                                                                                        |
| 3.0    | 8.19E-3  | 3.46E-2  |                                                                                                                        |
| 4.0    | 6.43E-3  | 1.85E-2  |                                                                                                                        |
| 5.0    | 4.85E-3  | 9.30E-3  | Uses Tropospheric Extinction Coefficients                                                                              |
| 6.0    | 3.54E-3  | 7.71E-3  |                                                                                                                        |
| 7.0    | 2.30E-3  | 6.22E-3  |                                                                                                                        |
| 8.0    | 1.41E-3  | 3.36E-3  |                                                                                                                        |
| 9.0    | 9.80E-4  | 1.81E-3  |                                                                                                                        |
| 10.0   | 7.87E-4  | 1.85E-3  |                                                                                                                        |
| 11.0   | 7.14E-4  | 2.11E-3  |                                                                                                                        |
| 12.0   | 6.63E-4  | 2.45E-3  |                                                                                                                        |
| 13.0   | 6.22E-4  | 2.80E-3  |                                                                                                                        |
| 14.0   | 6.45E-4  | 2.89E-3  | Uses Background Stratospheric Extinction Coefficients for "CLEAR" and Aged Volcanic Extinction Coefficients for "HAZY" |
| 15.0   | 6.43E-4  | 2.92E-3  |                                                                                                                        |
| 16.0   | 6.41E-4  | 2.74E-3  |                                                                                                                        |
| 17.0   | 6.01E-4  | 2.46E-3  |                                                                                                                        |
| 18.0   | 5.63E-4  | 2.10E-3  |                                                                                                                        |
| 19.0   | 4.92E-4  | 1.71E-3  |                                                                                                                        |
| 20.0   | 4.23E-4  | 1.35E-3  |                                                                                                                        |
| 21.0   | 3.52E-4  | 1.09E-3  |                                                                                                                        |
| 22.0   | 2.96E-4  | 8.60E-4  |                                                                                                                        |
| 23.0   | 2.42E-4  | 6.60E-4  |                                                                                                                        |
| 24.0   | 1.90E-4  | 5.15E-4  |                                                                                                                        |
| 25.0   | 1.50E-4  | 4.10E-4  |                                                                                                                        |
| 30.0   | 3.32E-5  | 7.60E-5  |                                                                                                                        |
| 35.0   | 1.65E-5  | 2.45E-5  |                                                                                                                        |
| 40.0   | 8.00E-6  | 8.00E-6  |                                                                                                                        |
| 45.0   | 4.02E-6  | 4.02E-6  | Uses Meteoric Dust Extinction Coefficients                                                                             |
| 50.0   | 2.10E-6  | 2.10E-6  |                                                                                                                        |
| 70.0   | 1.60E-7  | 1.60E-7  |                                                                                                                        |
| 100.0  | 9.30E-10 | 9.30E-10 |                                                                                                                        |

#### 4. ATMOSPHERIC MODELS

The atmospheric models used in the LASER computer code have been described by McClatchey et al<sup>14</sup> and the six standard models of temperature, pressure, water vapor and ozone distributions as a function of height are included here in Table 6. A number of additional gases of importance to the computation of molecular absorption have been assumed to be uniformly mixed by volume in the atmosphere at the concentrations given in Table 5. If the user of the LASER computer code is interested in performing an extinction coefficient calculation for an atmospheric model differing from the six models provided as input, he may simply substitute an alternative set of input data for any one of the models, being careful to use the same units for all quantities. The aerosol models have been described in Section 3 and the reader is referred to References 12 and 13 for a more thorough discussion.

Table 5. Concentrations of Uniformly Mixed Gases

| Constituent      | Concentration (ppm V) |
|------------------|-----------------------|
| CO <sub>2</sub>  | 330                   |
| N <sub>2</sub> O | 0.28                  |
| CO               | 0.075                 |
| CH <sub>4</sub>  | 1.6                   |
| O <sub>2</sub>   | $2.095 \times 10^5$   |
| N <sub>2</sub>   | $7.808 \times 10^5$   |

14. McClatchey, R.A., Fenn, R.W., Selby, J.E.A., Volz, F.E., and Garing, J.S. (1972) Optical Properties of the Atmosphere (Third Edition), AFCRL-72-0497, ERF No. 411.

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties

| TROPICAL    |                  |               |                                |                                    |                              |
|-------------|------------------|---------------|--------------------------------|------------------------------------|------------------------------|
| Ht.<br>(km) | Pressure<br>(mb) | Temp.<br>(°K) | Density<br>(g/m <sup>3</sup> ) | Water Vapor<br>(g/m <sup>3</sup> ) | Ozone<br>(g/m <sup>3</sup> ) |
| 0           | 1.013E+03        | 300.0         | 1.167E+03                      | 1.9E+01                            | 5.6E-05                      |
| 1           | 9.040E+02        | 294.0         | 1.064E+03                      | 1.3E+01                            | 5.6E-05                      |
| 2           | 8.050E+02        | 288.0         | 9.689E+02                      | 9.3E+00                            | 5.4E-05                      |
| 3           | 7.150E+02        | 284.0         | 8.756E+02                      | 4.7E+00                            | 5.1E-05                      |
| 4           | 6.330E+02        | 277.0         | 7.951E+02                      | 2.2E+00                            | 4.7E-05                      |
| 5           | 5.590E+02        | 270.0         | 7.199E+02                      | 1.5E+00                            | 4.5E-05                      |
| 6           | 4.920E+02        | 264.0         | 6.501E+02                      | 8.5E-01                            | 4.3E-05                      |
| 7           | 4.32E+02         | 257.0         | 5.855E+02                      | 4.7E-01                            | 4.1E-05                      |
| 8           | 3.7E+02          | 250.0         | 5.258E+02                      | 2.5E-01                            | 3.9E-05                      |
| 9           | 3.28E+02         | 244.0         | 4.708E+02                      | 1.2E-01                            | 3.9E-05                      |
| 10          | 2.860E+02        | 237.0         | 4.202E+02                      | 5.0E-02                            | 3.9E-05                      |
| 11          | 2.470E+02        | 230.0         | 3.740E+02                      | 1.7E-02                            | 4.1E-05                      |
| 12          | 2.130E+02        | 224.0         | 3.316E+02                      | 6.0E-03                            | 4.3E-05                      |
| 13          | 1.820E+02        | 217.0         | 2.929E+02                      | 1.8E-03                            | 4.5E-05                      |
| 14          | 1.560E+02        | 210.0         | 2.578E+02                      | 1.0E-03                            | 4.5E-05                      |
| 15          | 1.320E+02        | 204.0         | 2.260E+02                      | 7.6E-04                            | 4.7E-05                      |
| 16          | 1.110E+02        | 197.0         | 1.972E+02                      | 6.4E-04                            | 4.7E-05                      |
| 17          | 9.370E+01        | 195.0         | 1.676E+02                      | 5.6E-04                            | 6.9E-05                      |
| 18          | 7.890E+01        | 199.0         | 1.382E+02                      | 5.0E-04                            | 9.0E-05                      |
| 19          | 6.660E+01        | 203.0         | 1.145E+02                      | 4.9E-04                            | 1.4E-04                      |
| 20          | 5.650E+01        | 207.0         | 9.515E+01                      | 4.5E-04                            | 1.9E-04                      |
| 21          | 4.800E+01        | 211.0         | 7.938E+01                      | 5.1E-04                            | 2.4E-04                      |
| 22          | 4.090E+01        | 215.0         | 6.645E+01                      | 5.1E-04                            | 2.8E-04                      |
| 23          | 3.500E+01        | 217.0         | 5.618E+01                      | 5.4E-04                            | 3.2E-04                      |
| 24          | 3.000E+01        | 219.0         | 4.763E+01                      | 6.0E-04                            | 3.4E-04                      |
| 25          | 2.570E+01        | 221.0         | 4.045E+01                      | 6.7E-04                            | 3.4E-04                      |
| 30          | 1.220E+01        | 232.0         | 1.831E+01                      | 3.6E-04                            | 2.4E-04                      |
| 35          | 6.000E+00        | 243.0         | 8.600E+00                      | 1.1E-04                            | 9.2E-05                      |
| 40          | 3.050E+00        | 254.0         | 4.181E+00                      | 4.3E-05                            | 4.1E-05                      |
| 45          | 1.590E+00        | 265.0         | 2.097E+00                      | 1.9E-05                            | 1.3E-05                      |
| 50          | 8.540E-01        | 270.0         | 1.101E+00                      | 6.3E-06                            | 4.3E-06                      |
| 70          | 5.790E-02        | 219.0         | 9.210E-02                      | 1.4E-07                            | 8.6E-08                      |
| 100         | 3.000E-04        | 210.0         | 5.000E-04                      | 1.0E-09                            | 4.3E-11                      |

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties (Cont.)

| MIDLATITUDE SUMMER |                  |               |                                |                                    |                              |
|--------------------|------------------|---------------|--------------------------------|------------------------------------|------------------------------|
| Ht.<br>(km)        | Pressure<br>(mb) | Temp.<br>(°K) | Density<br>(g/m <sup>3</sup> ) | Water Vapor<br>(g/m <sup>3</sup> ) | Ozone<br>(g/m <sup>3</sup> ) |
| 0                  | 1.013E+03        | 294.0         | 1.191E+03                      | 1.4E+01                            | 6.0E-05                      |
| 1                  | 9.020E+02        | 290.0         | 1.080E+03                      | 9.3E+00                            | 6.0E-05                      |
| 2                  | 8.020E+02        | 285.0         | 9.757E+02                      | 5.9E+00                            | 6.0E-05                      |
| 3                  | 7.100E+02        | 279.0         | 8.846E+02                      | 3.3E+00                            | 6.2E-05                      |
| 4                  | 6.280E+02        | 273.0         | 7.998E+02                      | 1.9E+00                            | 6.4E-05                      |
| 5                  | 5.540E+02        | 267.0         | 7.211E+02                      | 1.0E+00                            | 6.6E-05                      |
| 6                  | 4.870E+02        | 261.0         | 6.487E+02                      | 6.1E-01                            | 6.9E-05                      |
| 7                  | 4.260E+02        | 255.0         | 5.830E+02                      | 3.7E-01                            | 7.5E-05                      |
| 8                  | 3.720E+02        | 248.0         | 5.225E+02                      | 2.1E-01                            | 7.9E-05                      |
| 9                  | 3.240E+02        | 242.0         | 4.669E+02                      | 1.2E-01                            | 8.6E-05                      |
| 10                 | 2.810E+02        | 235.0         | 4.159E+02                      | 6.4E-02                            | 9.0E-05                      |
| 11                 | 2.430E+02        | 229.0         | 3.693E+02                      | 2.2E-02                            | 1.1E-04                      |
| 12                 | 2.090E+02        | 222.0         | 3.269E+02                      | 6.0E-03                            | 1.2E-04                      |
| 13                 | 1.790E+02        | 216.0         | 2.882E+02                      | 1.8E-03                            | 1.5E-04                      |
| 14                 | 1.530E+02        | 216.0         | 2.464E+02                      | 1.0E-03                            | 1.8E-04                      |
| 15                 | 1.300E+02        | 216.0         | 2.104E+02                      | 7.6E-04                            | 1.9E-04                      |
| 16                 | 1.110E+02        | 216.0         | 1.797E+02                      | 6.4E-04                            | 2.1E-04                      |
| 17                 | 9.500E+01        | 216.0         | 1.535E+02                      | 5.6E-04                            | 2.4E-04                      |
| 18                 | 8.120E+01        | 216.0         | 1.305E+02                      | 5.0E-04                            | 2.8E-04                      |
| 19                 | 6.950E+01        | 217.0         | 1.110E+02                      | 4.9E-04                            | 3.2E-04                      |
| 20                 | 5.70E+01         | 218.0         | 9.453E+01                      | 4.5E-04                            | 3.4E-04                      |
| 21                 | 5.100E+01        | 219.0         | 8.056E+01                      | 5.1E-04                            | 3.6E-04                      |
| 22                 | 4.370E+01        | 220.0         | 6.872E+01                      | 5.1E-04                            | 3.6E-04                      |
| 23                 | 3.760E+01        | 222.0         | 5.867E+01                      | 5.4E-04                            | 3.4E-04                      |
| 24                 | 3.220E+01        | 223.0         | 5.014E+01                      | 6.0E-04                            | 3.2E-04                      |
| 25                 | 2.770E+01        | 224.0         | 4.288E+01                      | 6.7E-04                            | 3.0E-04                      |
| 30                 | 1.320E+01        | 234.0         | 1.322E+01                      | 3.6E-04                            | 2.0E-04                      |
| 35                 | 6.520E+00        | 245.0         | 6.519E+00                      | 1.1E-04                            | 9.2E-05                      |
| 40                 | 3.330E+00        | 258.0         | 3.330E+00                      | 4.3E-05                            | 4.1E-05                      |
| 45                 | 1.760E+00        | 270.0         | 1.757E+00                      | 1.9E-05                            | 1.3E-05                      |
| 50                 | 9.510E-01        | 276.0         | 9.512E-01                      | 6.3E-06                            | 4.3E-06                      |
| 70                 | 6.710E-02        | 218.0         | 6.706E-02                      | 1.4E-07                            | 8.6E-08                      |
| 100                | 3.000E-04        | 210.0         | 5.000E-04                      | 1.0E-09                            | 4.3E-11                      |

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties (Cont.)

| MIDLATITUDE WINTER |                  |               |                                |                                    |                              |
|--------------------|------------------|---------------|--------------------------------|------------------------------------|------------------------------|
| Ht.<br>(km)        | Pressure<br>(mb) | Temp.<br>(°K) | Density<br>(g/m <sup>3</sup> ) | Water Vapor<br>(g/m <sup>3</sup> ) | Ozone<br>(g/m <sup>3</sup> ) |
| 0                  | 1.016E+03        | 272.2         | 1.301E+03                      | 3.5E+00                            | 6.0E-05                      |
| 1                  | 8.973E+02        | 268.7         | 1.162E+03                      | 2.5E+00                            | 5.4E-05                      |
| 2                  | 7.897E+02        | 265.2         | 1.037E+03                      | 1.8E+00                            | 4.9E-05                      |
| 3                  | 6.938E+02        | 261.7         | 9.230E+02                      | 1.2E+00                            | 4.9E-05                      |
| 4                  | 6.081E+02        | 255.7         | 8.282E+02                      | 6.6E-01                            | 4.9E-05                      |
| 5                  | 5.313E+02        | 249.7         | 7.411E+02                      | 3.8E-01                            | 5.8E-05                      |
| 6                  | 4.627E+02        | 243.7         | 6.614E+02                      | 2.1E-01                            | 6.4E-05                      |
| 7                  | 4.016E+02        | 237.7         | 5.886E+02                      | 8.5E-02                            | 7.7E-05                      |
| 8                  | 3.473E+02        | 231.7         | 5.222E+02                      | 3.5E-02                            | 9.0E-05                      |
| 9                  | 2.992E+02        | 225.7         | 4.619E+02                      | 1.6E-02                            | 1.2E-04                      |
| 10                 | 2.568E+02        | 219.7         | 4.072E+02                      | 7.5E-03                            | 1.6E-04                      |
| 11                 | 2.199E+02        | 219.2         | 3.496E+02                      | 6.9E-03                            | 2.1E-04                      |
| 12                 | 1.882E+02        | 218.7         | 2.999E+02                      | 6.0E-03                            | 2.6E-04                      |
| 13                 | 1.610E+02        | 218.2         | 2.572E+02                      | 1.8E-03                            | 3.0E-04                      |
| 14                 | 1.378E+02        | 217.7         | 2.206E+02                      | 1.0E-03                            | 3.2E-04                      |
| 15                 | 1.178E+02        | 217.2         | 1.890E+02                      | 7.6E-04                            | 3.4E-04                      |
| 16                 | 1.007E+02        | 216.7         | 1.620E+02                      | 6.4E-04                            | 3.6E-04                      |
| 17                 | 8.610E+01        | 216.2         | 1.388E+02                      | 5.6E-04                            | 3.9E-04                      |
| 18                 | 7.350E+01        | 215.7         | 1.188E+02                      | 5.0E-04                            | 4.1E-04                      |
| 19                 | 6.280E+01        | 215.2         | 1.017E+02                      | 4.9E-04                            | 4.3E-04                      |
| 20                 | 5.370E+01        | 215.2         | 8.690E+01                      | 4.5E-04                            | 4.5E-04                      |
| 21                 | 4.580E+01        | 215.2         | 7.421E+01                      | 5.1E-04                            | 4.3E-04                      |
| 22                 | 3.910E+01        | 215.2         | 6.338E+01                      | 5.1E-04                            | 4.3E-04                      |
| 23                 | 3.340E+01        | 215.2         | 5.415E+01                      | 5.4E-04                            | 3.9E-04                      |
| 24                 | 2.860E+01        | 215.2         | 4.624E+01                      | 6.0E-04                            | 3.6E-04                      |
| 25                 | 2.430E+01        | 215.2         | 3.950E+01                      | 6.7E-04                            | 3.4E-04                      |
| 30                 | 1.110E+01        | 217.4         | 1.783E+01                      | 3.6E-04                            | 1.9E-04                      |
| 35                 | 5.180E+00        | 227.8         | 7.824E+00                      | 1.1E-04                            | 9.2E-05                      |
| 40                 | 2.530E+00        | 243.2         | 3.625E+00                      | 4.3E-05                            | 4.1E-05                      |
| 45                 | 1.290E+00        | 258.5         | 1.741E+00                      | 1.9E-05                            | 1.3E-05                      |
| 50                 | 6.820E-01        | 265.7         | 8.954E-01                      | 6.3E-06                            | 4.3E-06                      |
| 70                 | 4.670E-02        | 230.7         | 7.051E-02                      | 1.4E-07                            | 8.6E-08                      |
| 100                | 3.000E-04        | 210.2         | 5.000E-04                      | 1.0E-09                            | 4.3E-11                      |

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties (Cont.)

| SUBARCTIC SUMMER |                  |               |                                |                                    |                              |
|------------------|------------------|---------------|--------------------------------|------------------------------------|------------------------------|
| Ht.<br>(km)      | Pressure<br>(mb) | Temp.<br>(°K) | Density<br>(g/m <sup>3</sup> ) | Water Vapor<br>(g/m <sup>3</sup> ) | Ozone<br>(g/m <sup>3</sup> ) |
| 0                | 1.010E+03        | 287.0         | 1.220E+03                      | 9.1E+00                            | 4.9E-05                      |
| 1                | 8.860E+02        | 282.0         | 1.110E+03                      | 6.0E+00                            | 5.4E-05                      |
| 2                | 7.929E+02        | 276.0         | 9.971E+02                      | 4.2E+00                            | 5.6E-05                      |
| 3                | 7.000E+02        | 271.0         | 8.985E+02                      | 2.7E+00                            | 5.8E-05                      |
| 4                | 6.160E+02        | 266.0         | 8.077E+02                      | 1.7E+00                            | 6.0E-05                      |
| 5                | 5.410E+02        | 260.0         | 7.244E+02                      | 1.0E+00                            | 6.4E-05                      |
| 6                | 4.730E+02        | 253.0         | 6.519E+02                      | 5.4E-01                            | 7.1E-05                      |
| 7                | 4.130E+02        | 246.0         | 5.849E+02                      | 2.9E-01                            | 7.5E-05                      |
| 8                | 3.590E+02        | 239.0         | 5.231E+02                      | 1.3E-02                            | 7.9E-05                      |
| 9                | 3.107E+02        | 232.0         | 4.663E+02                      | 4.2E-02                            | 1.1E-04                      |
| 10               | 2.677E+02        | 225.0         | 4.142E+02                      | 1.5E-02                            | 1.3E-04                      |
| 11               | 2.300E+02        | 225.0         | 3.559E+02                      | 9.4E-03                            | 1.8E-04                      |
| 12               | 1.977E+02        | 225.0         | 3.059E+02                      | 6.0E-03                            | 2.1E-04                      |
| 13               | 1.700E+02        | 225.0         | 2.630E+02                      | 1.6E-03                            | 2.6E-04                      |
| 14               | 1.460E+02        | 225.0         | 2.260E+02                      | 1.0E-03                            | 2.8E-04                      |
| 15               | 1.250E+02        | 225.0         | 1.943E+02                      | 7.6E-04                            | 3.2E-04                      |
| 16               | 1.080E+02        | 225.0         | 1.671E+02                      | 6.4E-04                            | 3.4E-04                      |
| 17               | 9.280E+01        | 225.0         | 1.436E+02                      | 5.6E-04                            | 3.9E-04                      |
| 18               | 7.980E+01        | 225.0         | 1.235E+02                      | 5.0E-04                            | 4.1E-04                      |
| 19               | 6.860E+01        | 225.0         | 1.062E+02                      | 4.9E-04                            | 4.1E-04                      |
| 20               | 5.890E+01        | 225.0         | 9.128E+01                      | 4.5E-04                            | 3.9E-04                      |
| 21               | 5.070E+01        | 225.0         | 7.849E+01                      | 5.1E-04                            | 3.6E-04                      |
| 22               | 4.360E+01        | 225.0         | 6.750E+01                      | 5.1E-04                            | 3.2E-04                      |
| 23               | 3.750E+01        | 225.0         | 5.805E+01                      | 5.4E-04                            | 3.0E-04                      |
| 24               | 3.227E+01        | 226.0         | 4.963E+01                      | 6.0E-04                            | 2.8E-04                      |
| 25               | 2.780E+01        | 228.0         | 4.247E+01                      | 6.7E-04                            | 2.6E-04                      |
| 30               | 1.340E+01        | 235.0         | 1.338E+01                      | 3.6E-04                            | 1.4E-04                      |
| 35               | 6.610E+00        | 247.0         | 6.614E+00                      | 1.1E-04                            | 9.2E-05                      |
| 40               | 3.400E+00        | 262.0         | 3.404E+00                      | 4.3E-05                            | 4.1E-05                      |
| 45               | 1.810E+00        | 274.0         | 1.817E+00                      | 1.9E-05                            | 1.3E-05                      |
| 50               | 9.870E-01        | 277.0         | 9.868E-01                      | 6.3E-06                            | 4.3E-06                      |
| 70               | 7.070E-02        | 216.0         | 7.071E-02                      | 1.4E-07                            | 8.6E-08                      |
| 100              | 3.000E-04        | 210.0         | 5.000E-04                      | 1.0E-09                            | 4.3E-11                      |

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties (Cont.)

| SUBARCTIC WINTER |                  |               |                                |                                    |                              |
|------------------|------------------|---------------|--------------------------------|------------------------------------|------------------------------|
| Ht.<br>(km)      | Pressure<br>(mb) | Temp.<br>(°K) | Density<br>(g/m <sup>3</sup> ) | Water Vapor<br>(g/m <sup>3</sup> ) | Ozone<br>(g/m <sup>3</sup> ) |
| 0                | 1.013E+03        | 257.1         | 1.372E+03                      | 1.2E+00                            | 4.1E-05                      |
| 1                | 8.878E+02        | 259.1         | 1.193E+03                      | 1.2E+00                            | 4.1E-05                      |
| 2                | 7.775E+02        | 255.9         | 1.058E+03                      | 9.4E-01                            | 4.1E-05                      |
| 3                | 6.798E+02        | 252.7         | 9.366E+02                      | 6.8E-01                            | 4.3E-05                      |
| 4                | 5.932E+02        | 247.7         | 8.339E+02                      | 4.1E-01                            | 4.5E-05                      |
| 5                | 5.158E+02        | 240.9         | 7.457E+02                      | 2.0E-01                            | 4.7E-05                      |
| 6                | 4.467E+02        | 234.1         | 6.646E+02                      | 9.8E-02                            | 4.9E-05                      |
| 7                | 3.853E+02        | 227.3         | 5.904E+02                      | 5.4E-02                            | 7.1E-05                      |
| 8                | 3.308E+02        | 220.6         | 5.226E+02                      | 1.1E-02                            | 9.0E-05                      |
| 9                | 2.829E+02        | 217.2         | 4.538E+02                      | 8.4E-03                            | 1.6E-04                      |
| 10               | 2.418E+02        | 217.2         | 3.879E+02                      | 5.5E-03                            | 2.4E-04                      |
| 11               | 2.067E+02        | 217.2         | 3.315E+02                      | 3.8E-03                            | 3.2E-04                      |
| 12               | 1.766E+02        | 217.2         | 2.834E+02                      | 2.6E-03                            | 4.3E-04                      |
| 13               | 1.510E+02        | 217.2         | 2.422E+02                      | 1.8E-03                            | 4.7E-04                      |
| 14               | 1.291E+02        | 217.2         | 2.071E+02                      | 1.0E-03                            | 4.9E-04                      |
| 15               | 1.103E+02        | 217.2         | 1.770E+02                      | 7.6E-04                            | 5.6E-04                      |
| 16               | 9.431E+01        | 216.6         | 1.517E+02                      | 6.4E-04                            | 6.2E-04                      |
| 17               | 8.058E+01        | 216.0         | 1.300E+02                      | 5.6E-04                            | 6.2E-04                      |
| 18               | 6.882E+01        | 215.4         | 1.113E+02                      | 5.0E-04                            | 6.2E-04                      |
| 19               | 5.875E+01        | 214.8         | 9.529E+01                      | 4.9E-04                            | 6.0E-04                      |
| 20               | 5.014E+01        | 214.1         | 8.155E+01                      | 4.5E-04                            | 5.6E-04                      |
| 21               | 4.277E+01        | 213.6         | 6.976E+01                      | 5.1E-04                            | 5.1E-04                      |
| 22               | 3.647E+01        | 213.0         | 5.966E+01                      | 5.1E-04                            | 4.7E-04                      |
| 23               | 3.109E+01        | 212.4         | 5.100E+01                      | 5.4E-04                            | 4.3E-04                      |
| 24               | 2.649E+01        | 211.8         | 4.358E+01                      | 6.0E-04                            | 3.6E-04                      |
| 25               | 2.256E+01        | 211.2         | 3.722E+01                      | 6.7E-04                            | 3.2E-04                      |
| 30               | 1.020E+01        | 216.0         | 1.645E+01                      | 3.6E-04                            | 1.5E-04                      |
| 35               | 4.701E+00        | 222.2         | 7.368E+00                      | 1.1E-04                            | 9.2E-05                      |
| 40               | 2.243E+00        | 234.7         | 3.330E+00                      | 4.3E-05                            | 4.1E-05                      |
| 45               | 1.113E+00        | 247.0         | 1.569E+00                      | 1.9E-05                            | 1.3E-05                      |
| 50               | 5.719E-01        | 259.3         | 7.682E-01                      | 6.3E-06                            | 4.3E-06                      |
| 70               | 4.016E-02        | 245.7         | 5.695E-02                      | 1.4E-07                            | 8.6E-08                      |
| 100              | 3.000E-04        | 210.0         | 5.000E-04                      | 1.0E-09                            | 4.3E-11                      |

Table 6. Model Atmospheres Used as a Basis of the Computation of Atmospheric Optical Properties (Cont.)

| U. S. STANDARD ATMOSPHERE, 1962 |                  |               |                                |                                    |                              |
|---------------------------------|------------------|---------------|--------------------------------|------------------------------------|------------------------------|
| Ht.<br>(km)                     | Pressure<br>(mb) | Temp.<br>(°K) | Density<br>(g/m <sup>3</sup> ) | Water Vapor<br>(g/m <sup>3</sup> ) | Ozone<br>(g/m <sup>3</sup> ) |
| 0                               | 1.013E+03        | 288.1         | 1.225E+03                      | 5.9E+00                            | 5.4E-05                      |
| 1                               | 8.986E+02        | 281.6         | 1.111E+03                      | 4.2E+00                            | 5.4E-05                      |
| 2                               | 7.950E+02        | 275.1         | 1.007E+03                      | 2.9E+00                            | 5.4E-05                      |
| 3                               | 7.012E+02        | 268.7         | 9.093E+02                      | 1.8E+00                            | 5.0E-05                      |
| 4                               | 6.166E+02        | 262.2         | 8.193E+02                      | 1.1E+00                            | 4.6E-05                      |
| 5                               | 5.405E+02        | 255.7         | 7.364E+02                      | 6.4E-01                            | 4.5E-05                      |
| 6                               | 4.722E+02        | 249.2         | 6.601E+02                      | 3.8E-01                            | 4.5E-05                      |
| 7                               | 4.111E+02        | 242.7         | 5.900E+02                      | 2.1E-01                            | 4.8E-05                      |
| 8                               | 3.565E+02        | 236.2         | 5.258E+02                      | 1.2E-01                            | 5.2E-05                      |
| 9                               | 3.080E+02        | 229.7         | 4.671E+02                      | 4.6E-02                            | 7.1E-05                      |
| 10                              | 2.650E+02        | 223.2         | 4.135E+02                      | 1.8E-02                            | 9.0E-05                      |
| 11                              | 2.270E+02        | 216.8         | 3.648E+02                      | 8.2E-03                            | 1.3E-04                      |
| 12                              | 1.940E+02        | 216.6         | 3.118E+02                      | 3.7E-03                            | 1.6E-04                      |
| 13                              | 1.658E+02        | 216.6         | 2.666E+02                      | 1.8E-03                            | 1.7E-04                      |
| 14                              | 1.417E+02        | 216.6         | 2.279E+02                      | 3.4E-04                            | 1.9E-04                      |
| 15                              | 1.211E+02        | 216.6         | 1.948E+02                      | 7.2E-04                            | 2.1E-04                      |
| 16                              | 1.035E+02        | 216.6         | 1.665E+02                      | 6.1E-04                            | 2.3E-04                      |
| 17                              | 8.850E+01        | 216.6         | 1.423E+02                      | 5.2E-04                            | 2.8E-04                      |
| 18                              | 7.565E+01        | 216.6         | 1.216E+02                      | 4.4E-04                            | 3.2E-04                      |
| 19                              | 6.467E+01        | 216.6         | 1.040E+02                      | 4.4E-04                            | 3.5E-04                      |
| 20                              | 5.529E+01        | 216.6         | 8.891E+01                      | 4.4E-04                            | 3.8E-04                      |
| 21                              | 4.729E+01        | 217.6         | 7.572E+01                      | 4.8E-04                            | 3.8E-04                      |
| 22                              | 4.047E+01        | 218.6         | 6.451E+01                      | 5.2E-04                            | 3.9E-04                      |
| 23                              | 3.467E+01        | 219.5         | 5.500E+01                      | 5.7E-04                            | 3.8E-04                      |
| 24                              | 2.972E+01        | 220.6         | 4.694E+01                      | 6.1E-04                            | 3.6E-04                      |
| 25                              | 2.549E+01        | 221.6         | 4.003E+01                      | 6.6E-04                            | 3.4E-04                      |
| 30                              | 1.197E+01        | 226.5         | 1.841E+01                      | 3.8E-04                            | 2.0E-04                      |
| 35                              | 5.746E+00        | 236.5         | 8.463E+00                      | 1.6E-04                            | 1.1E-04                      |
| 40                              | 2.871E+00        | 250.4         | 3.996E+00                      | 6.7E-05                            | 4.9E-05                      |
| 45                              | 1.491E+00        | 264.2         | 1.966E+00                      | 3.2E-05                            | 1.7E-05                      |
| 50                              | 7.978E-01        | 270.6         | 1.027E+00                      | 1.2E-05                            | 4.0E-06                      |
| 70                              | 5.520E-02        | 219.7         | 8.754E-02                      | 1.5E-07                            | 8.6E-08                      |
| 100                             | 3.008E-04        | 210.0         | 4.989E-04                      | 1.0E-09                            | 4.3E-11                      |

## 5. COMPUTATIONAL TECHNIQUES FOR MOLECULAR ABSORPTION

A Lorentz line profile as given in Eq. (4) was assumed for each line in the lower atmosphere except as modified (see Section 2) for carbon dioxide lines.

$$k = \frac{S\alpha}{\pi[(\nu - \nu_0)^2 + \alpha^2]} \quad (4)$$

In Eq. (4),  $S$  is the line intensity,  $\alpha$  is the half-width,  $\nu_0$  the central line frequency, and  $\nu$  the laser frequency. For pressures less than 10 mb, a Voigt profile<sup>15</sup> is used in the calculations. The laser frequency ( $\nu$ ) is assumed monochromatic for the purposes of this calculation. In general, a large number of absorption lines belonging to different molecules contribute to the attenuation at any specific laser frequency, so the total absorption coefficient must be evaluated as indicated by Eq. (5)

$$k_m = \sum_j \sum_i \frac{S_{ij} \alpha_{ij} m_j}{\pi[(\nu - \nu_{ij})^2 + \alpha_{ij}^2]} \quad (5)$$

where  $m_j$  represents the amount of the  $j^{\text{th}}$  absorbing gas and where  $i$  is an index over all lines belonging to the same molecular specie and  $m_j$  is the molecular abundance of the  $j^{\text{th}}$  molecular species per kilometer.

Pressure broadening enters through the  $\alpha$  values, the Lorentz line width being given by  $\alpha = \alpha_0 \sqrt{P/P_0} \sqrt{T_0/T}$ . The line intensity ( $S$ ) is also temperature dependent through the population of the lower state of the transition and through the partition functions. These temperature and pressure effects have been included for all lines. As indicated in Section 2, the LASER program considers all line wings within  $20 \text{ cm}^{-1}$  of the laser frequency in question as contributing to the absorption coefficient and all lines outside of this  $20 \text{ cm}^{-1}$  limit are omitted in the calculation.

The extinction due to molecular scattering, aerosol absorption and aerosol scattering are separately computed and tabulated in the output from LASER. The total extinction coefficient for a given path can then be obtained by summing these four components as indicated in Eq. (1). The transmission for a horizontal path is then given by Eq. (6) where  $\tau$  is the transmission and  $R$  is the range in kilometers

15. Young, C. (1965) J. Quant. Spectrosc. Radiative Transfer 5:549.

$$\tau(\nu) = \exp [-\gamma(\nu) R] \quad . \quad (6)$$

## 6. RESULTS

The results we wish to describe here fall into three categories: (1) The LASER Computer Code which will be described and documented in Appendix A; (2) Extinction Coefficients for a number of specific laser frequencies generated with the LASER computer program (see Appendix B); and (3) High resolution spectral plots covering the regions between 740 and 1400  $\text{cm}^{-1}$  (7.1 and 13.5  $\mu\text{m}$ ), 1880 and 2180  $\text{cm}^{-1}$  (4.6 and 5.3  $\mu\text{m}$ ) and 2360 and 2960  $\text{cm}^{-1}$  (3.4 and 4.2  $\mu\text{m}$ ) which are given in Appendix C. We have provided spectra in Appendix C covering the regions of laser emission by  $\text{CO}_2$ , CO, and DF. We wish to emphasize differences in the continuum model for water vapor in both the 8 to 14- $\mu\text{m}$  region (740 to 1400  $\text{cm}^{-1}$ ) and the 3.5 to 4.2- $\mu\text{m}$  regions (2360 to 3020  $\text{cm}^{-1}$ ) as well as some modifications of individual line parameters primarily in the 3.5 to 4.2  $\mu\text{m}$  region. These "infinite" resolution spectra have been generated by performing monochromatic calculations at steps of 0.01  $\text{cm}^{-1}$  over the entire range of frequency of each plot. Such spectral plots can be generated with the computer program provided in Reference 1 and the AFGL Atmospheric Line Parameters Compilation discussed in Section 1 of this report. Figure C1 provides spectra for a 10-km horizontal path at sea level and Figure C2 provides spectra for a 10-km horizontal path at an altitude of 12 km.

Table 7 contains a detailed list of all laser frequencies for which extinction coefficients were provided in an earlier report.<sup>5</sup> Based on our more up-to-date absorption modeling, we have included revised molecular absorption coefficients in Table 7, containing contributions from both discrete lines and molecular continuum absorption for three of the model atmospheres described in Table 5 at sea level (Tropical, U.S. Standard, and Subarctic Winter) and for the 11 to 12-km altitude layer (only for the U.S. Standard Atmosphere).

A comparison of Table 7 with a similar table in Reference 5 indicates the following: (1) Somewhat lower absorption coefficients for most of the  $\text{CO}_2$  emission lines. This is principally due to the modifications made to the water vapor continuum absorption. Occasionally, a line (such as the P40 line of  $\text{CO}_2$ ) shows a drastic increase due to an error made in the earlier report. (2) The DF laser emission region shows a significant increase principally due to the inclusion of the water vapor continuum - absorption by the water vapor continuum was omitted in this spectral region in the earlier calculations. Occasionally the changes differ

Table 7. Attenuation Coefficients for Laser Frequencies

| CO <sub>2</sub> Laser Parameters |                       | Atmospheric Absorption Coefficients<br>(km <sup>-1</sup> ) |                        |                   |                        |
|----------------------------------|-----------------------|------------------------------------------------------------|------------------------|-------------------|------------------------|
| 00011 → 10001                    |                       | Height = 0 km (Sea Level)                                  |                        | Height = 11-12 km |                        |
| Rot. ID                          | $\nu(\text{cm}^{-1})$ | $K_{\text{trop.}}$                                         | $K_{\text{U.S. Std.}}$ | $K_{\text{sw}}$   | $K_{\text{U.S. Std.}}$ |
| *P40                             | 924.975               | 3.95                                                       | 1.09                   | 0.150             | 0.00150                |
| P38                              | 927.009               | 0.423                                                      | 0.0718                 | 0.0121            | 0.00108                |
| P36                              | 929.018               | 0.698                                                      | 0.128                  | 0.0163            | 0.00149                |
| P34                              | 931.002               | 0.428                                                      | 0.0807                 | 0.0164            | 0.00203                |
| P32                              | 932.961               | 0.432                                                      | 0.0856                 | 0.0190            | 0.00273                |
| P30                              | 934.895               | 0.442                                                      | 0.0926                 | 0.0220            | 0.00344                |
| P28                              | 936.805               | 0.445                                                      | 0.0991                 | 0.0255            | 0.00431                |
| P26                              | 938.689               | 0.449                                                      | 0.105                  | 0.0287            | 0.00533                |
| P24                              | 940.549               | 0.458                                                      | 0.111                  | 0.0320            | 0.00632                |
| *P22                             | 942.384               | 0.460                                                      | 0.116                  | 0.0353            | 0.00741                |
| *P20                             | 944.195               | 0.480                                                      | 0.125                  | 0.0386            | 0.00838                |
| *P18                             | 945.981               | 0.468                                                      | 0.124                  | 0.398             | 0.00905                |
| *P16                             | 947.743               | 0.523                                                      | 0.138                  | 0.0426            | 0.00968                |
| P14                              | 949.480               | 0.467                                                      | 0.124                  | 0.0409            | 0.00982                |
| P12                              | 951.193               | 0.450                                                      | 0.118                  | 0.0392            | 0.00970                |
| P10                              | 952.882               | 0.450                                                      | 0.113                  | 0.0364            | 0.00900                |
| P8                               | 954.546               | 0.437                                                      | 0.104                  | 0.0321            | 0.00786                |
| P6                               | 956.186               | 0.417                                                      | 0.0917                 | 0.0266            | 0.00640                |
| P4                               | 957.802               | 0.391                                                      | 0.0766                 | 0.0198            | 0.00448                |
| *P2                              | 959.393               | 0.432                                                      | 0.0742                 | 0.0133            | 0.00235                |
| R0                               | 961.734               | 0.386                                                      | 0.0597                 | 0.00897           | 0.00117                |
| R2                               | 963.264               | 0.376                                                      | 0.0689                 | 0.0163            | 0.00349                |
| R4                               | 964.770               | 0.373                                                      | 0.0830                 | 0.0234            | 0.00560                |
| R6                               | 966.251               | 0.427                                                      | 0.100                  | 0.0304            | 0.00752                |
| R8                               | 967.708               | 0.424                                                      | 0.108                  | 0.0357            | 0.00908                |
| R10                              | 969.141               | 0.430                                                      | 0.116                  | 0.0396            | 0.0101                 |
| R12                              | 970.548               | 0.536                                                      | 0.141                  | 0.0436            | 0.0107                 |
| R14                              | 971.931               | 0.473                                                      | 0.132                  | 0.0443            | 0.0108                 |
| *R16                             | 973.289               | 0.523                                                      | 0.144                  | 0.0454            | 0.0106                 |
| *R18                             | 974.623               | 0.452                                                      | 0.129                  | 0.0432            | 0.0100                 |
| *R20                             | 975.931               | 1.32                                                       | 0.329                  | 0.0602            | 0.00906                |
| *R22                             | 977.215               | 0.552                                                      | 0.147                  | 0.0407            | 0.00805                |
| R24                              | 978.473               | 0.425                                                      | 0.111                  | 0.0339            | 0.00687                |
| R26                              | 979.706               | 0.409                                                      | 0.103                  | 0.0301            | 0.00578                |
| R28                              | 980.919               | 0.402                                                      | 0.0966                 | 0.0266            | 0.00476                |
| R30                              | 982.097               | 0.485                                                      | 0.115                  | 0.0261            | 0.00380                |
| R32                              | 983.253               | 0.380                                                      | 0.0817                 | 0.0196            | 0.00323                |
| R34                              | 984.384               | 0.392                                                      | 0.0796                 | 0.0169            | 0.00231                |
| R36                              | 985.489               | 0.360                                                      | 0.0684                 | 0.0138            | 0.00177                |
| R38                              | 986.568               | 0.352                                                      | 0.0633                 | 0.0117            | 0.00128                |
| R40                              | 987.621               | 0.345                                                      | 0.0590                 | 0.0101            | 0.00109                |
| 00011 → 10002                    |                       |                                                            |                        |                   |                        |
| *P20                             | 1046.854              | 0.409                                                      | 0.142                  | 0.0588            | 0.0364                 |
| *P18                             | 1048.661              | 0.430                                                      | 0.152                  | 0.0650            | 0.0672                 |
| *P16                             | 1050.441              | 0.452                                                      | 0.164                  | 0.0735            | 0.0647                 |
| *R16                             | 1075.988              | 0.473                                                      | 0.162                  | 0.0614            | 0.0168                 |
| *R18                             | 1077.303              | 0.403                                                      | 0.144                  | 0.0581            | 0.0159                 |
| *R20                             | 1078.591              | 0.400                                                      | 0.139                  | 0.0546            | 0.0151                 |

Table 7. Attenuation Coefficients for Laser Frequencies (Cont.)

| DF Laser Parameter |         |                           | Atmospheric Absorption Coefficients<br>(km <sup>-1</sup> ) |                        |                   |                        |
|--------------------|---------|---------------------------|------------------------------------------------------------|------------------------|-------------------|------------------------|
|                    |         |                           | Height - 0 km (Sea Level)                                  |                        | Height = 11-12 km |                        |
| Band               | Rot. ID | $\nu$ (cm <sup>-1</sup> ) | $K_{\text{trop.}}$                                         | $K_{\text{U.S. Std.}}$ | $K_{\text{sw}}$   | $K_{\text{U.S. Std.}}$ |
| 1-0                | P1      | 2884.934                  | 0.123                                                      | 0.0612                 | 0.0374            | 5.91E-3                |
|                    | P2      | 2862.652                  | 0.0617                                                     | 0.0320                 | 0.0156            | 4.07E-4                |
|                    | P3      | 2839.779                  | 0.0695                                                     | 0.0225                 | 4.73E-3           | 7.57E-5                |
|                    | P4      | 2816.362                  | 0.0688                                                     | 0.0215                 | 5.19E-3           | 1.02E-4                |
|                    | P5      | 2792.437                  | 0.0927                                                     | 0.0302                 | 9.48E-3           | 1.34E-4                |
|                    | P6      | 2767.914                  | 0.119                                                      | 0.0410                 | 0.0159            | 7.63E-4                |
|                    | P7      | 2743.028                  | 0.0449                                                     | 0.0160                 | 7.00E-3           | 1.53E-4                |
|                    | *P8     | 2717.536                  | 0.227                                                      | 0.0682                 | 0.0162            | 1.62E-4                |
|                    | P9      | 2691.409                  | 0.0504                                                     | 0.0189                 | 9.45E-3           | 1.19E-3                |
|                    | *P10    | 2665.20                   | 0.0611                                                     | 0.0245                 | 0.0143            | 1.40E-3                |
|                    | P11     | 2638.396                  | 0.531                                                      | 0.164                  | 0.0383            | 3.56E-4                |
|                    | P12     | 2611.125                  | 0.0347                                                     | 0.0127                 | 5.83E-3           | 1.14E-4                |
|                    | P13     | 2584.91                   | 0.0445                                                     | 0.0219                 | 0.0156            | 5.76E-4                |
|                    | P14     | 2557.09                   | 0.0477                                                     | 0.0309                 | 0.0280            | 6.40E-3                |
|                    | P15     | 2527.06                   | 0.0426                                                     | 0.0241                 | 0.0195            | 6.20E-4                |
|                    | P16     | 2498.02                   | 0.0602                                                     | 0.0375                 | 0.0330            | 1.11E-3                |
| 2-1                | P3      | 2750.05                   | 0.0710                                                     | 0.0245                 | 0.00954           | 2.53E-4                |
|                    | P4      | 2727.38                   | 0.0663                                                     | 0.0219                 | 0.00747           | 9.91E-5                |
|                    | P5      | 2703.98                   | 0.0408                                                     | 0.0140                 | 0.00562           | 1.03E-4                |
|                    | *P6     | 2680.28                   | 0.114                                                      | 0.0391                 | 0.0150            | 5.06E-4                |
|                    | P7      | 2655.97                   | 0.106                                                      | 0.0378                 | 0.0167            | 5.93E-3                |
|                    | *P8     | 2631.09                   | 0.0382                                                     | 0.0156                 | 0.00947           | 3.23E-3                |
|                    | P9      | 2605.87                   | 0.0820                                                     | 0.0268                 | 0.00924           | 1.82E-4                |
|                    | *P10    | 2580.16                   | 0.0560                                                     | 0.0373                 | 0.0346            | 2.28E-3                |
|                    | P11     | 2553.97                   | 0.0419                                                     | 0.0256                 | 0.0232            | 1.15E-3                |
|                    | P12     | 2527.47                   | 0.0426                                                     | 0.0247                 | 0.0206            | 1.76E-3                |
|                    | P13     | 2500.32                   | 0.0553                                                     | 0.0360                 | 0.0327            | 1.76E-3                |
|                    | P16     | 2417.27                   | 0.125                                                      | 0.0990                 | 0.0994            | 3.52E-3                |
| 3-2                | P3      | 2662.17                   | 0.0611                                                     | 0.0208                 | 0.00773           | 1.92E-4                |
|                    | P4      | 2640.04                   | 0.0866                                                     | 0.0301                 | 0.0109            | 6.23E-4                |
|                    | P5      | 2617.41                   | 0.0316                                                     | 0.0119                 | 0.00592           | 1.53E-4                |
|                    | P6      | 2594.23                   | 0.0458                                                     | 0.0179                 | 0.00904           | 2.31E-4                |
|                    | P7      | 2570.51                   | 0.0733                                                     | 0.0510                 | 0.0510            | 7.29E-3                |
|                    | *P8     | 2546.37                   | 0.0611                                                     | 0.0432                 | 0.0420            | 3.16E-3                |
|                    | P9      | 2521.81                   | 0.0432                                                     | 0.0248                 | 0.0204            | 6.50E-4                |
|                    | *P10    | 2496.61                   | 0.0631                                                     | 0.0391                 | 0.0342            | 1.15E-3                |
|                    | P11     | 2471.34                   | 0.0866                                                     | 0.0596                 | 0.0557            | 2.03E-3                |
|                    | P12     | 2445.29                   | 0.106                                                      | 0.0820                 | 0.0806            | 2.85E-3                |
|                    | P13     | 2419.02                   | 0.124                                                      | 0.0975                 | 0.0978            | 3.47E-3                |
|                    | P14     | 2392.46                   | 0.194                                                      | 0.149                  | 0.125             | 4.06E-3                |
| 4-3                | P5      | 2532.50                   | 0.0414                                                     | 0.0228                 | 0.0181            | 5.73E-4                |
|                    | P6      | 2509.86                   | 0.0490                                                     | 0.0302                 | 0.0261            | 8.67E-4                |
|                    | P7      | 2486.83                   | 0.0652                                                     | 0.0440                 | 0.0406            | 1.45E-3                |
|                    | *P8     | 2463.25                   | 0.108                                                      | 0.0695                 | 0.0624            | 2.47E-3                |
|                    | P9      | 2439.29                   | 0.110                                                      | 0.086                  | 0.085             | 3.06E-3                |
|                    | *P10    | 2414.89                   | 0.128                                                      | 0.101                  | 0.102             | 3.62E-3                |
| 5-4                | P7      | 2404.63                   | 0.135                                                      | 0.106                  | 0.106             | 3.77E-3                |
| 7-6                | P8      | 2222.68                   | 0.344                                                      | 0.327                  | 0.299             | 2.30E-2                |
|                    | *P10    | 2177.99                   | 0.0874                                                     | 0.0738                 | 0.0599            | 1.99E-3                |
|                    | P11     | 2155.03                   | 0.220                                                      | 0.0677                 | 0.0254            | 1.06E-3                |
|                    | P12     | 2131.68                   | 0.290                                                      | 0.180                  | 0.175             | 4.09E-2                |

Table 7. Attenuation Coefficients for Laser Frequencies (Cont.)

| DF Laser Parameter (Cont.) |         |                       | Atmospheric Absorption Coefficients<br>(km <sup>-1</sup> ) |                        |                   |                        |
|----------------------------|---------|-----------------------|------------------------------------------------------------|------------------------|-------------------|------------------------|
|                            |         |                       | Height - 0 km (Sea Level)                                  |                        | Height = 11-12 km |                        |
| Band                       | Rot. ID | $\nu(\text{cm}^{-1})$ | $K_{\text{trop.}}$                                         | $K_{\text{U.S. Std.}}$ | $K_{\text{sw}}$   | $K_{\text{U.S. Std.}}$ |
| 8-7                        | P7      | 2165.93               | 0.0626                                                     | 0.0423                 | 0.0408            | 2.05E-3                |
|                            | P8      | 2144.80               | 1.55                                                       | 0.377                  | 0.0399            | 3.43E-4                |
|                            | P9      | 2123.24               | 0.259                                                      | 0.0698                 | 0.0190            | 3.63E-3                |
|                            | *P10    | 2101.27               | 0.172                                                      | 0.0584                 | 0.0225            | 6.67E-3                |
|                            | P12     | 2056.14               | 0.144                                                      | 0.0449                 | 0.0192            | 7.67E-4                |
|                            | P13     | 2033.01               | 0.190                                                      | 0.0472                 | 0.00617           | 1.36E-5                |
| 9-8                        | P6      | 2108.48               | 0.0686                                                     | 0.0229                 | 0.00897           | 4.93E-3                |
|                            | P7      | 2088.34               | 0.562                                                      | 0.140                  | 0.0210            | 4.89E-3                |
|                            | P8      | 2067.76               | 0.932                                                      | 0.262                  | 0.0768            | 3.93E-5                |
|                            | *P10    | 2025.36               | 0.855                                                      | 0.209                  | 0.0277            | 2.73E-5                |
|                            | P11     | 2003.56               | 0.441                                                      | 0.111                  | 0.0148            | 1.50E-5                |
|                            | P12     | 1981.38               | 0.623                                                      | 0.149                  | 0.0187            | 1.08E-5                |

| HF Laser Parameter |         |                       | Atmospheric Absorption Coefficients<br>(km <sup>-1</sup> ) |                        |                   |                        |
|--------------------|---------|-----------------------|------------------------------------------------------------|------------------------|-------------------|------------------------|
|                    |         |                       | Height - 0 km (Sea Level)                                  |                        | Height = 11-12 km |                        |
| Band               | Rot. ID | $\nu(\text{cm}^{-1})$ | $K_{\text{trop.}}$                                         | $K_{\text{U.S. Std.}}$ | $K_{\text{sw}}$   | $K_{\text{U.S. Std.}}$ |
| 1-0                | P11     | 3436.12               | 1.74                                                       | 0.401                  | 0.0449            | 0.00033                |
|                    | P12     | 3381.50               | 0.512                                                      | 0.139                  | 0.0237            | 0.00033                |
| 2-1                | *P8     | 3435.17               | 0.987                                                      | 0.265                  | 0.0400            | 0.00094                |
| 3-2                | P6      | 3373.46               | 0.354                                                      | 0.0952                 | 0.0169            | 0.00091                |
| 4-3                | P8      | 3130.09               | 0.698                                                      | 0.212                  | 0.0508            | 0.00025                |
| 5-4                | P9      | 3083.83               | 1.14                                                       | 0.356                  | 0.0862            | 0.00153                |
|                    | P4      | 3150.67               | 0.289                                                      | 0.0837                 | 0.0167            | 0.00004                |
|                    | *P6     | 2921.74               | 0.0231                                                     | 0.00738                | 0.00300           | 0.000121               |
|                    | *P7     | 2880.70               | 0.0176                                                     | 0.00494                | 0.000889          | 1.0E-6                 |
|                    | P8      | 2838.59               | 0.323                                                      | 0.0983                 | 0.0190            | 0.000037               |

Table 7. Attenuation Coefficients for Laser Frequencies (Cont.)

| CO Laser Parameters |         |                       | Atmospheric Absorption Coefficients<br>(km <sup>-1</sup> ) |                        |                   |                        |
|---------------------|---------|-----------------------|------------------------------------------------------------|------------------------|-------------------|------------------------|
|                     |         |                       | Height = 0 km (Sea Level)                                  |                        | Height = 11-12 km |                        |
| Band                | Rot. ID | $\nu(\text{cm}^{-1})$ | $K_{\text{trop.}}$                                         | $K_{\text{U.S. Std.}}$ | $K_{\text{SW}}$   | $K_{\text{U.S. Std.}}$ |
| 1-0                 | P2      | 2135.549              | 0.743                                                      | 0.278                  | 0.168             | 1.87E-1                |
|                     | *P14    | 2086.325              | 0.465                                                      | 0.244                  | 0.170             | 1.32E-1                |
|                     | P17     | 2073.267              | 0.703                                                      | 0.257                  | 0.108             | 5.00E-2                |
|                     | P18     | 2068.849              | 0.329                                                      | 0.159                  | 0.106             | 3.65E-2                |
|                     | P21     | 2055.402              | 0.173                                                      | 0.108                  | 0.0874            | 1.23E-2                |
|                     | P22     | 2050.856              | 0.184                                                      | 0.0813                 | 0.0465            | 6.71E-3                |
|                     | P25     | 2037.027              | 0.520                                                      | 0.148                  | 0.0344            | 1.82E-3                |
|                     | P26     | 2032.354              | 0.221                                                      | 0.0665                 | 0.0158            | 9.88E-4                |
|                     | P27     | 2027.651              | 0.853                                                      | 0.245                  | 0.0488            | 9.82E-4                |
|                     | P30     | 2013.353              | 0.603                                                      | 0.158                  | 0.0235            | 8.86E-5                |
| 2-1                 | P1      | 2112.977              | 0.120                                                      | 0.0324                 | 0.00766           | 4.68E-4                |
|                     | P2      | 2109.132              | 0.0695                                                     | 0.0314                 | 0.0183            | 6.95E-3                |
|                     | P3      | 2105.256              | 0.131                                                      | 0.0408                 | 0.0113            | 2.73E-3                |
|                     | P4      | 2101.342              | 0.144                                                      | 0.0448                 | 0.0142            | 3.76E-3                |
|                     | P7      | 2089.393              | 1.95                                                       | 0.480                  | 0.0601            | 4.81E-3                |
|                     | P8      | 2085.343              | 0.232                                                      | 0.0716                 | 0.0303            | 2.57E-3                |
|                     | P9      | 2081.258              | 0.189                                                      | 0.0551                 | 0.0155            | 1.14E-3                |
|                     | P11     | 2072.987              | 0.421                                                      | 0.129                  | 0.0353            | 1.94E-3                |
|                     | P12     | 2068.802              | 0.295                                                      | 0.125                  | 0.0753            | 5.21E-3                |
|                     | *P15    | 2056.046              | 0.193                                                      | 0.0526                 | 0.0171            | 6.51E-4                |
|                     | P16     | 2051.729              | 1.42                                                       | 0.317                  | 0.0375            | 9.25E-4                |
|                     | P17     | 2047.379              | 0.457                                                      | 0.161                  | 0.0715            | 2.63E-3                |
|                     | P19     | 2038.582              | 0.450                                                      | 0.123                  | 0.0242            | 2.92E-4                |
|                     | P21     | 2029.656              | 0.195                                                      | 0.0521                 | 0.00853           | 3.25E-5                |
|                     | P22     | 2025.145              | 0.650                                                      | 0.166                  | 0.0237            | 3.02E-5                |
|                     | P25     | 2011.423              | 0.498                                                      | 0.130                  | 0.0184            | 1.45E-5                |
|                     | P26     | 2006.786              | 0.977                                                      | 0.249                  | 0.0332            | 1.90E-5                |
|                     | P27     | 2002.118              | 0.357                                                      | 0.0968                 | 0.0159            | 1.29E-5                |
| 3-2                 | P28     | 1997.419              | 1.07                                                       | 0.297                  | 0.0519            | 4.07E-5                |
|                     | P1      | 2086.594              | 0.474                                                      | 0.122                  | 0.0246            | 2.20E-3                |
|                     | P2      | 2082.784              | 0.128                                                      | 0.0372                 | 0.0110            | 8.42E-4                |
|                     | P3      | 2078.940              | 0.778                                                      | 0.270                  | 0.116             | 3.72E-2                |
|                     | P4      | 2075.061              | 0.388                                                      | 0.110                  | 0.0249            | 3.47E-3                |
|                     | P5      | 2071.148              | 0.148                                                      | 0.0449                 | 0.0157            | 9.87E-4                |
|                     | P6      | 2067.200              | 0.816                                                      | 0.232                  | 0.0629            | 2.50E-3                |
|                     | P7      | 2063.218              | 0.968                                                      | 0.274                  | 0.0723            | 2.45E-3                |
|                     | P8      | 2059.203              | 0.641                                                      | 0.182                  | 0.0423            | 9.16E-4                |
|                     | P10     | 2951.071              | 0.425                                                      | 0.123                  | 0.0263            | 6.10E-4                |
|                     | P11     | 2046.954              | 1.07                                                       | 0.264                  | 0.0358            | 2.34E-4                |
|                     | P12     | 2042.864              | 1.80                                                       | 0.489                  | 0.0903            | 8.93E-4                |
|                     | P13     | 2038.621              | 0.452                                                      | 0.121                  | 0.0215            | 2.48E-4                |
|                     | P14     | 2034.405              | 1.11                                                       | 0.259                  | 0.0255            | 3.24E-5                |
|                     | *P15    | 2030.157              | 0.440                                                      | 0.111                  | 0.0144            | 1.64E-5                |
|                     | P16     | 2025.875              | 1.33                                                       | 0.349                  | 0.0539            | 6.55E-5                |
|                     | P17     | 2021.561              | 0.897                                                      | 0.227                  | 0.0307            | 8.00E-5                |
|                     | P19     | 2012.835              | 0.693                                                      | 0.184                  | 0.0262            | 2.75E-5                |
|                     | P20     | 2008.424              | 1.99                                                       | 0.511                  | 0.0704            | 4.18E-5                |
|                     | P21     | 2003.981              | 0.360                                                      | 0.0921                 | 0.0137            | 1.46E-4                |
|                     | P25     | 1985.891              | 1.38                                                       | 0.368                  | 0.0550            | 3.32E-5                |
|                     | P26     | 1981.290              | 1.12                                                       | 0.244                  | 0.0241            | 1.18E-5                |

Table 7. Attenuation Coefficients for Laser Frequencies (Cont.)

| CO Laser Parameters (Cont.) |         |                       | Atmospheric Absorption Coefficients<br>( $\text{km}^{-1}$ ) |                        |                   |                        |
|-----------------------------|---------|-----------------------|-------------------------------------------------------------|------------------------|-------------------|------------------------|
|                             |         |                       | Height - 0 km (Sea Level)                                   |                        | Height = 11-12 km |                        |
| Band                        | Rot. ID | $\nu(\text{cm}^{-1})$ | $k_{\text{trop.}}$                                          | $k_{\text{U.S. Std.}}$ | $k_{\text{sw}}$   | $k_{\text{U.S. Std.}}$ |
| 3-2                         | P27     | 1976.658              | 1.26                                                        | 0.361                  | 0.0735            | 8.21E-5                |
|                             | P28     | 1971.995              | 0.709                                                       | 0.192                  | 0.0310            | 4.77E-5                |
|                             | P30     | 1962.577              | 1.57                                                        | 0.428                  | 0.0690            | 5.50E-5                |
| 4-3                         | P2      | 2056.506              | 0.177                                                       | 0.105                  | 0.0891            | 4.73E-3                |
|                             | P3      | 2052.697              | 0.144                                                       | 0.0443                 | 0.0154            | 4.86E-4                |
|                             | P4      | 2048.853              | 0.358                                                       | 0.119                  | 0.0521            | 1.92E-3                |
|                             | P5      | 2044.975              | 0.907                                                       | 0.250                  | 0.0444            | 2.17E-4                |
|                             | P7      | 2037.116              | 0.666                                                       | 0.178                  | 0.0356            | 5.13E-3                |
|                             | P8      | 2033.135              | 0.215                                                       | 0.0529                 | 6.75E-3           | 1.51E-5                |
|                             | P9      | 2029.121              | 0.206                                                       | 0.0563                 | 0.0101            | 8.78E-5                |
|                             | P10     | 2025.074              | 0.599                                                       | 0.155                  | 0.0229            | 6.88E-5                |
|                             | P11     | 2020.993              | 1.01                                                        | 0.260                  | 0.0359            | 3.06E-5                |
|                             | P13     | 2012.731              | 0.691                                                       | 0.185                  | 0.0262            | 3.66E-5                |
|                             | P14     | 2008.550              | 1.69                                                        | 0.441                  | 0.0636            | 5.12E-5                |
|                             | *P15    | 2004.337              | 0.362                                                       | 0.0915                 | 0.0126            | 1.73E-5                |
|                             | P17     | 1995.812              | 1.32                                                        | 0.351                  | 0.0545            | 3.56E-5                |
|                             | P20     | 1982.783              | 0.759                                                       | 0.205                  | 0.0304            | 2.71E-5                |
| 5-4                         | P21     | 1978.375              | 0.323                                                       | 0.0878                 | 0.0146            | 3.05E-5                |
|                             | P22     | 1973.936              | 0.444                                                       | 0.121                  | 0.0196            | 1.53E-5                |
|                             | P2      | 2030.297              | 0.414                                                       | 0.104                  | 0.0135            | 1.89E-5                |
|                             | P6      | 2014.993              | 1.96                                                        | 0.509                  | 0.0731            | 1.46E-4                |
|                             | *P7     | 2011.082              | 0.589                                                       | 0.154                  | 0.0220            | 1.54E-5                |
|                             | P8      | 2007.127              | 2.08                                                        | 0.528                  | 0.0696            | 1.78E-4                |
|                             | P9      | 2003.158              | 0.449                                                       | 0.114                  | 0.0156            | 1.06E-5                |
|                             | P11     | 1995.100              | 1.90                                                        | 0.504                  | 0.0778            | 5.16E-5                |
|                             | *P14    | 1982.764              | 0.784                                                       | 0.213                  | 0.0311            | 4.00E-5                |
|                             | *P15    | 1978.586              | 0.309                                                       | 0.0836                 | 0.0136            | 1.67E-5                |
|                             | *P16    | 1974.376              | 0.461                                                       | 0.125                  | 0.0201            | 1.52E-5                |
|                             | P21     | 1952.238              | 1.04                                                        | 0.284                  | 0.0474            | 4.43E-5                |
|                             | P25     | 1935.035              | 1.50                                                        | 0.408                  | 0.0720            | 1.72E-3                |
|                             | P26     | 1930.506              | 1.37                                                        | 0.373                  | 0.0610            | 7.10E-5                |
| 6-5                         | P2      | 2004.155              | 0.820                                                       | 0.187                  | 0.0179            | 5.04E-5                |
|                             | P3      | 2000.415              | 0.892                                                       | 0.249                  | 0.0447            | 3.69E-5                |
|                             | P4      | 1996.641              | 1.22                                                        | 0.316                  | 0.0475            | 5.07E-5                |
|                             | P7      | 1985.115              | 0.835                                                       | 0.221                  | 0.0331            | 2.73E-5                |
|                             | P8      | 1981.205              | 2.30                                                        | 0.481                  | 0.0369            | 1.52E-5                |
|                             | P9      | 1977.261              | 0.516                                                       | 0.143                  | 0.0252            | 2.11E-5                |
|                             | P10     | 1973.284              | 0.502                                                       | 0.136                  | 0.0218            | 2.31E-5                |
|                             | *P15    | 1952.901              | 1.06                                                        | 0.290                  | 0.0482            | 4.29E-5                |
|                             | P19     | 1936.007              | 1.42                                                        | 0.386                  | 0.0643            | 1.20E-4                |
|                             | P3      | 1974.409              | 0.453                                                       | 0.123                  | 0.0200            | 1.49E-5                |
| 7-6                         | P4      | 1970.670              | 1.30                                                        | 0.348                  | 0.0543            | 3.77E-5                |
|                             | P6      | 1963.089              | 1.41                                                        | 0.381                  | 0.0609            | 4.75E-5                |
|                             | P7      | 1959.247              | 1.09                                                        | 0.295                  | 0.0482            | 4.97E-5                |
|                             | P14     | 1931.380              | 1.51                                                        | 0.407                  | 0.0664            | 1.19E-4                |

from a constant offset and appear more erratic. Such variations are due to some modified absorption line data and are exemplified by the P10 line of the 7-6 vibrational transition located at  $2177.99 \text{ cm}^{-1}$  which has actually decreased by about 50 percent despite the inclusion of the water vapor continuum. (3) Changes in absorption coefficients in the HF and CO emission region result principally from changes in the molecular absorption line parameters.

Laser emission frequencies identified with an asterisk in Table 7 have been used as input to the LASER program and charts of the four extinction coefficients identified in Eq. (1) have been included in Appendix B. The determination of which charts to include in Appendix B and which to omit was based on the following: (1) In view of the capability for the user to use the LASER program for his own purposes, it seemed unreasonable to include charts for all previously published laser frequencies, even though revisions can be made to all previously published results; (2) charts are included for several lines which the authors have found to be of great current interest; (3) charts are included for a few laser frequencies where previously published results are felt to be in gross error.

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## Appendix A

### The LASER Computer Program

A general flow chart for LASER is given in Figure A1 which shows the basic routines of the computer program. More detailed flow charts are given in Figures A2, A3, and A4 for the main program (LASER) and the subroutines ATMOS and CONT, respectively. The main program reads in the atmospheric models and all other data. The basic molecular absorption coefficient due to discrete absorption lines is performed in subroutine ATMOS. Subroutine CONT adds in the various sources of continuous extinction: Molecular scattering, molecular absorption continua, aerosol absorption and scattering effects. There are no flow charts provided for either the RDTAPE or VOIGT subroutines. The RDTAPE subroutine simply reads the AFGL Atmospheric Absorption Line Parameters Tape and places in storage the molecular absorption line data pertinent to the laser emission frequencies and atmospheric path defined as input. The VOIGT subroutine computes a combined Doppler-Lorentz line shape when the atmospheric pressure is between 10 mb and 0.1 mb. The VOIGT subroutine has been taken from the work of Young<sup>15</sup> where a complete description of the mathematics used in the computer routine can be obtained.

Following the computer flow charts, we have provided a complete listing of the LASER computer program, together with all required input data. If the user desires an extinction coefficient chart similar to those provided in Appendix B, he need only add a single card to the data deck corresponding to the READ statement at Line A 187 in the main program (PROGRAM LASER). This card must have

the frequency (in  $\text{cm}^{-1}$ ) and the BOUND value (corresponding to the maximum frequency spread from an absorption line center that its contribution will be considered) according to the FORMAT (2F10.3). The following is an example of the input data required on this card to generate the laser extinction coefficient chart corresponding to the laser emission frequency,  $924.975 \text{ cm}^{-1}$  in Appendix B:

\*\*\*924.975\*\*\*20.000

If the Bound value is not specified, a default option in the LASER program will set it equal to 20.00.

If the user of the LASER Program wishes to insert an atmospheric model that differs from the six models available as standard input, it is necessary to substitute his data (or model) for one of the standard models in the same format, with quantities provided in the same units as indicated in Table 5, and with the same number of atmospheric levels used to describe the model. The easiest way to insert an alternative model is to maintain consistency with the height structure indicated in the models of Table 5. That is, temperature, pressure, water vapor and ozone data should be inserted for the same 33 altitude levels defined in Table 5. Although a complete 33-level model should always be defined, it is appropriate to substitute data for any one or more levels in one of the models, in order to obtain results for a problem where a more limited set of atmospheric data is available. If the user intends to deviate further from the form of these models, it will be necessary to perform additional modifications to the computer program.

Due to the small variations in molecular scattering coefficients among the six standard atmospheric models, we have only provided these results for the U.S. Standard Atmosphere. If the user desires molecular scattering coefficient results for any other model, he need simply interchange the desired atmospheric model to the position of the sixth model.

A definition of all variables used in program LASER is contained in the computer listing. Copious comment cards have been used throughout in an effort to provide for the user the required detailed understanding of the physics and the flow of logic in the program.

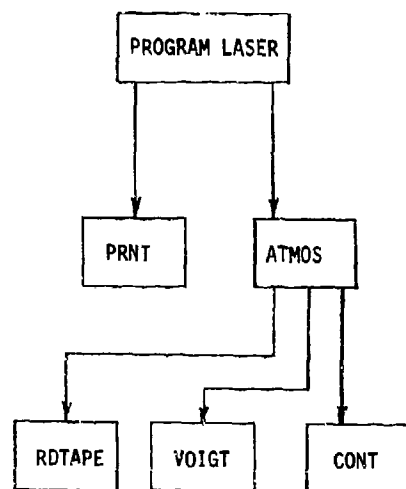


Figure A1. General Flow Chart for LASER Program

PROGRAM LASER  
(Main Program)

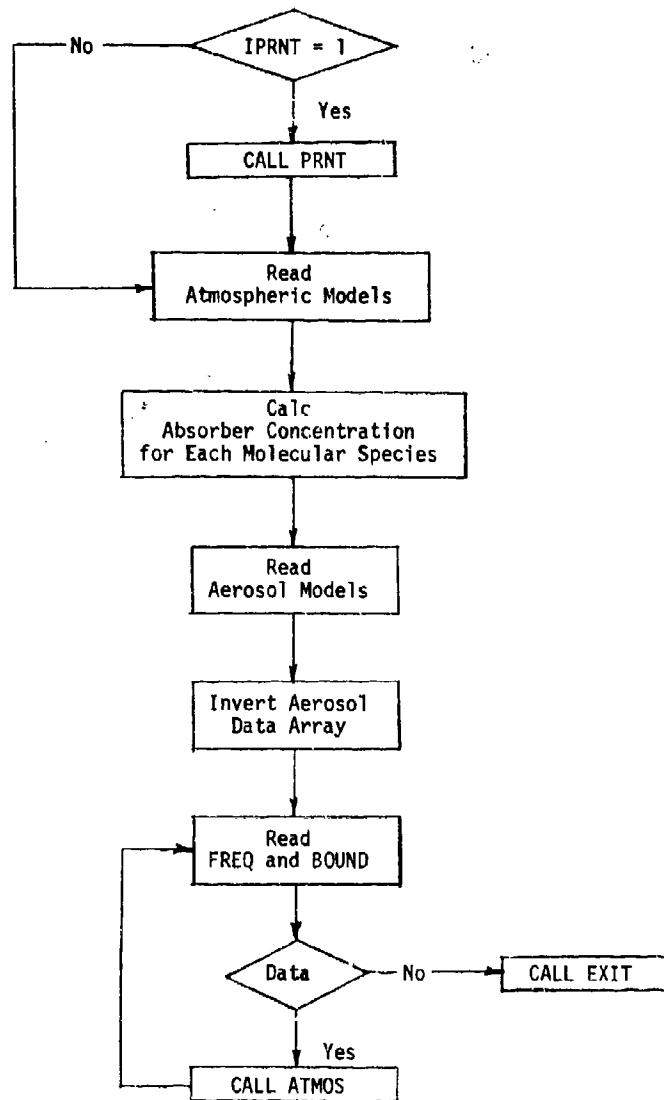


Figure A2. Detailed Flow Chart for LASER Program

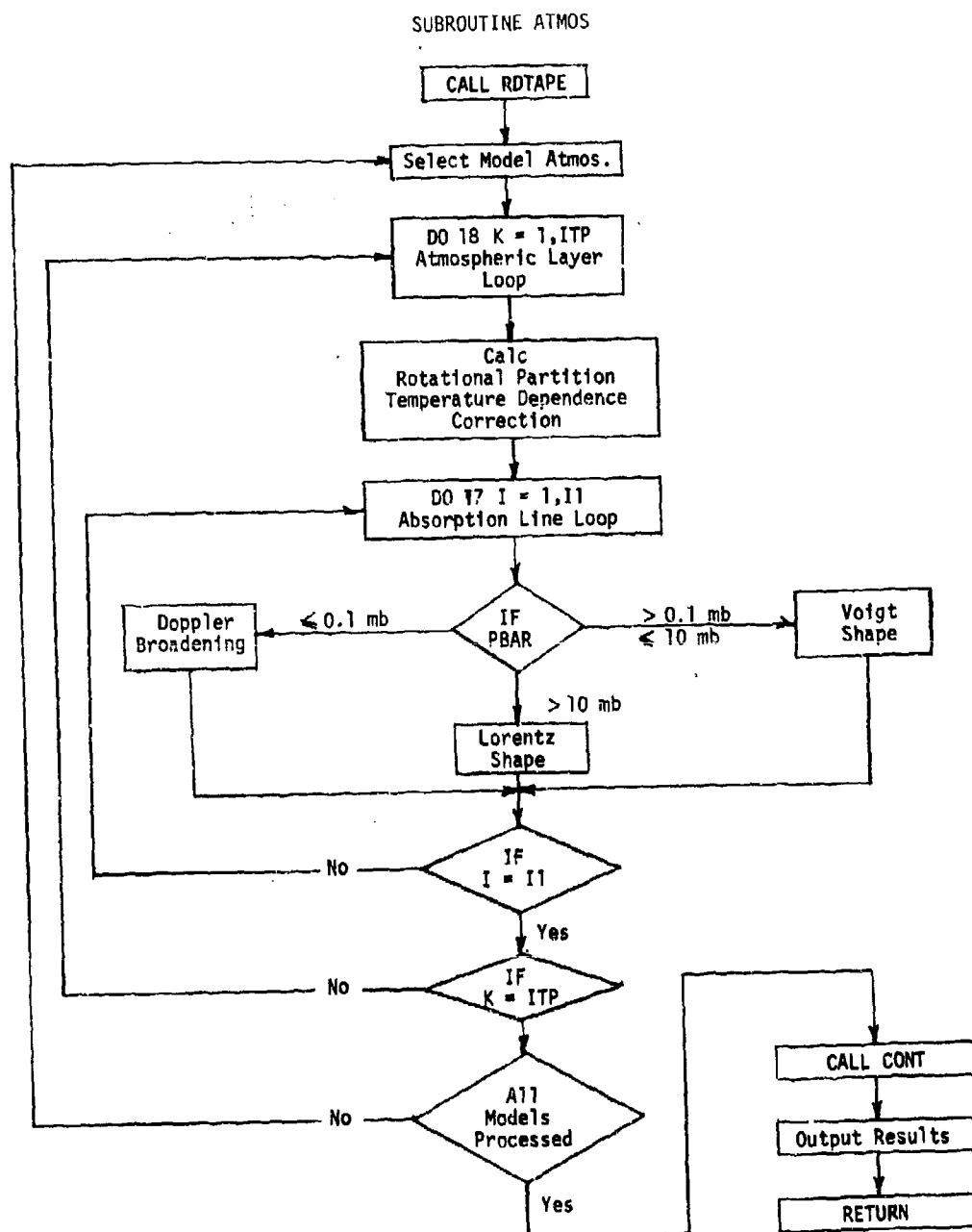


Figure A3. Detailed Flow Chart for Subroutine ATMOS

# SUBROUTINE CONT

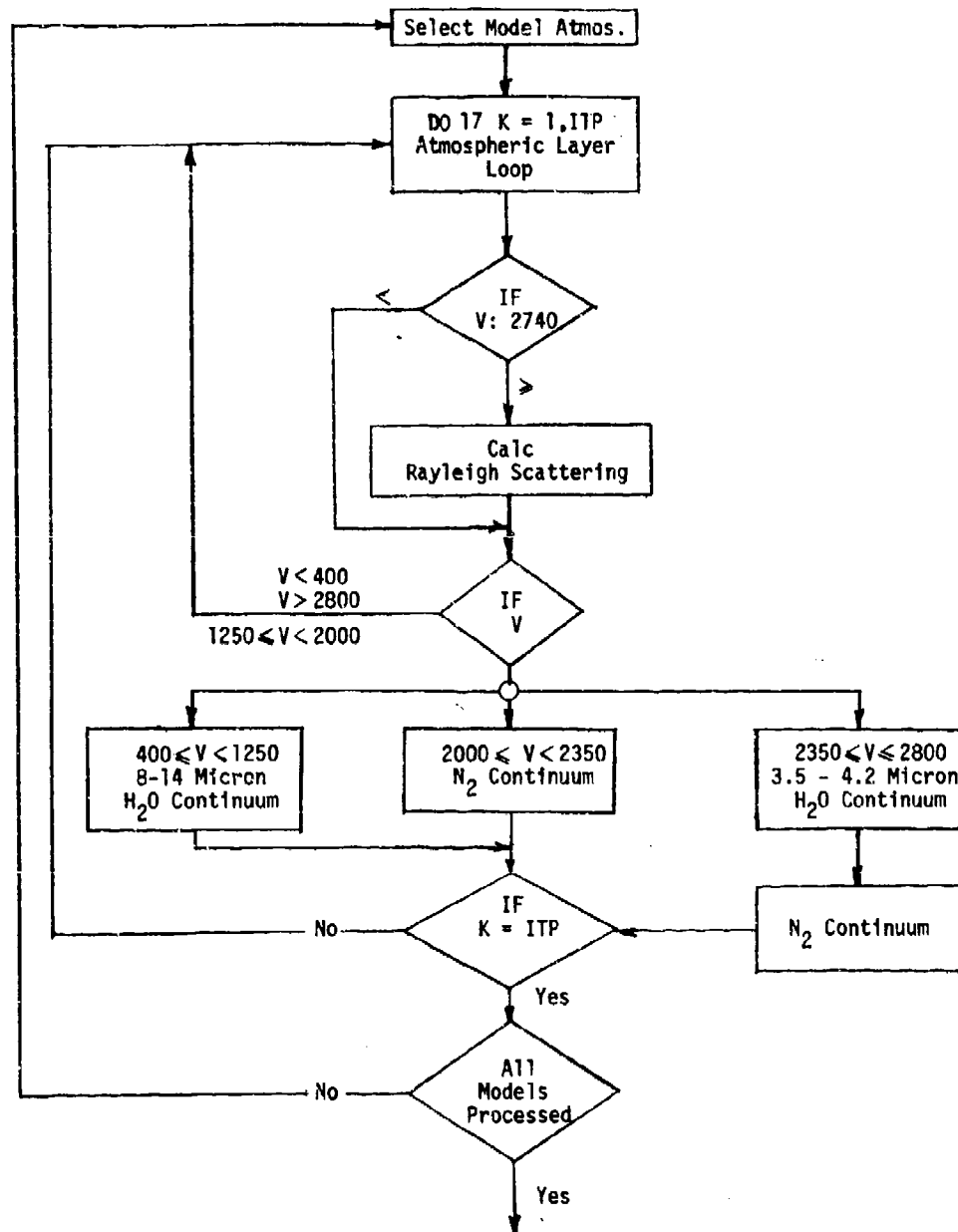


Figure A4. Detailed Flow Chart for CONT Subroutine

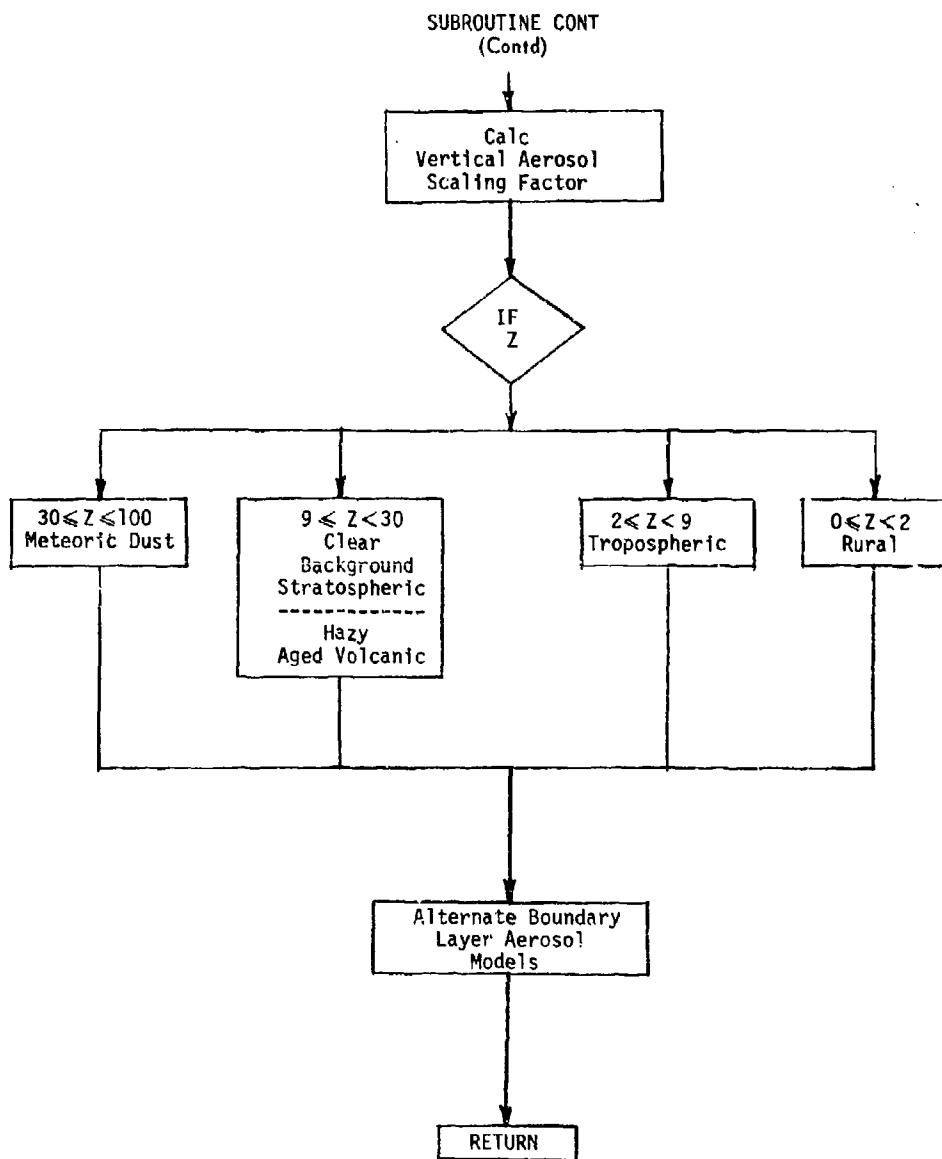


Figure A4. Detailed Flow Chart for CONT Subroutine (Contd)

|                                                                          |   |    |
|--------------------------------------------------------------------------|---|----|
| PROGRAM LASER(INPUT,OUTPUT,TAPE3)                                        | A | 1  |
| C LASER CALCULATES ATMOSPHERIC TRANSMITTANCE THROUGH ATMOSPHERE WITH ITP | A | 2  |
| C LEVELS AND PRINTS OUT VALUES FROM LOWEST PRESSURE TO EACH LEVEL.       | A | 3  |
| C                                                                        | A | 4  |
| C A INPUT DATA FOR VOIGT SUBROUTINE                                      | A | 5  |
| C AAB AEROSOL ABSORPTION COEFFICIENT - INPUT DATA                        | A | 6  |
| C ALFAB LINE HALF WIDTH                                                  | A | 7  |
| C ANL HEIGHT INCREMENT - INPUT DATA                                      | A | 8  |
| C ARSMOOL AEROSOL MODEL - INPUT DATA                                     | A | 9  |
| C ASC AEROSOL SCATTERING COEFFICIENT - INPUT DATA                        | A | 10 |
| C ATMOOL ATMOSPHERIC MODEL - INPUT DATA                                  | A | 11 |
| C BOUND LIMIT OUTSIDE OF WHICH LINE CONTRIBUTIONS ARE NOT                | A | 12 |
| C CONSIDERED - INPUT DATA                                                | A | 13 |
| C CAS CLEAR AEROSOL SCATTERING COEFFICIENT (50 KM SEA LEVEL              | A | 14 |
| C VISIBILITY) - OUTPUT DATA                                              | A | 15 |
| C CAY MOLECULAR ABSORPTION COEFFICIENT - OUTPUT DATA                     | A | 16 |
| C CHI MODIFICATION TO THE LORENTZ LINE SHAPE FOR CO2                     | A | 17 |
| C - INPUT DATA                                                           | A | 18 |
| C CNZ NITROGEN CONTINUUM ABSORPTION COEFFICIENT - INPUT DATA             | A | 19 |
| C CON WATER VAPOR CONTINUUM COEFFICIENT FOR 3.5-4.2 MICRONS              | A | 20 |
| C - INPUT DATA                                                           | A | 21 |
| C DELTAZ DIFFERENCE BETWEEN TWO ADJACENT LAYERS                          | A | 22 |
| C DNU FREQUENCY INCREMENT ASSOCIATED WITH LORENTZ MODIFICATION           | A | 23 |
| C - INPUT DATA                                                           | A | 24 |
| C EPP ENERGY OF LOWER STATE OF TRANSITION                                | A | 25 |
| C FA AEROSOL MODEL FREQUENCY - INPUT DATA                                | A | 26 |
| C FKG INITIAL FREQUENCY FOR THE 3.5-4.2 WATER VAPOR CONTINUUM            | A | 27 |
| C - INPUT DATA                                                           | A | 28 |
| C FNZ NITROGEN CONTINUUM ABSORPTION COEFFICIENT FREQUENCY                | A | 29 |
| C - INPUT DATA                                                           | A | 30 |
| C GNU LINE FREQUENCY                                                     | A | 31 |
| C HAS HAZY: AEROSOL SCATTERING COEFFICIENT (5 KM SEA LEVEL               | A | 32 |
| C VISIBILITY) - OUTPUT DATA                                              | A | 33 |
| C HCONV $0.1 \times 3.34 \times 10^{22}$ MOLECULES/CM2                   | A | 34 |
| C HM INPUT DATA FOR VOIGT SUBROUTINE                                     | A | 35 |
| C HZ1 VERTICAL SCALING FACTOR FOR CLEAR AEROSOL MODEL                    | A | 36 |
| C - INPUT DATA                                                           | A | 37 |
| C HZ2 VERTICAL SCALING FACTOR FOR HAZY AEROSOL MODEL                     | A | 38 |
| C - INPUT DATA                                                           | A | 39 |
| C IPRNT PRINT CONTROL FOR SUBROUTINE PRNT. IPRNT= 1, CALL PRNT           | A | 40 |
| C ITP NUMBER OF ATMOSPHERIC LAYERS - INPUT DATA                          | A | 41 |
| C JT NUMBER OF ELEMENTS IN THE LORENTZ MODIFICATION FACTOR               | A | 42 |
| C - INPUT DATA                                                           | A | 43 |
| C KSAM NUMBER OF MODEL ATMOSPHERES - INPUT DATA                          | A | 44 |
| C MOL MOLECULE IDENTIFIER (1= H2O, 2= CO2, 3= O3, 4= N2O,                | A | 45 |
| C 5= CO, 6= CH4, 7= O2)                                                  | A | 46 |
| C NH NUMBER OF ELEMENTS FOR THE VOIGT INPUT DATA HM AND XX               | A | 47 |
| C O3CON CONVERSION FACTOR FROM CM/M**3 TO MOLECULES/CM**2                | A | 48 |
| C P ATMOSPHERIC LEVEL PRESSURE - INPUT DATA                              | A | 49 |
| C S ABSORPTION LINE INTENSITY                                            | A | 50 |
| C SEC SECANT ANGLE                                                       | A | 51 |
| C T ATMOSPHERIC LAYER TEMPERATURE - INPUT DATA                           | A | 52 |
| C TA1 CLEAR: AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA                | A | 53 |
| C TA2 HAZY: AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA                 | A | 54 |
| C TEMP1 TEMPORARY DATA STORAGE FOR AEROSOL VARIABLE FA                   | A | 55 |
| C TEMP2 TEMPORARY DATA STORAGE FOR AEROSOL VARIABLE ASC                  | A | 56 |
| C TEMP3 TEMPORARY DATA STORAGE FOR AEROSOL VARIABLE AAB                  | A | 57 |
| C TH RAYLEIGH (MOLECULAR) SCATTERING COEFFICIENT                         | A | 58 |
| C - OUTPUT DATA                                                          | A | 59 |
| C UNF UNIFORMLY MIXED GAS CONSTANTS FOR: CO2, N2O, CO, CH4, O2           | A | 60 |
| C V FREQUENCY AT WHICH THE EXTINCTION COEFFICIENT ARE BEING              | A | 61 |
| C CALCULATED - INPUT DATA                                                | A | 62 |
| C VTOP UPPER FREQUENCY LIMIT FOR THE LINE CONTRIBUTIONS.                 | A | 63 |

|   |      |                                                                    |       |
|---|------|--------------------------------------------------------------------|-------|
| C |      | VTOP= J+BOUND                                                      | A 64  |
| C | W    | ABSORBER CONCENTRATION                                             | A 65  |
| C | WBAR | MEAN WATER VAPOR CONCENTRATION FOR A LAYER                         | A 66  |
| C | WG   | SEA LEVEL VALUES OF MOLECULAR ABUNDANCES                           | A 67  |
| C | WH   | WATER VAPOR CONCENTRATION AT A SPECIFIC LEVEL                      | A 68  |
| C | WH1  | SCALE HEIGHT ASSOCIATED WITH WATER VAPOR                           | A 69  |
| C | WH3  | SCALE HEIGHT ASSOCIATED WITH OZONE                                 | A 70  |
| C | WO   | OZONE CONCENTRATION AT A SPECIFIC LEVEL                            | A 71  |
| C | WO3  | MEAN OZONE CONCENTRATION FOR A LAYER                               | A 72  |
| C | WID  | INTERMEDIATE QUANTITY ASSOCIATED WITH COMPUTING                    | A 73  |
| C |      | INTEGRATED WATER AMOUNT                                            | A 74  |
| C | W3D  | INTERMEDIATE QUANTITY ASSOCIATED WITH COMPUTING                    | A 75  |
| C |      | INTEGRATED OZONE AMOUNT                                            | A 76  |
| C | XX   | INPUT DATA FOR VOIGT SUBROUTINE                                    | A 77  |
| C | Z    | ATMOSPHERIC HEIGHT (KM)                                            | A 78  |
| C |      |                                                                    | A 79  |
|   |      | COMMON GNU(1000),S(1000),ALFA0(1000),EPP(1000),MOL(1000)           | A 80  |
|   |      | COMMON Z(40),P(6,40),T(6,40),W(6,7,40),CAY(6,40),WG(6,7)           | A 81  |
|   |      | COMMON TH(6,40),TA1(4,40),TA2(4,40)                                | A 82  |
|   |      | COMMON FA(7,70),ASC(7,70),AAB(7,70),CAS(7,40),HAS(7,40)            | A 83  |
|   |      | COMMON /BLK1/ JT,ONU(20),CHI(20),AML(40)                           | A 84  |
|   |      | COMMON /BLK2/ FK,CON(20),FN2(100),CN2(100),HZ1(40),HZ2(40)         | A 85  |
|   |      | COMMON /BLK3/ NH,HH(10),XX(10),A(42)                               | A 86  |
|   |      | DIMENSION ATM0DL(6,2), ARSH0DL(7,4)                                | A 87  |
|   |      | DIMENSION UNF(7), WH(6,40), WO(6,40)                               | A 88  |
|   |      | DATA (UNF(M),M=1,7)/0.0,7.102E+21,0.0,5.918E+18,1.614E+18,3.443E+1 | A 89  |
|   |      | 19,4.519E+24/                                                      | A 90  |
|   |      | DATA HCONV,OSCON/3.34F+21,1.255E+21/                               | A 91  |
|   |      | PRINT 15                                                           | A 92  |
|   |      | IPRNT=1                                                            | A 93  |
|   |      | IF (IPRNT.F0.1) CALL PRNT                                          | A 94  |
|   |      | VTOP=0                                                             | A 95  |
|   |      | READ 17, ITP,SEC,KSAM                                              | A 96  |
|   |      | PRINT 18, ITP,SEC,KSAM                                             | A 97  |
|   |      | DO 1 I=1,6                                                         | A 98  |
|   |      | READ 19, (WG(I,M),M=1,7)                                           | A 99  |
| 1 |      | CONTINUE                                                           | A 100 |
|   |      | PRINT 20, ((WG(I,M),M=1,7),I=1,6)                                  | A 101 |
| C |      |                                                                    | A 102 |
| C |      | K= 1 TROPICAL                                                      | A 103 |
| C |      | K= 2 MIDLATITUDE SUMMER                                            | A 104 |
| C |      | K= 3 MIDLATITUDE WINTER                                            | A 105 |
| C |      | K= 4 SUBARCTIC SUMMER                                              | A 106 |
| C |      | K= 5 SUBARCTIC WINTER                                              | A 107 |
| C |      | K= 6 U.S. STANDARD                                                 | A 108 |
|   |      | DO 2 J=1,3                                                         | A 109 |
|   |      | I2=2*J                                                             | A 110 |
|   |      | I1=I2-1                                                            | A 111 |
|   |      | READ 21, ((ATM0DL(I,I1),I1=1,2),I=I1,I2)                           | A 112 |
|   |      | DO 2 L=1,ITP                                                       | A 113 |
|   |      | K=ITP-L+1                                                          | A 114 |
|   |      | READ 22, Z(K), (P(I,K),T(I,K),WH(I,K),WO(I,K),I=I1,I2)             | A 115 |
| 2 |      | CONTINUE                                                           | A 116 |
| C |      |                                                                    | A 117 |
| C |      | MOLECULAR DENSITIES ARE ASSUMED TO DECREASE EXPONENTIALLY          | A 118 |
| C |      | BETWEEN CONSECUTIVES LEVELS.                                       | A 119 |
| C |      |                                                                    | A 120 |
|   |      | K1=ITP-1                                                           | A 121 |
|   |      | DO 6 I=1,6                                                         | A 122 |
|   |      | DO 6 K=1,K1                                                        | A 123 |
|   |      | WBAR=(WH(I,K)+WH(I,K+1))/2.0                                       | A 124 |
|   |      | WO3=(WO(I,K)+WO(I,K+1))/2.0                                        | A 125 |
|   |      | DELTA7=Z(K)-Z(K+1)                                                 | A 126 |
|   |      | WID=WH(I,K)/WH(I,K+1)                                              | A 127 |
|   |      | W3D=WO(I,K)/WO(I,K+1)                                              | A 128 |
|   |      | WH1=-DELTA7/ALOG(WID)                                              | A 129 |

|    |                                                                   |       |
|----|-------------------------------------------------------------------|-------|
|    | WH3=-DELTA7/ALOG(W3D)                                             | A 130 |
|    | IF (ABS(W1D-1.00).LT.0.1) GO TO 3                                 | A 131 |
|    | W(I,1,K)=WH1*HCONV*(WH(I,K+1)-WH(I,K))                            | A 132 |
|    | GO TO 4                                                           | A 133 |
| 3  | W(I,1,K)=WBA2*HCONV*DELTA7                                        | A 134 |
| 4  | IF (ABS(W3D-1.00).LT.0.1) GO TO 5                                 | A 135 |
|    | W(I,3,K)=WH3*O3CON*(W0(I,K+1)-W0(I,K))                            | A 136 |
|    | GO TO 6                                                           | A 137 |
| 5  | W(I,3,K)=W03*O3CON*DELTA7                                         | A 138 |
| 6  | CONTINUE                                                          | A 139 |
|    | DO 9 I=1,6                                                        | A 140 |
|    | PRINT 23, (ATMODL(I,II),II=1,2)                                   | A 141 |
| C  |                                                                   | A 142 |
| C  | THE MOLECULAR DENSITIES OF UNIFORMLY MIXED GASES IN A GIVEN LAYER | A 143 |
| C  | IS DIRECTLY RELATED TO THE PRESSURE INCREMENT BETWEEN             | A 144 |
| C  | THE LAYER BOUNDARIES.                                             | A 145 |
| C  |                                                                   | A 146 |
|    | DO 7 K=1,K1                                                       | A 147 |
|    | DO 7 M=1,7                                                        | A 148 |
|    | IF (M.EQ.1.OR.M.EQ.3) GO TO 7                                     | A 149 |
|    | W(I,M,K)=((P(I,K+1)-P(I,K))/1013.0)*UNF(M)                        | A 150 |
| 7  | CONTINUE                                                          | A 151 |
|    | DO 8 K=1,K1                                                       | A 152 |
|    | PRINT 24, (Z(K),P(I,K),T(I,K), (W(I,M,K),M=1,7))                  | A 153 |
| 8  | CONTINUE                                                          | A 154 |
|    | PRINT 24, Z(ITP),P(I,ITP),T(I,ITP)                                | A 155 |
| 9  | CONTINUE                                                          | A 156 |
|    | DO 10 I=1,7                                                       | A 157 |
|    | READ 25, (ARSMODL(I,II),II=1,4)                                   | A 158 |
|    | READ 26, (FA(I,J),ASC(I,J),AAB(I,J),J=1,61)                       | A 159 |
| 10 | CONTINUE                                                          | A 160 |
| C  |                                                                   | A 161 |
| C  | FOR OUR PURPOSES THE AEROSOL EXTINCTION COEFFICIENT ARRAYS        | A 162 |
| C  | ARE INVERTED.                                                     | A 163 |
| C  |                                                                   | A 164 |
|    | DO 11 I=1,7                                                       | A 165 |
|    | DO 11 J=1,30                                                      | A 166 |
|    | L=61-J+1                                                          | A 167 |
|    | TEMP1=FA(I,L)                                                     | A 168 |
|    | TEMP2=ASC(I,L)                                                    | A 169 |
|    | TEMP3=AAB(I,L)                                                    | A 170 |
|    | FA(I,L)=FA(I,J)                                                   | A 171 |
|    | ASC(I,L)=ASC(I,J)                                                 | A 172 |
|    | AAB(I,L)=AAB(I,J)                                                 | A 173 |
|    | FA(I,J)=TEMP1                                                     | A 174 |
|    | ASC(I,J)=TEMP2                                                    | A 175 |
|    | AAB(I,J)=TEMP3                                                    | A 176 |
| 11 | CONTINUE                                                          | A 177 |
|    | DO 12 I=1,7                                                       | A 178 |
|    | DO 12 J=1,61                                                      | A 179 |
|    | FA(I,J)=1.0E+04/FA(I,J)                                           | A 180 |
| 12 | CONTINUE                                                          | A 181 |
|    | PRINT 16                                                          | A 182 |
|    | DO 13 I=1,7                                                       | A 183 |
|    | PRINT 27, (ARSMODL(I,II),II=1,4)                                  | A 184 |
|    | PRINT 28, (FA(I,J),ASC(I,J),AAB(I,J),J=1,61)                      | A 185 |
| 13 | CONTINUE                                                          | A 186 |
| 14 | READ 29, V,BOUND                                                  | A 187 |
|    | IF (BOUND.LE.0.0) BOUND=20.0                                      | A 188 |
|    | #FIND 3                                                           | A 189 |
|    | IF (V.EQ.0) GO TO 15                                              | A 190 |
|    | IF (V.LT.VTOP) #FIND 3                                            | A 191 |
|    | CALL ATMOS (V,BOUND,VTOP,SEC,ITP,KSAM)                            | A 192 |
|    | GO TO 14                                                          | A 193 |
| 15 | CONTINUE                                                          | A 194 |
|    | CALL EXIT                                                         | A 195 |

|    |                                                                       |       |
|----|-----------------------------------------------------------------------|-------|
| C  |                                                                       | A 196 |
| 16 | FORMAT (I1H1)                                                         | A 197 |
| 17 | FORMAT (I3,F7.3,I3)                                                   | A 198 |
| 18 | FORMAT (////6*X,*ITP=*I3/63X,*SEC=*F6.3/63X,*KSAM=*I3)                | A 199 |
| 19 | FORMAT (7E10.3)                                                       | A 200 |
| 20 | FORMAT (////44X,*SEA LEVEL VALUES OF MOLECULAR ABUNDANCES*/58X,*I     | A 201 |
|    | 1MOLECULES/SQ CM/KM)/(32X,7(1PE10.2)))                                | A 202 |
| 21 | FORMAT (2(A10,A0))                                                    | A 203 |
| 22 | FORMAT (F6.1,2(F10.3,F6.1,2E10.1))                                    | A 204 |
| 23 | FORMAT (I1H1//54X,A10,A6//44X,*ALL QUANTITIES IN UNITS OF MOLECUL     | A 205 |
|    | 1FS/SQ CM//44X,*CONTAINED BETWEEN SUCCESSION HEIGHT INCREMENTS.*//44X | A 206 |
|    | 2,*FIRST ROW IS FOR LAYER FROM 100 - 70 KM.*//13X,*HT*,3X,*PRESSURE   | A 207 |
|    | 3*,3X,*TEMP*,5X,*WATER*,8X,*CARBON*,10X,*NITROUS*,7X,*CARBON*/12X,*   | A 208 |
|    | 4(KM)*.4X,*(MP)*.6X,*(K)*.5X,*VAPOR*,7X,*DIOXIDE*,7X,*OZONE*,8X,*OX   | A 209 |
|    | SIDE*,7X,*MONOXIDE*,5X,*METHANE*,7X,*OXYGEN*/                         | A 210 |
| 24 | FORMAT (11X,0PF5.1,0PF10.3,0PF7.1,7(1PE13.5))                         | A 211 |
| 25 | FORMAT (4A6)                                                          | A 212 |
| 26 | FORMAT (3(F8.2,2F7.5))                                                | A 213 |
| 27 | FORMAT (////56X,4A6//7X,4(5X,*FREQUENCY*,3X,*SCAT*,5X,*ABS*)/7X,4(    | A 214 |
|    | 17X,*CM-1)*.2(4X,*COEF*))//                                           | A 215 |
| 28 | FORMAT ((9X,4(1F13.3,2F8.5)))                                         | A 216 |
| 29 | FORMAT (2F10.3)                                                       | A 217 |
|    | END                                                                   | A 218 |
|    | SUBROUTINE ATMOS (V,BOUND,VTOP,SEC,ITP,KSAM)                          | B 1   |
| C  | AAR AFROSOL ABSORPTION COEFFICIENT - INPUT DATA                       | B 2   |
| C  | ABSLI MOLECULAR ABSORPTION COEFFICIENT                                | B 3   |
| C  | ALFAD LINE HALF WIDTH                                                 | B 4   |
| C  | ALPHAD DOPPLER HALF-WIDTH                                             | B 5   |
| C  | ALPHAL LORENTZ HALF-WIDTH                                             | B 6   |
| C  | AML HEIGHT INCREMENT - INPUT DATA                                     | B 7   |
| C  | ARGO INTERMEDIATE QUANTITY ASSOCIATED WITH DOPPLER BROADENING         | B 8   |
| C  | ASC AFROSOL SCATTERING COEFFICIENT - INPUT DATA                       | B 9   |
| C  | BOUND LIMIT OUTSIDE OF WHICH LINE CONTRIBUTIONS ARE NOT               | B 10  |
| C  | CONSFRED - INPUT DATA                                                 | B 11  |
| C  | C VELOCITY OF LIGHT                                                   | B 12  |
| C  | CA HALF-WIDTH TEMPERATURE CORRECTION FACTOR                           | B 13  |
| C  | CAS CLEAR AFROSOL SCATTERING COEFFICIENT (50 KM SEA LEVEL             | B 14  |
| C  | VISIBILITY) - OUTPUT DATA                                             | B 15  |
| C  | CAY MOLECULAR ABSORPTION COEFFICIENT - OUTPUT DATA                    | B 16  |
| C  | CHI MODIFICATION TO THE LORENTZ LINE SHAPE FOR CO2                    | B 17  |
| C  | - INPUT DATA                                                          | B 18  |
| C  | CONST $(R*1.0E-03)/(A*1.0E+05)$ , WHERE R IS GAS CONSTANT AND A       | B 19  |
| C  | IS AVOGADRO'S NUMBER                                                  | B 20  |
| C  | CS1 BOLTZMANN'S TEMPERATURE CORRECTION FACTOR                         | B 21  |
| C  | CS2 PARTITION FUNCTION TEMPERATURE CORRECTION                         | B 22  |
| C  | C5 $2 * \text{BOLTZMANN'S CONSTANT} * \text{AVOGADRO'S NUMBER}$       | B 23  |
| C  | C6 $1/PI**0.5$                                                        | B 24  |
| C  | DFL HEIGHT INCREMENT BETWEEN LAYERS                                   | B 25  |
| C  | DNV FREQUENCY INCREMENT ASSOCIATED WITH LORENTZ MODIFICATION          | B 26  |
| C  | - INPUT DATA                                                          | B 27  |
| C  | FPP ENERGY OF LOWER STATE OF TRANSITION                               | B 28  |
| C  | GNU LINE FREQUENCY                                                    | B 29  |
| C  | H ATMOSPHERIC HEIGHT (KM)                                             | B 30  |
| C  | HAS HAZY AFROSOL SCATTERING COEFFICIENT (5 KM SEA LEVEL               | B 31  |
| C  | VISIBILITY) - OUTPUT DATA                                             | B 32  |
| C  | IK1 ATMOSPHERIC MODEL INDEX                                           | B 33  |
| C  | IPRNT PRINT CONTROL                                                   | B 34  |
| C  | II NUMBER OF ABSORPTION LINES                                         | B 35  |
| C  | ITD NUMBER OF ATMOSPHERIC LAYERS - INPUT DATA                         | B 36  |
| C  | JT NUMBER OF ELEMENTS IN THE LORENTZ MODIFICATION FACTOR              | B 37  |
| C  | - INPUT DATA                                                          | B 38  |
| C  | KSAM NUMBER OF MODEL ATMOSPHERES - INPUT DATA                         | B 39  |
| C  | M MOLECULAR SPECIE INDEX NUMBER                                       | B 40  |
| C  | MOL MOLECULE IDENTIFIER (1= H2O, 2= CO2, 3= O3, 4= N2O,               | B 41  |
| C  | 5= CO, 6= CH4, 7= O2)                                                 | B 42  |
| C  | P ATMOSPHERIC LEVEL PRESSURE - INPUT DATA                             | B 43  |

|   |                                                              |                                                                                  |   |     |
|---|--------------------------------------------------------------|----------------------------------------------------------------------------------|---|-----|
| C | PBAR                                                         | AVRAGE LAYER PRESSURE                                                            | B | 44  |
| C | PEFF                                                         | EFFECTIVE PRESSURE (INCLUDES WATER VAPOR BROADENING FACTOR)                      | B | 45  |
| C |                                                              |                                                                                  | B | 46  |
| C | PH2O                                                         | WATER VAPOR PRESSURE                                                             | B | 47  |
| C | PI                                                           | RATIO OF CIRCUMFERENCE OF A CIRCLE TO ITS DIAMETER                               | B | 48  |
| C | RATIO                                                        | INTERMEDIATE QUANTITY ASSOCIATED WITH LORENTZ LINE MODIFICATION                  | B | 49  |
| C |                                                              |                                                                                  | B | 50  |
| C | S                                                            | ABSOR ION LINE INTENSITY                                                         | B | 51  |
| C | SFC                                                          | SECANT ANGLE                                                                     | B | 52  |
| C | ST                                                           | TEMPERATURE CORRECTED LINE INTENSITY                                             | B | 53  |
| C | T                                                            | ATMOSPHERIC LAYER TEMPERATURE - INPUT DATA                                       | B | 54  |
| C | YA1                                                          | CLEAR: AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA                              | B | 55  |
| C | TA2                                                          | HAZY: AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA                               | B | 56  |
| C | TBAR                                                         | AVRAGE LAYER TEMPERATURE                                                         | B | 57  |
| C | TEMP0                                                        | 296 (K)                                                                          | B | 58  |
| C | TM                                                           | RAYLEIGH (MOLECULAR) SCATTERING COEFFICIENT - OUTPUT DATA                        | B | 59  |
| C |                                                              |                                                                                  | B | 60  |
| C | V                                                            | FREQUENCY AT WHICH THE EXTINCTION COEFFICIENTS ARE BEING CALCULATED - INPUT DATA | B | 61  |
| C | VBOT                                                         | LOWER FREQUENCY LIMIT FOR THE LINE CONTRIBUTIONS. VBOT= V-BOUND                  | B | 62  |
| C |                                                              |                                                                                  | B | 63  |
| C | VTOP                                                         | UPPER FREQUENCY LIMIT FOR THE LINE CONTRIBUTIONS. VTOP= V+BOUND                  | B | 64  |
| C |                                                              |                                                                                  | B | 65  |
| C | VXY                                                          | VOIGT LINE SHAPE VARIABLE                                                        | B | 66  |
| C | W                                                            | ABSORBER CONCENTRATION                                                           | B | 67  |
| C | WG                                                           | SFA LEVEL VALUES OF MOLECULAR ABUNDANCES                                         | B | 68  |
| C | WMOL                                                         | MOLECULAR WEIGHT                                                                 | B | 69  |
| C | WV                                                           | WAVELENGTH CORRESPONDING TO FREQUENCY, V                                         | B | 70  |
| C | X                                                            | VOIGT LINE SHAPE VARIABLE                                                        | B | 71  |
| C | X1                                                           | LORENTZ LINE MODIFICATION VARIABLE                                               | B | 72  |
| C | Y                                                            | VOIGT LINE SHAPE VARIABLE                                                        | B | 73  |
| C | 7                                                            | ABSOLUTE DISTANCE FROM THE LINE CENTER FREQUENCY V                               | B | 74  |
|   |                                                              | COMMON GNU(1000),S(1000),ALFA0(1000),EPP(1000),MOL(1000)                         | B | 75  |
|   |                                                              | COMMON H(40),P(6,40),T(6,40),W(6,7,40),CAY(6,40),WG(6,7)                         | B | 76  |
|   |                                                              | COMMON TM(6,40),TA1(4,40),TA2(4,40)                                              | B | 77  |
|   |                                                              | COMMON FA(7,70),ASC(7,70),AAB(7,70),CAS(7,40),HAS(7,40)                          | B | 78  |
|   |                                                              | COMMON /BLK1/ JT,GNU(20),CHI(20),AML(40)                                         | B | 79  |
|   |                                                              | DIMENSION WTMOL(7), CS2(7), ALPHAD(7), DEL(7)                                    | B | 80  |
|   |                                                              | DIMENSION ST(1000)                                                               | B | 81  |
|   |                                                              | DATA C,C5,C6,PI/2.99791E+10,1.6629E+08,0.56419,3.1415927/                        | B | 82  |
|   |                                                              | DATA (WTMOL(I),I=1,7)/18.0,44.0,46.0,44.0,28.0,16.0,32.0/                        | B | 83  |
|   |                                                              | DATA (DEL(I),I=1,7)/30.0,20.0,5*5.0/                                             | B | 84  |
|   |                                                              | DATA CONST/1.380258E-24/                                                         | B | 85  |
| C |                                                              |                                                                                  | B | 86  |
| C | CONST=                                                       | (R*1.0E-03)/(A*1.0E+05)                                                          | B | 87  |
| C |                                                              | = (8.3144E+07*1.0E-03)/(6.0238E+23*1.0E+05)                                      | B | 88  |
| C |                                                              |                                                                                  | B | 89  |
|   | IPRNT=0                                                      |                                                                                  | B | 90  |
|   | IK1=0                                                        |                                                                                  | B | 91  |
|   | VBOT=V-BOUND                                                 |                                                                                  | B | 92  |
|   | VTOP=V+BOUND                                                 |                                                                                  | B | 93  |
|   | CALL RDTAPE (VBOT,VTOP,I1,ITP,SEC)                           |                                                                                  | B | 94  |
|   |                                                              |                                                                                  | B | 95  |
| C |                                                              |                                                                                  | B | 96  |
| C | DO 18 IS THE MAJOR COMPUTATIONAL LOOP ON ATMOSPHERIC LAYER   |                                                                                  | B | 97  |
| C | WITHIN WHICH MONOCHROMATIC MOLECULAR ABSORPTION COEFFICIENTS |                                                                                  | B | 98  |
| C | ARE COMPUTED.                                                |                                                                                  | B | 99  |
| C |                                                              |                                                                                  | B | 100 |
| 1 | IK1=IK1+1                                                    |                                                                                  | B | 101 |
|   | TEMP0=296.0                                                  |                                                                                  | B | 102 |
|   | DO 18 K=1,ITP                                                |                                                                                  | B | 103 |
|   | IF (K.EQ.ITP) GO TO 2                                        |                                                                                  | B | 104 |
|   | PBAR=(P(IK1,K)+P(IK1,K+1))/2.0                               |                                                                                  | B | 105 |
|   | TBAR=(T(IK1,K)+T(IK1,K+1))/2.0                               |                                                                                  | B | 106 |
|   | PH2O=CONST*TBAR*W(IK1,1,K)/ABS(H(K)-H(K+1))                  |                                                                                  | B | 107 |
|   | GO TO 3                                                      |                                                                                  | B | 108 |
| 2 | PBAR=P(IK1,ITP)                                              |                                                                                  | B | 109 |

|    |                                                                   |       |
|----|-------------------------------------------------------------------|-------|
|    | TBAR=T(IK1,ITP)                                                   | B 110 |
|    | PH20=CONST*TRAR*WG(IK1,1)                                         | B 111 |
| 3  | CS1=(TEMP0-TBAR)/(TEMP0*TBAR*0.6951)                              | B 112 |
|    | GA=SQRT(296.0/TBAR)                                               | B 113 |
| C  |                                                                   | B 114 |
| C  | DETERMINE CORRECT TEMPERATURE DEPENDENCE OF ROTATIONAL PARTITION  | B 115 |
| C  | FUNCTION                                                          | B 116 |
| C  |                                                                   | B 117 |
|    | DO 6 M=1,7                                                        | B 118 |
|    | GO TO (4,5,4,5,5,4,5), M                                          | B 119 |
| 4  | CS2(M)=(TEMP0/TBAR)**1.5                                          | B 120 |
|    | GO TO 6                                                           | B 121 |
| 5  | CS2(M)=TEMP0/TBAR                                                 | B 122 |
| 6  | ALPHA(M)=SQRT(CS2*TRAR/WHOL(M))*V/C                               | B 123 |
|    | DO 7 I=1,I1                                                       | B 124 |
|    | M=MOL(I)                                                          | B 125 |
| 7  | ST(I)=S(I)*CS2(M)*EXP(-EPP(I)*CS1)                                | B 126 |
|    | CAY(IK1,K)=0.0                                                    | B 127 |
| C  |                                                                   | B 128 |
| C  | DO 17 LOOP CYCLES THRU ALL ABSORPTION LINES READ FROM HITRAN TAPE | B 129 |
| C  | AND ADD THEIR CONTRIBUTIONS TO THE ABSORPTION COEFFICIENT         | B 130 |
| C  | AT THE FREQUENCY, V.                                              | B 131 |
| C  |                                                                   | B 132 |
|    | DO 17 I=1,I1                                                      | B 133 |
|    | M=MOL(I)                                                          | B 134 |
|    | PEFF=PBAR                                                         | B 135 |
|    | IF (M.EQ.1) PEFF=PBAR+4.0*PH20                                    | B 136 |
|    | ALPHA=ALFA0(I)*PEFF*GA/1013.0                                     | B 137 |
|    | Z=ABS(V-GNU(I))                                                   | B 138 |
|    | IF (M.NE.2) X1=1.0                                                | B 139 |
|    | IF (M.NE.2) GO TO 10                                              | B 140 |
|    | X1=0.0                                                            | B 141 |
|    | JT1=JT-1                                                          | B 142 |
|    | DO 9 L=1,JT1                                                      | B 143 |
|    | IF (Z.GF.DNU(L).AND.Z.LE.DNU(L+1)) GO TO A                        | B 144 |
|    | GO TO 9                                                           | B 145 |
| 8  | RATIO=(CHI(L+1)-CHI(L))/(DNU(L+1)-DNU(L))                         | B 146 |
|    | X1=RATIO*(Z-DNU(L))+CHI(L)                                        | B 147 |
|    | GO TO 11                                                          | B 148 |
| 9  | CONTINUE                                                          | B 149 |
| 10 | CONTINUE                                                          | B 150 |
| C  |                                                                   | B 151 |
| C  | IF PBAR .LE. 0.1 MB, PURE DOPPLER BROADENING APPLIES.             | B 152 |
| C  |                                                                   | B 153 |
| 11 | IF (PBAR-0.10) 12,12,13                                           | B 154 |
| 12 | ARGD=Z/ALPHA(M)                                                   | B 155 |
|    | IF (ARGD.GT.10.0) GO TO 17                                        | B 156 |
|    | ABSLI=(C6/ALPHA(M))*ST(I)*EXP(-(ARGD)**2)*W(IK1,M,K)              | B 157 |
|    | CAY(IK1,K)=CAY(IK1,K)+ABSLI                                       | B 158 |
|    | GO TO 17                                                          | B 159 |
| C  |                                                                   | B 160 |
| C  | IF PBAR IS BETWEEN 0.1 AND 10 MB, VOIGT SHAPE APPLIES.            | B 161 |
| C  |                                                                   | B 162 |
| 13 | IF (PBAR-10.0) 14,14,15                                           | B 163 |
| 14 | X=Z/ALPHA(M)                                                      | B 164 |
|    | Y=ALPHA/ALPHA(M)                                                  | B 165 |
|    | VXY=VOIGT(X,Y)                                                    | B 166 |
|    | ABSLI=VXY*ST(I)*0.56419/ALPHA(M)*W(IK1,M,K)                       | B 167 |
|    | CAY(IK1,K)=CAY(IK1,K)+ABSLI                                       | B 168 |
|    | IF (VXY.LT.0.0) PRINT 24, X,Y,VXY                                 | B 169 |
|    | GO TO 17                                                          | B 170 |
| C  |                                                                   | B 171 |
| C  | IF PBAR .GT. 10 MB, LORENTZ SHAPE APPLIES.                        | B 172 |
| C  |                                                                   | B 173 |
| 15 | IF (K.EQ.ITP) GO TO 16                                            | B 174 |
|    | CAY(IK1,K)=ST(I)*ALPHA/(PI*(7*7*ALPHA*ALPHA))*W(IK1,M,K)*X1+CAY   | B 175 |

|    |                                                                                          |        |
|----|------------------------------------------------------------------------------------------|--------|
|    | 1(IK1,K)                                                                                 | 9 176  |
|    | GO TO 17                                                                                 | 9 177  |
| 16 | CAY(IK1,K)=ST(I)*ALPHAL*WG(IK1,M)/(PI*(Z*Z+ALPHAL*ALPHAL))*X1+CAY(IK1,K)                 | 9 178  |
| 17 | CONTINUE                                                                                 | 9 179  |
| 18 | CONTINUE                                                                                 | 9 180  |
|    | IF (IPRNT.FO.1) PRINT 25, V                                                              | 9 181  |
|    | IF (IK1.GE.KSAM) GO TO 19                                                                | 9 182  |
|    | GO TO 1                                                                                  | 9 183  |
| 19 | CALL CONT (V,ITP,KSAM,SEC)                                                               | 9 184  |
| C  |                                                                                          | 9 185  |
| C  | EXTINCTION COEFFICIENT FOR HIGH ATMOSPHERIC LAYERS MUST BE                               | 9 186  |
| C  | DIVIDED BY LAYER THICKNESS SO THAT ALL RESULTS ARE IN                                    | 9 187  |
| C  | UNITS, KM**-1.                                                                           | 9 188  |
| C  |                                                                                          | 9 189  |
|    | DO 20 I=1,KSAM                                                                           | 9 190  |
|    | DO 20 K=1,7                                                                              | 9 191  |
|    | CAY(I,K)=CAY(I,K)/DEL(K)                                                                 | 9 192  |
| 20 | CONTINUE                                                                                 | 9 193  |
|    | WV=10000.0/V                                                                             | 9 194  |
|    | PRINT 26, WV,V                                                                           | 9 195  |
|    | DO 23 KO=1,ITP                                                                           | 9 196  |
|    | K=ITP-KO+1                                                                               | 9 197  |
|    | DO 21 I=1,KSAM                                                                           | 9 198  |
|    | IF (CAY(I,K).LT.1.0E-6) CAY(I,K)=0.                                                      | 9 199  |
|    | IF (TM(I,K).LT.1.0E-6) TM(I,K)=0.                                                        | 9 200  |
| 21 | CONTINUE                                                                                 | 9 201  |
|    | DO 22 I=1,4                                                                              | 9 202  |
|    | IF (TA1(I,K).LT.1.0E-6) TA1(I,K)=0.0                                                     | 9 203  |
|    | IF (CAS(I,K).LT.1.0E-6) CAS(I,K)=0.0                                                     | 9 204  |
|    | IF (TA2(I,K).LT.1.0E-6) TA2(I,K)=0.0                                                     | 9 205  |
|    | IF (HAS(I,K).LT.1.0E-6) HAS(I,K)=0.0                                                     | 9 206  |
| 22 | CONTINUE                                                                                 | 9 207  |
|    | PRINT 27, AML(K),CAY(6,K),TM(6,K),(CAY(JM,K),JM=1,5),TA1(1,K),CAS(1,K),TA2(1,K),HAS(1,K) | 9 208  |
| 23 | CONTINUE                                                                                 | 9 209  |
|    | PRINT 28                                                                                 | 9 210  |
|    | PRINT 29, TA2(4,ITP),HAS(4,ITP)                                                          | 9 211  |
|    | PRINT 30, TA1(3,ITP),CAS(3,ITP),TA2(3,ITP),HAS(3,ITP)                                    | 9 212  |
|    | PRINT 31, TA1(2,ITP),CAS(2,ITP)                                                          | 9 213  |
|    | PRINT 32, V,BOUND                                                                        | 9 214  |
|    | PRINT 33, I1,GNU(1),GNU(I1)                                                              | 9 215  |
|    | I1=0                                                                                     | 9 216  |
|    | RETURN                                                                                   | 9 217  |
| C  |                                                                                          | 9 218  |
| 24 | FORMAT (* X,Y,VX!,*,3E15.6)                                                              | 9 219  |
| 25 | FORMAT (4H V =F11.4)                                                                     | 9 220  |
| 26 | FORMAT (1H1,39X,*WAVELENGTH = *,F15.6,* MICROMETERS*/40X,* FREQUEN                       | 9 221  |
|    | 1CY = *,F15.3,* WAVENUMBER*///19X,*U.S.*,16X,2(5X,*MIDLAT*),1X,2(2X                      | 9 222  |
|    | 2,*SUBARCTIC*),18X,*AFROSOL*/17X,*STANDARD*,7X,*TROPICAL*,4X,*SUMME                      | 9 223  |
|    | 3*,5X,*WINTER*,5X,*SUMMER*,5X,*WINTER*,10X,*CLEAR*,16X,*HAZY*//)                         | 9 224  |
| 27 | FORMAT (A10,1PF11.2,1PE9.2,5(1PE11.2),2(1PF11.2,1PE9.2))                                 | 9 225  |
| 28 | FORMAT (///43X,*ALTERNATE BOUNDARY LAYER AEROSOL MODELS*//49X,*CLEA                      | 9 226  |
|    | 1R*,17X,*HAZY*//)                                                                        | 9 227  |
| 29 | FORMAT (29X,*URBAN *,2(9F *****),3X,2(1PF9.2)/)                                          | 9 228  |
| 30 | FORMAT (29X,*HARTTIME *,2(1PF9.2),3X,2(1PF9.2)/)                                         | 9 229  |
| 31 | FORMAT (29X,*TROPOSPHERIC*,2(1PF9.2),3X,2(9H *****)/)                                    | 9 230  |
| 32 | FORMAT (///29X,*V=*F12.3,* BOUND= *F12.3)                                                | 9 231  |
| 33 | FORMAT (29X,*I1= *,15,3X,*GNU(1)= *,F10.3,3X,*GNU(I1)= *,F10.3)                          | 9 232  |
|    | END                                                                                      | 9 233  |
|    | SUBROUTINE ROTAPE (V1,V2,I1,ITP,SEC)                                                     | 9 234  |
| C  | ALFA0 LINE HALF WIDTH                                                                    | 9 235- |
| C  | ALP LINE HALF-WIDTH TIMES THE AVERAGE ATMOSPHERIC PRESSURE                               | C 1    |
| C  | FPP ENERGY OF LOWER STATE OF TRANSITION                                                  | C 2    |
| C  | GNU LINE FREQUENCY                                                                       | C 3    |
| C  | TEDE TAPE/DISK END OF FILE COUNT                                                         | C 4    |
|    |                                                                                          | C 5    |
|    |                                                                                          | C 6    |

|   |       |                                                              |   |    |
|---|-------|--------------------------------------------------------------|---|----|
| C | ITI   | MOLECULAR LINE SPECIE IDENTIFICATION TAPE/DISK               | C | 7  |
| C |       | - INPUT DATA                                                 | C | 8  |
| C | ITP   | NUMBER OF ATMOSPHERIC LAYERS - INPUT DATA                    | C | 9  |
| C | I1    | NUMBER OF ABSORPTION LINES                                   | C | 10 |
| C | MOL   | MOLECULE IDENTIFIER (1= H2O, 2= CO2, 3= O3, 4= N2O,          | C | 11 |
| C |       | 5= CO, 6= CH4, 7= O2)                                        | C | 12 |
| C | NIREC | NUMBER OF LINES PER RECORD                                   | C | 13 |
| C | P     | ATMOSPHERIC LEVEL PRESSURE - INPUT DATA                      | C | 14 |
| C | PATH  | OPTICAL DEPTH AT LINE CENTER FOR 1 - KM SEA LEVEL PATH       | C | 15 |
| C | S     | ABSORPTION LINE INTENSITY                                    | C | 16 |
| C | SEC   | SECANT ANGLE                                                 | C | 17 |
| C | TI    | ABSORPTION LINE DATA TAPE/DISK - INPUT DATA                  | C | 18 |
| C | TMAX  | MAXIMUM FREQUENCY OF A TAPE/DISK RECORD                      | C | 19 |
| C | TMIN  | MINIMUM FREQUENCY OF A TAPE/DISK RECORD                      | C | 20 |
| C | TTM   | INTERMEDIATE FREQUENCY STORAGE VARIABLE                      | C | 21 |
| C | V     | FREQUENCY AT WHICH THE EXTINCTION COEFFICIENTS ARE BEING     | C | 22 |
| C |       | CALCULATED - INPUT DATA                                      | C | 23 |
| C | VREC  | INTERMEDIATE MAXIMUM FREQUENCY STORAGE VARIABLE              | C | 24 |
| C | VRUN  | INTERMEDIATE FREQUENCY STORAGE VARIABLE                      | C | 25 |
| C | V1    | LOWER FREQUENCY LIMIT FOR THE LINE CONTRIBUTIONS.            | C | 26 |
| C |       | VBOT= V-BOUND                                                | C | 27 |
| C | V2    | UPPER FREQUENCY LIMIT FOR THE LINE CONTRIBUTIONS.            | C | 28 |
| C |       | VTOP= V+BOUND                                                | C | 29 |
| C | WG    | SCALEVEL VALUES OF MOLECULAR ABUNDANCES                      | C | 30 |
| C | WING  | LINE WING CONTRIBUTION TO ABSOLUTE COEFFICIENT (USED FOR     | C | 31 |
| C |       | REJECTING WEAK LINES)                                        | C | 32 |
| C | Z     | ABSOLUTE DISTANCE FROM THE LINE CENTER FREQUENCY V           | C | 33 |
|   |       | COMMON GNU(1000),S(1000),ALFAD(1000),EPP(1000),MOL(1000)     | C | 34 |
|   |       | COMMON W(40),P(6,40),T(6,40),W(6,7,40),CAY(6,40),WG(6,7)     | C | 35 |
|   |       | COMMON TH(6,40),TA1(4,40),TA2(4,40)                          | C | 36 |
|   |       | COMMON FA(7,70),ASC(7,70),AAS(7,70),CAS(7,40),HAS(7,40)      | C | 37 |
|   |       | DIMENSION TI(250,12), ITI(250)                               | C | 38 |
| C |       | PREPARE TO READ TAPE                                         | C | 39 |
|   |       | TTM=0.                                                       | C | 40 |
|   |       | IEOF=0                                                       | C | 41 |
|   |       | V=(V1+V2)/2.                                                 | C | 42 |
|   |       | J=1                                                          | C | 43 |
| 1 |       | READ (3) TMIN,TMAX,NIREC,((TI(I,K),K=1,12),ITI(I),I=1,NIREC) | C | 44 |
|   |       | IF (IEOF(3)) 2,3                                             | C | 45 |
| 2 |       | IEOF=IEOF+1                                                  | C | 46 |
|   |       | IF (IEOF.GT.50) GO TO 11                                     | C | 47 |
|   |       | GO TO 1                                                      | C | 48 |
| 3 |       | VREC=TMAX                                                    | C | 49 |
|   |       | IF (TTM.GT.TMIN) GO TO 1                                     | C | 50 |
|   |       | TTM=TMAX                                                     | C | 51 |
|   |       | IEOF=0                                                       | C | 52 |
|   |       | IF (VREC-V1) 1,4,4                                           | C | 53 |
| 4 |       | DO 5 I=1,NIREC                                               | C | 54 |
|   |       | VRUN=TI(I,1)                                                 | C | 55 |
|   |       | IF (VRUN.GE.V1) GO TO 6                                      | C | 56 |
| 5 |       | CONTINUE                                                     | C | 57 |
| 6 |       | DO 9 N=I,NIREC                                               | C | 58 |
|   |       | VRUN=TI(N,1)                                                 | C | 59 |
|   |       | IF (VRUN.GT.V2) GO TO 11                                     | C | 60 |
|   |       | M=ITI(N)                                                     | C | 61 |
|   |       | GNU(J)=TI(N,1)                                               | C | 62 |
|   |       | S(J)=TI(N,2)                                                 | C | 63 |
|   |       | ALFAD(J)=TI(N,3)                                             | C | 64 |
|   |       | EPP(J)=TI(N,4)                                               | C | 65 |
|   |       | MOL(J)=ITI(N)                                                | C | 66 |
|   |       | IF (ALFAD(J).GT.0.0001) GO TO 8                              | C | 67 |
|   |       | PRINT 12, ALFAD(J),GNU(J)                                    | C | 68 |
|   |       | STOP 1                                                       | C | 69 |
|   |       | ALP=ALFAD(J)*C(1,1)*F(1,ITP)/2076.0                          | C | 70 |
|   |       | PATH=S(J)*WG(1,N)*SEC/(3.1415927*ALP)                        | C | 71 |
|   |       | IF (PATH.LT.0.0001) GO TO 9                                  | C | 72 |

|    |                                                                |       |
|----|----------------------------------------------------------------|-------|
|    | Z=ABS(V-GNU(J))                                                | C 73  |
|    | WING=1.0                                                       | C 74  |
|    | IF (Z.GT.1.0) WING=S(J)*WG(1,M)*ALP*SEC/(3.1415927*Z**2)       | C 75  |
|    | IF (WING.LT.1.0E-5) GO TO 9                                    | C 76  |
|    | J=J+1                                                          | C 77  |
|    | IF (J.GT.1000) GO TO 10                                        | C 78  |
| 9  | CONTINUE                                                       | C 79  |
|    | IF (VREC-V2) 1,11,11                                           | C 80  |
| 10 | PRINT 13                                                       | C 81  |
| 11 | I1=J-1                                                         | C 82  |
|    | RETURN                                                         | C 83  |
|    |                                                                | C 84  |
| 12 | FORMAT (////30X,(2H*** ALFA0=E12.4,3X,7HAT GNU=F10.3,6H *****) | C 85  |
| 13 | FORMAT (* DIMENSION EXCEEDED *)                                | C 86  |
|    | END                                                            | C 87- |
|    | SUBROUTINE CONT (V,ITP,KSAM,SEC)                               | D 1   |
| C  | AAB AEROSOL ABSORPTION COEFFICIENT - INPUT DATA                | D 2   |
| C  | ABSOR 8 - 14 MICRON CONTINUUM ABSORPTION COEFFICIENT           | D 3   |
| C  | AKCL CLEAR AEROSOL ABSORPTION COEFFICIENT INTERPOLATED AT      | D 4   |
| C  | FREQUENCY V                                                    | D 5   |
| C  | AKHZ HAZY AEROSOL ABSORPTION COEFFICIENT INTERPOLATED AT       | D 6   |
| C  | FREQUENCY V                                                    | D 7   |
| C  | ASC AEROSOL SCATTERING COEFFICIENT - INPUT DATA                | D 8   |
| C  | ASHZ HAZY AEROSOL SCATTERING COEFFICIENT INTERPOLATED AT       | D 9   |
| C  | FREQUENCY V                                                    | D 10  |
| C  | CAS CLEAR AEROSOL SCATTERING COEFFICIENT (50 KM SEA LEVEL      | D 11  |
| C  | VISIBILITY) - OUTPUT DATA                                      | D 12  |
| C  | CAY MOLECULAR ABSORPTION COEFFICIENT - OUTPUT DATA             | D 13  |
| C  | CCONT INTERPOLATED ABSORPTION COEFFICIENT FROM THE NITROGEN    | D 14  |
| C  | DATA TABLE                                                     | D 15  |
| C  | CC1 273/1013                                                   | D 16  |
| C  | CNCS NITROGEN-BROADENED WATER VAPOR CONTINUUM ABSORPTION       | D 17  |
| C  | COEFFICIENT                                                    | D 18  |
| C  | CN2 NITROGEN CONTINUUM ABSORPTION COEFFICIENT - INPUT DATA     | D 19  |
| C  | CON WATER VAPOR CONTINUUM COEFFICIENT FOR 3.5-4.2 MICRONS      | D 20  |
| C  | - INPUT DATA                                                   | D 21  |
| C  | DELN2 INTERMEDIATE QUANTITY RELATED TO THE NITROGEN CONTINUUM  | D 22  |
| C  | DELP PRESSURE DIFFERENCE BETWEEN ATMOSPHERIC LEVELS            | D 23  |
| C  | FVH1 CLFAP VERTICAL SCALING FACTOR                             | D 24  |
| C  | FVH2 HAZY VERTICAL SCALING FACTOR                              | D 25  |
| C  | FVN DENSITY FACTOR FOR RAYLEIGH SCATTERING COEFFICIENT         | D 26  |
| C  | FA AEROSOL MODEL FREQUENCY - INPUT DATA                        | D 27  |
| C  | FAC INTERMEDIATE INTERPOLATING DATA FOR THE AEROSOL            | D 28  |
| C  | FREQUENCY DATA                                                 | D 29  |
| C  | FN2 NITROGEN CONTINUUM ABSORPTION COEFFICIENT FREQUENCY        | D 30  |
| C  | - INPUT DATA                                                   | D 31  |
| C  | HAS HAZY AEROSOL SCATTERING COEFFICIENT (5 KM SEA LEVEL        | D 32  |
| C  | VISIBILITY) - OUTPUT DATA                                      | D 33  |
| C  | HA1 INTERMEDIATE VERTICAL SCALING DATA FOR CLEAR AEROSOL       | D 34  |
| C  | MODEL                                                          | D 35  |
| C  | HA2 INTERMEDIATE VERTICAL SCALING DATA FOR HAZY AEROSOL        | D 36  |
| C  | MODEL                                                          | D 37  |
| C  | HM INTERMEDIATE MOLECULAR SCATTERING PARAMETER                 | D 38  |
| C  | HZ1 VERTICAL SCALING FACTOR FOR CLEAR AEROSOL MODEL            | D 39  |
| C  | - INPUT DATA                                                   | D 40  |
| C  | HZ2 VERTICAL SCALING FACTOR FOR HAZY AEROSOL MODEL             | D 41  |
| C  | - INPUT DATA                                                   | D 42  |
| C  | H2OLAY WATER VAPOR CONCENTRATION                               | D 43  |
| C  | IPRNT PRINT CONTROL PARAMETER                                  | D 44  |
| C  | ITP NUMBER OF ATMOSPHERIC LAYERS - INPUT DATA                  | D 45  |
| C  | KSAM NUMBER OF MODEL ATMOSPHERES - INPUT DATA                  | D 46  |
| C  | LC CLFAP AEROSOL MODEL INDEX                                   | D 47  |
| C  | LH HAZY AEROSOL MODEL INDEX                                    | D 48  |
| C  | M PRINT LOOP INDEX                                             | D 49  |
| C  | MH INDEX USED FOR 3.5 - 4.2 MICRON WATER CONTINUUM TABLE       | D 50  |
| C  | LOOK-UP                                                        | D 51  |

|   |      |                                                             |   |     |
|---|------|-------------------------------------------------------------|---|-----|
| C | P    | ATMOSPHERIC LEVEL PRESSURE - INPUT DATA                     | 0 | 52  |
| C | PBAR | AVERAGE LAYER PRESSURE                                      | 0 | 53  |
| C | SEC  | SECANT ANGLE                                                | 0 | 54  |
| C | T    | ATMOSPHERIC LAYER TEMPERATURE - INPUT DATA                  | 0 | 55  |
| C | TA1  | CLEAR AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA          | 0 | 56  |
| C | TA2  | HAZY AEROSOL ABSORPTION COEFFICIENT - OUTPUT DATA           | 0 | 57  |
| C | TBAR | AVERAGE LAYER TEMPERATURE                                   | 0 | 58  |
| C | TDEP | INTERMEDIATE CONSTANT FOR THE 3.5-4.2 MICR CONTINUUM        | 0 | 59  |
| C |      | CALCULATION                                                 | 0 | 60  |
| C | TM   | RAYLEIGH (MOLECULAR) SCATTERING COEFFICIENT                 | 0 | 61  |
| C |      | - OUTPUT DATA                                               | 0 | 62  |
| C | TN2  | ABSORPTION COEFFICIENT DUE TO NITROGEN CONTINUUM            | 0 | 63  |
| C | TX5  | INTERMEDIATE CONSTANT FOR THE 3.5-4.2 MICR CONTINUUM        | 0 | 64  |
| C |      | CALCULATION                                                 | 0 | 65  |
| C | V    | FREQUENCY AT WHICH THE EXTINCTION COEFFICIENT ARE BEING     | 0 | 66  |
| C |      | CALCULATED - INPUT DATA                                     | 0 | 67  |
| C | W    | ABSORBER CONCENTRATION                                      | 0 | 68  |
| C | WG   | SCALEVAL VALUES OF MOLECULAR ABUNDANCES                     | 0 | 69  |
| C | XH   | INTERMEDIATE CONSTANT FOR THE 3.5-4.2 MICR CONTINUUM        | 0 | 70  |
| C |      | CALCULATION                                                 | 0 | 71  |
| C | XI   | INTERMEDIATE CONSTANT FOR THE 3.5-4.2 MICR CONTINUUM        | 0 | 72  |
| C |      | CALCULATION                                                 | 0 | 73  |
| C | Z    | ATMOSPHERIC HEIGHT (KM)                                     | 0 | 74  |
|   |      | COMMON GNU(1000),S(1000),ALFA0(1000),EPP(1000),MOL(1000)    | 0 | 75  |
|   |      | COMMON Z(40),P(6,40),T(6,40),W(6,7,40),CAY(6,40),WG(6,7)    | 0 | 76  |
|   |      | COMMON TM(6,40),TA1(4,40),TA2(4,40)                         | 0 | 77  |
|   |      | COMMON FA(7,70),ASC(7,70),AAB(7,70),CAS(7,70),HAS(7,40)     | 0 | 78  |
|   |      | COMMON /BLK2/ FKC,CON(20),FNZ(100),CN2(100),HZ1(40),HZ2(40) | 0 | 79  |
|   |      | DIMENSION FVM(40)                                           | 0 | 80  |
|   |      | IPRNT=0                                                     | 0 | 81  |
|   |      | CC1=273.0/1013.0                                            | 0 | 82  |
|   |      | IF (IPRNT.EQ.1) PRINT 33, (CAY(N,ITP-1),N=1,5)              | 0 | 83  |
|   |      | DO 15 J=1,KSAM                                              | 0 | 84  |
|   |      | DO 17 K=1,ITP                                               | 0 | 85  |
|   |      | DO 1 I=1,4                                                  | 0 | 86  |
|   |      | TA1(I,K)=0.0                                                | 0 | 87  |
|   |      | TA2(I,K)=0.0                                                | 0 | 88  |
|   |      | CAS(I,K)=0.0                                                | 0 | 89  |
|   |      | HAS(I,K)=0.0                                                | 0 | 90  |
| 1 |      | CONTINUE                                                    | 0 | 91  |
|   |      | IF (K.EQ.ITP) TBAR=T(J,ITP)                                 | 0 | 92  |
|   |      | IF (K.EQ.ITP) GO TO 2                                       | 0 | 93  |
|   |      | PBAR=(P(J,K)+P(J,K+1))/2.0                                  | 0 | 94  |
|   |      | TBAR=(T(J,K)+T(J,K+1))/2.0                                  | 0 | 95  |
| 2 |      | IF (V.LT.2740.0) GO TO 5                                    | 0 | 96  |
| C |      |                                                             | 0 | 97  |
| C |      | RAYLEIGH (MOLECULAR) SCATTERING.                            | 0 | 98  |
| C |      |                                                             | 0 | 99  |
|   |      | IF (K.EQ.ITP) GO TO 3                                       | 0 | 100 |
|   |      | HM=1.0/ALOG((P(J,K+1)*T(J,K))/(P(J,K)*T(J,K+1)))            | 0 | 101 |
|   |      | EVH(K)=CC1*HM*((P(J,K+1)/T(J,K+1))-(P(J,K)/T(J,K)))         | 0 | 102 |
|   |      | GO TO 4                                                     | 0 | 103 |
| 3 |      | FVM(K)=CC1*P(J,ITP)/T(J,ITP)                                | 0 | 104 |
| 4 |      | TM(J,K)=9.807E-20*EVH(K)*V**4.0117                          | 0 | 105 |
|   |      | GO TO 6                                                     | 0 | 106 |
| 5 |      | TM(J,K)=0.0                                                 | 0 | 107 |
| 6 |      | IF (V.LT.400.0) GO TO 17                                    | 0 | 108 |
|   |      | IF (V.LT.1250.0) GO TO 7                                    | 0 | 109 |
|   |      | IF (V.LT.2000.0) GO TO 17                                   | 0 | 110 |
|   |      | IF (V.LT.2350.0) GO TO 11                                   | 0 | 111 |
|   |      | IF (V.GT.2800.0) GO TO 17                                   | 0 | 112 |
| C |      |                                                             | 0 | 113 |
| C |      | 3.5 TO 4.2 MICRON H2O CONTINUUM                             | 0 | 114 |
| C |      |                                                             | 0 | 115 |
|   |      | XI=(V-2350.0)/50.0+1.0                                      | 0 | 116 |
|   |      | HM=XI+1.001                                                 | 0 | 117 |

|    |                                                         |       |
|----|---------------------------------------------------------|-------|
|    | XH=XI-FLOAT(MH)                                         | 0 118 |
|    | TX5=CON(MH)                                             | 0 119 |
|    | TX5=TX5+XH*(CON(MH)-CON(MH-1))                          | 0 120 |
|    | CCONT=TX5/3.34E+22                                      | 0 121 |
|    | TDEP=EXP(4.56*(296.0/TBAR-1.0))                         | 0 122 |
|    | CNCS=0.12*TDEP                                          | 0 123 |
|    | GO TO 8                                                 | 0 124 |
| C  |                                                         | 0 125 |
| C  | 8 TO 14 MICROM H2O CONTINUUM                            | 0 126 |
| C  |                                                         | 0 127 |
| 7  | CCONT=(4.18+5578.*EXP(-7.07E-3*V))/3.34E+22             | 0 128 |
|    | TDEP=1.                                                 | 0 129 |
|    | IF (V.GT.700.0) TDEP=EXP(6.08*(296.0/TBAR-1.0))         | 0 130 |
|    | CNCS=0.002                                              | 0 131 |
| 8  | IF (K.EQ.ITP) GO TO 9                                   | 0 132 |
|    | H2OLAY=H(J,I,K)                                         | 0 133 |
|    | PH20=4.712E-23*H2OLAY/ALOG(P(J,K+1)/P(J,K))             | 0 134 |
|    | GO TO 10                                                | 0 135 |
| 9  | H2OLAY=HG(J,I)                                          | 0 136 |
|    | PH20=1.38E-24*H2OLAY*T(J,ITP)                           | 0 137 |
|    | PBAR=P(J,ITP)                                           | 0 138 |
| 10 | ABSOR=CCONT*(PH20*TDEP+CNCS*(PBAR-PH20))/1013.          | 0 139 |
|    | CAY(J,K)=ABSOR*H2OLAY*SEC+CAY(J,K)                      | 0 140 |
|    | IF (V.GE.2350.0) GO TO 11                               | 0 141 |
|    | GO TO 17                                                | 0 142 |
| C  |                                                         | 0 143 |
| C  | COMPUTE NITROGEN CONTINUUM                              | 0 144 |
| C  |                                                         | 0 145 |
| 11 | DO 13 I=1,90                                            | 0 146 |
|    | IF (V.GE.FN2(I).AND.V.LE.FN2(I+1)) GO TO 12             | 0 147 |
|    | GO TO 13                                                | 0 148 |
| 12 | DELN2=(CN2(I+1)-CN2(I))/(FN2(I+1)-FN2(I))               | 0 149 |
|    | CCONT=DELN2*(V-FN2(I))+CN2(I)                           | 0 150 |
|    | GO TO 14                                                | 0 151 |
| 13 | CONTINUE                                                | 0 152 |
| 14 | IF (K.EQ.ITP) GO TO 15                                  | 0 153 |
|    | DEL P=P(J,K+1)-P(J,K)                                   | 0 154 |
|    | TN2=0.781*CCONT*(PBAR/1013.0)*29.24*TBAR*(DEL P/1013.0) | 0 155 |
|    | GO TO 16                                                | 0 156 |
| 15 | PBAR=P(J,ITP)                                           | 0 157 |
|    | TN2=0.781*CCONT*(PBAR/1013.0)**2*1000.0*296.0/T(J,ITP)  | 0 158 |
| 16 | CAY(J,K)=CAY(J,K)+TN2*SEC                               | 0 159 |
| 17 | CONTINUE                                                | 0 160 |
| 18 | CONTINUE                                                | 0 161 |
|    | IF (V.LT.FA(1,1)) RETURN                                | 0 162 |
| C  |                                                         | 0 163 |
| C  | COMPUTE AEROSOL EXTINCTION COEFFICIENTS.                | 0 164 |
| C  |                                                         | 0 165 |
|    | DO 19 J=1,60                                            | 0 166 |
|    | IF (V.GE.FA(1,J).AND.V.LE.FA(1,J+1)) GO TO 20           | 0 167 |
| 19 | CONTINUE                                                | 0 168 |
|    | PRINT 14                                                | 0 169 |
|    | STOP 2                                                  | 0 170 |
| 20 | FAC=(V-FA(1,J))/(FA(1,J+1)-FA(1,J))                     | 0 171 |
|    | DO 32 K=1,ITP                                           | 0 172 |
|    | IF (K.EQ.ITP) GO TO 24                                  | 0 173 |
|    | IF (HZ1(K).EQ.HZ1(K+1)) GO TO 21                        | 0 174 |
|    | HA1=1.0/ALOG(HZ1(K+1)/HZ1(K))                           | 0 175 |
|    | EVH1=HA1*(HZ1(K+1)-HZ1(K))                              | 0 176 |
|    | GO TO 22                                                | 0 177 |
| 21 | EVH1=HZ1(K)                                             | 0 178 |
| 22 | IF (HZ2(K).EQ.HZ2(K+1)) GO TO 23                        | 0 179 |
|    | HA2=1.0/ALOG(HZ2(K+1)/HZ2(K))                           | 0 180 |
|    | EVH2=HA2*(HZ2(K+1)-HZ2(K))                              | 0 181 |
|    | GO TO 25                                                | 0 182 |
| 23 | EVH2=HZ2(K)                                             | 0 183 |

|    |                                                                    |        |
|----|--------------------------------------------------------------------|--------|
|    | GO TO 25                                                           | D 154  |
| 24 | EVH1=HZ1(ITP)                                                      | D 155  |
|    | EVH2=HZ2(ITP)                                                      | D 156  |
| 25 | IF (Z(K).LE.100.0.AND.7(K).GE.30.0) GO TO 26                       | D 157  |
|    | IF (Z(K).LE.10.0.AND.Z(K).GE.9.0) GO TO 27                         | D 158  |
|    | IF (Z(K).LE.9.0.AND.7(K).GE.2.0) GO TO 26                          | D 159  |
|    | IF (Z(K).LE.2.0.AND.Z(K).GE.0.0) GO TO 29                          | D 160  |
| C  | METEORIC DUST MODEL                                                | D 161  |
| 26 | LC=7                                                               | D 162  |
|    | LH=7                                                               | D 163  |
|    | GO TO 30                                                           | D 164  |
| C  | CLFAR: BACKGROUND STRATOSPHERIC, HAZY+ AGED VOLCANIC               | D 165  |
| 27 | LC=5                                                               | D 166  |
|    | LH=6                                                               | D 167  |
|    | GO TO 30                                                           | D 168  |
| C  | TROPOSPHERIC MODEL                                                 | D 169  |
| 28 | LC=2                                                               | D 200  |
|    | LH=2                                                               | D 201  |
|    | GO TO 30                                                           | D 202  |
| C  | RURAL MODEL                                                        | D 203  |
| 29 | LC=1                                                               | D 204  |
|    | LH=1                                                               | D 205  |
| 30 | AKCL=(AAB(LC,J+1)-AAB(LC,J))*FAC+AAB(LC,J)                         | D 206  |
|    | AKHZ=AKCL                                                          | D 207  |
|    | ASCL=(ASC(LC,J+1)-ASC(LC,J))*FAC+ASC(LC,J)                         | D 208  |
|    | ASHZ=ASCL                                                          | D 209  |
|    | IF (LC.EQ.LH) GO TO 31                                             | D 210  |
|    | AKHZ=(AAB(LH,J+1)-AAB(LH,J))*FAC+AAB(LH,J)                         | D 211  |
|    | ASHZ=(ASC(LH,J+1)-ASC(LH,J))*FAC+ASC(LH,J)                         | D 212  |
| 31 | TA1(1,K)=EVH1*AKCL                                                 | D 213  |
|    | TA2(1,K)=EVH2*AKHZ                                                 | D 214  |
|    | CAS(1,K)=EVH1*ASCL                                                 | D 215  |
|    | HAS(1,K)=EVH2*ASHZ                                                 | D 216  |
|    | IF (K.LT.ITP) GO TO 32                                             | D 217  |
|    | AKHZ=(AAB(4,J+1)-AAB(4,J))*FAC+AAB(4,J)                            | D 218  |
|    | ASHZ=(ASC(4,J+1)-ASC(4,J))*FAC+ASC(4,J)                            | D 219  |
|    | TA2(4,ITP)=EVH2*AKHZ                                               | D 220  |
|    | HAS(4,ITP)=EVH2*ASHZ                                               | D 221  |
|    | AKCL=(AAB(3,J+1)-AAB(3,J))*FAC+AAB(3,J)                            | D 222  |
|    | AKHZ=AKCL                                                          | D 223  |
|    | ASCL=(ASC(3,J+1)-ASC(3,J))*FAC+ASC(3,J)                            | D 224  |
|    | ASHZ=ASCL                                                          | D 225  |
|    | TA1(3,ITP)=EVH1*AKCL                                               | D 226  |
|    | TA2(3,ITP)=EVH2*AKHZ                                               | D 227  |
|    | CAS(3,ITP)=EVH1*ASCL                                               | D 228  |
|    | HAS(3,ITP)=EVH2*ASHZ                                               | D 229  |
|    | AKCL=(AAB(2,J+1)-AAB(2,J))*FAC+AAB(2,J)                            | D 230  |
|    | ASCL=(ASC(2,J+1)-ASC(2,J))*FAC+ASC(2,J)                            | D 231  |
|    | TA1(2,ITP)=EVH1*AKCL                                               | D 232  |
|    | CAS(2,ITP)=EVH1*ASCL                                               | D 233  |
| 32 | CONTINUE                                                           | D 234  |
|    | RETURN                                                             | D 235  |
| C  |                                                                    | D 236  |
| 33 | FORMAT (5F15.5)                                                    | D 237  |
| 34 | FORMAT (* FREQUENCY IS OUTSIDE RANGE OF AEROSOL DATA *)            | D 238  |
|    | END                                                                | D 239- |
|    | FUNCTION VOIGT (X,Y)                                               | F 1    |
|    | COMMON /9LK3/ NH,HH(10),XX(10),A(4?)                               | F 2    |
|    | DIMENSION RA(32), CA(32), RB(32), GB(32), B(44), AK(5), AM(5), DY( | F 3    |
|    | 14)                                                                | F 4    |
|    | X2=X*X                                                             | F 5    |
|    | Y2=Y*Y                                                             | F 6    |
|    | IF (X-5.0) 1,24,24                                                 | F 7    |
| 1  | IF (Y-1.) 6,6,2                                                    | F 8    |
| 2  | RA(1)=0.                                                           | F 9    |
|    | CA(1)=0.                                                           | F 10   |

|    |                                                                    |      |
|----|--------------------------------------------------------------------|------|
|    | K0(1)=1.                                                           | E 11 |
|    | CB(1)=0.                                                           | E 12 |
|    | RA(2)=X                                                            | E 13 |
|    | CA(2)=Y                                                            | E 14 |
|    | RB(2)=.5-X2+Y2                                                     | E 15 |
|    | CB(2)=-2.*X*Y                                                      | E 16 |
|    | CB1=CB(2)                                                          | E 17 |
|    | CA1=0.                                                             | E 18 |
|    | UV1=0.                                                             | E 19 |
|    | DO 4 J=2,31                                                        | E 20 |
|    | JPLUS=J+1                                                          | E 21 |
|    | JMINUS=J-1                                                         | E 22 |
|    | FLOATJ=JMINUS                                                      | E 23 |
|    | RR1=2.*FLOATJ*RB(2)                                                | E 24 |
|    | RA1=-FLOATJ*(2.*FLOATJ-1.)/2.                                      | E 25 |
|    | RA(JPLUS)=RB1*PA(J)-CB1*CA(J)+RA1*RA(JMINUS)-CA1*CA(JMINUS)        | E 26 |
|    | CA(JPLUS)=RB1*CA(J)+CB1*RA(J)+RA1*CA(JMINUS)+CA1*RA(JMINUS)        | E 27 |
|    | RB(JPLUS)=RB1*RB(J)-CB1*CB(J)+RA1*RB(JMINUS)-CA1*CB(JMINUS)        | E 28 |
|    | CB(JPLUS)=RB1*CB(J)+CB1*RB(J)+RA1*CB(JMINUS)+CA1*RB(JMINUS)        | E 29 |
|    | IF (JPLUS.GE.13) PRINT 31, JPLUS,RA(JPLUS),CB(JPLUS),CA(JPLUS),RB( | E 30 |
|    | 1JPLUS),X,Y                                                        | E 31 |
|    | IF (RA(JPLUS).GT.1.0E+10) PRINT 31, JPLUS,RA(JPLUS),CB(JPLUS),CA(J | E 32 |
|    | 1PLUS),RB(JPLUS),X,Y                                               | E 33 |
|    | IF (CB(JPLUS).GT.1.0E+10) PRINT 31, JPLUS,RA(JPLUS),CB(JPLUS),CA(J | E 34 |
|    | 1PLUS),RB(JPLUS),X,Y                                               | E 35 |
|    | UV=(CA(JPLUS)*RB(JPLUS)-RA(JPLUS)*CB(JPLUS))/(RB(JPLUS)*RB(JPLUS)+ | E 36 |
|    | 1CB(JPLUS)*CB(JPLUS))                                              | E 37 |
|    | IF (Y.LT.1.5) GO TO 3                                              | E 38 |
|    | IF (ABS(UV-UV1)-1.E-6) 5,4,4                                       | E 39 |
| 3  | IF (ABS(UV-UV1)-1.0E-5) 5,4,4                                      | E 40 |
| 4  | UV1=UV                                                             | E 41 |
| 5  | VOIGT=UV/1.772454                                                  | E 42 |
|    | RETURN                                                             | E 43 |
| 6  | IF (X-2.) 7,7,9                                                    | E 44 |
| 7  | AINT=1.                                                            | E 45 |
|    | MAX=12.+5.*X2                                                      | E 46 |
|    | DO 8 K=1,MAX                                                       | E 47 |
|    | AJ=MAX+1-K                                                         | E 48 |
| 9  | AINT=AINT*(-2.*X2)/(2.*AJ+1.)+1.                                   | E 49 |
|    | U=-2.*X*AINT                                                       | E 50 |
|    | GO TO 14                                                           | E 51 |
| 9  | IF (X-4.5) 10,12,12                                                | E 52 |
| 10 | B(43)=0.                                                           | E 53 |
|    | B(44)=0.                                                           | E 54 |
|    | J=42                                                               | E 55 |
|    | DO 11 K=1,42                                                       | E 56 |
|    | B(J)=.4*X*B(J+1)-B(J+2)+A(J)                                       | E 57 |
| 11 | J=J-1                                                              | E 58 |
|    | U=B(1)-B(1)                                                        | E 59 |
|    | GO TO 14                                                           | E 60 |
| 12 | AINT=1.0                                                           | E 61 |
|    | MAX=2.+40./X                                                       | E 62 |
|    | AMAX=MAX                                                           | E 63 |
|    | DO 13 K=1,MAX                                                      | E 64 |
|    | AINT=AINT*(2.*AMAX-1.)/(2.*X2)+1.                                  | E 65 |
| 13 | AMAX=AMAX-1.                                                       | E 66 |
|    | U=-AINT/X                                                          | E 67 |
| 14 | V=1.772454/EXP(X2)                                                 | E 68 |
|    | H=.02                                                              | E 69 |
|    | JH=Y/H                                                             | E 70 |
|    | IF (JH) 16,15,16                                                   | E 71 |
| 15 | H=Y                                                                | E 72 |
| 16 | Z=0.                                                               | E 73 |
|    | L=0                                                                | E 74 |
|    | DY(1)=0.                                                           | E 75 |
| 17 | DY(2)=H.2.                                                         | E 76 |

|    |                                                                    |       |
|----|--------------------------------------------------------------------|-------|
|    | OY(3)=OY(2)                                                        | E 77  |
|    | OY(4)=H                                                            | E 78  |
| 18 | AK(1)=0.                                                           | E 79  |
|    | AM(1)=0.                                                           | E 80  |
|    | DO 20 J=1,4                                                        | E 81  |
|    | YY=Z*OY(J)                                                         | E 82  |
|    | UU=U+.5*AK(J)                                                      | E 83  |
|    | VV=V+.5*AM(J)                                                      | E 84  |
|    | AK(J+1)=2.*(YY*UU+X*VV)*H                                          | E 85  |
|    | AM(J+1)=-2.*(1.+X*UU-YY*VV)*H                                      | E 86  |
|    | IF (J-3) 20,19,20                                                  | E 87  |
| 19 | AK(4)=2.*AK(4)                                                     | E 88  |
|    | AM(4)=AM(4)+AM(4)                                                  | E 89  |
| 20 | CONTINUE                                                           | E 90  |
|    | Z=Z+H                                                              | E 91  |
|    | L=L+1                                                              | E 92  |
|    | U=U+.1666667*(AK(2)+2.*AK(3)+AK(4)+AK(5))                          | E 93  |
|    | V=V+.1666667*(AM(2)+AM(3)+AM(4)+AM(5))                             | E 94  |
|    | IF (JM) 21,23,21                                                   | E 95  |
| 21 | IF (L-JM) 18,22,23                                                 | E 96  |
| 22 | AJM=JM                                                             | E 97  |
|    | H=Y-AJM*H                                                          | E 98  |
|    | GO TO 17                                                           | E 99  |
| 23 | VOIGT=V/1.772454                                                   | E 100 |
|    | RETURN                                                             | E 101 |
| 24 | IF (Y) 25,26,29                                                    | E 102 |
| 25 | PRINT 32, Y                                                        | E 103 |
|    | CALL EXIT                                                          | E 104 |
| 26 | IF (X2-88.) 26,28,27                                               | E 105 |
| 27 | VOIGT=0.                                                           | E 106 |
|    | RETURN                                                             | E 107 |
| 28 | VOIGT=1./EXP(X2)                                                   | E 108 |
|    | RETURN                                                             | E 109 |
| 29 | F1=0.                                                              | E 110 |
|    | DO 30 J=1,NH                                                       | E 111 |
| 30 | F1=F1+HH(J)/(Y2+(X-XX(J))*(X-XX(J))+HH(J)/(Y2+(X+XX(J))*(X+XX(J))) | E 112 |
|    | 1)                                                                 | E 113 |
|    | VOIGT=Y*F1/3.1415927                                               | E 114 |
|    | RETURN                                                             | E 115 |
| C  |                                                                    | E 116 |
| 31 | FORMAT (I5,4HRA =E13.6,4HCB =E13.6,4HCA =E13.6,4HCB =E13.6,3HX =E1 | E 117 |
|    | 13.6,3HY =E13.6)                                                   | E 118 |
| 32 | FORMAT (38H0ERROR VOIGT - RATIO LORENTZ/DOPPLER =,E15.7)           | E 119 |
|    | END                                                                | E 120 |
|    | SUBROUTINE PRNT                                                    | F 1   |
|    | COMMON /BLK1/ JT,DNU(20),CHI(20),AML(40)                           | F 2   |
|    | COMMON /BLK2/ FKC,CON(20),FN2(100),CN2(100),HZ1(40),HZ2(40)        | F 3   |
|    | COMMON /BLK3/ NH,HH(10),XX(10),A(42)                               | F 4   |
|    | DATA ITP/33/                                                       | F 5   |
|    | PRINT 1                                                            | F 6   |
|    | PRINT 2, FKC,(CON(I),I=1,15)                                       | F 7   |
|    | PRINT 3, (FN2(I),CN2(I),I=1,91)                                    | F 8   |
|    | PRINT 4, JT,(DNU(I),CHI(I),I=1,JT)                                 | F 9   |
|    | PRINT 5, NH,(HH(I),XX(I),I=1,NH)                                   | F 10  |
|    | PRINT 6, (A(I),I=1,42)                                             | F 11  |
|    | PRINT 7, ITP,(HZ1(I),I=1,ITP)                                      | F 12  |
|    | PRINT 8, ITP,(HZ2(I),I=1,ITP)                                      | F 13  |
|    | PRINT 1                                                            | F 14  |
|    | PRINT 9, ITP,(AKL(I),I=1,ITP)                                      | F 15  |
|    | RETURN                                                             | F 16  |
| C  |                                                                    | F 17  |
| 1  | FORMAT (1H1)                                                       | F 18  |
| 2  | FORMAT (51X,'WATER VAPOR CONTINUUM COEFFICIENTS*/55X,*FOR 3.5 - 4, | F 19  |
|    | 12 MICRONS (CON)*2/42X,*FKC(1)=*F7.1/(41X,6(1PE9.2)))              | F 20  |
| 3  | FORMAT (///47X,'NITROGEN CONTINUUM ABSORPTION COEFFICIENTS*/62X,*  | F 21  |
|    | ;(FN2 VS CN2)*2/42X,5(1PE9.1,1PE9.2)))                             | F 22  |

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4  FORMAT (///51X,*MOD1,CA:10N 10 LORFNT7 LINE SHAPE*/62X,*(ONU VS F 23
1CHI)*/47X,*JT=*I4/(40X,5(F6.1,F5.2))) F 24
5  FORMAT (1H1,53X,*INPUT DATA FOR VOIGT (HH, XX)*/54X,*NH=*I2/(53X, F 25
12(1PE15,A1)) F 26
6  FORMAT (///56X,*INPUT DATA FOR VOIGT (A)*/(37X,4(1PE15,7))) F 27
7  FORMAT (///46X,*VERTICAL SCALING FACTOR FOR CLEAR AEROSOL MODFL*/ F 28
1/44X,*ITP=*I3/(43X,5(1PE10,3))) F 29
8  FORMAT (///45X,*VERTICAL SCALING FACTOR FOR HAZY AEROSOL MODEL*/ F 30
144X,*ITP=*I3/(43X,5(1PE10,3))) F 31
9  FORMAT (///57X,*HEIGHT INCREMENTS (AML)*/47X,*ITP=*I3/(44X,5A10) F 32
1) F 33
END F 34-
BLOCK DATA G 1
COMMON /BLK1/ JT,ONU(20),CHI(20),AML(40) G 2
COMMON /BLK2/ FKC,CON(20),FN2(100),CN2(100),HZ1(40),HZ2(40) G 3
COMMON /BLK3/ NH,HH(10),XX(10),A(42) G 4
DATA JT,NH,FKC/16,3,7350.0/ G 5
DATA (CON(I),I=1,15)/.230,.187,.147,.117,.097,.087,.100,.120,.147, G 6
1.174,.200,.240,.280,.330,0.000/ G 7
DATA (FN2(I),I=1,91)/2000.0,2050.0,2075.0,2100.0,2125.0,2150.0,215 G 8
15.0,2160.0,2165.0,2170.0,2175.0,2180.0,2185.0,2190.0,2195.0,2200.0 G 9
2,2205.0,2210.0,2215.0,2220.0,2225.0,2230.0,2235.0,2240.0,2245.0,22 G 10
350.0,2255.0,2260.0,2265.0,2270.0,2275.0,2280.0,2285.0,2290.0,2295. G 11
40,2300.0,2305.0,2310.0,2315.0,2320.0,2325.0,2330.0,2335.0,2340.0,2 G 12
345.0,2350.0,2355.0,2360.0,2365.0,2370.0,2375.0,2380.0,2385.0,2390 G 13
6.0,2395.0,2400.0,2405.0,2410.0,2415.0,2420.0,2425.0,2430.0,2435.0, G 14
2440.0,2445.0,2450.0,2455.0,2460.0,2465.0,2470.0,2475.0,2480.0,248 G 15
85.0,2490.0,2495.0,2500.0,2505.0,2510.0,2515.0,2520.0,2525.0,2530.0 G 16
9,2535.0,2540.0,2545.0,2550.0,2555.0,2560.0,2565.0,2570.0,2575.0,2 G 17
580.0/ G 18
DATA (CN2(I),I=1,91)/1.00E-21,1.20E-07,1.80E-07,6.30E-07,2.00E-06, G 19
19.00E-06,1.13E-05,1.36E-05,1.65E-05,1.96E-05,2.16E-05,2.36E-05,2.6 G 19
23E-05,2.90E-05,3.15E-05,3.40E-05,3.66E-05,3.92E-05,4.26E-05,4.60E- G 20
305,4.95E-05,5.30E-05,5.65E-05,6.00E-05,6.30E-05,6.60E-05,6.89E-05, G 21
47.18E-05,7.39E-05,7.60E-05,7.84E-05,8.08E-05,8.39E-05,8.70E-05,9.1 G 22
59E-05,9.56E-05,1.04E-04,1.20E-04,1.36E-04,1.52E-04,1.60E-04,1.69E- G 23
604,1.60E-04,1.51E-04,1.37E-04,1.23E-04,1.19E-04,1.16E-04,1.14E-04, G 24
71.12E-04,1.12E-04,1.11E-04,1.11E-04,1.12E-04,1.14E-04,1.14E-04,1.1 G 25
82E-04,1.10E-04,1.07E-04,1.02E-04,9.90E-05,9.50E-05,9.00E-05,8.65E- G 26
905,8.20E-05,7.65E-05,7.05E-05,6.50E-05,6.10E-05,5.50E-05,4.95E-05, G 27
X4.50E-05,4.00E-05,3.75E-05,3.50E-05,3.10E-05,2.65E-05,2.50E-05,2.2 G 28
10E-05,1.95E-05,1.75E-05,1.60E-05,1.40E-05,1.20E-05,1.05E-05,9.50E- G 29
206,6.00E-06,3.50E-06,2.00E-06,1.50E-06,1.00E-20/ G 30
DATA (ONU(I),I=1,16)/0.0,5,6,7,8,9,10,1.2,1.5,2.0,2.5,3.0,5. G 31
10,8.0,10.0,15.0/ G 32
DATA (CHI(I),I=1,16)/1.00,1.00,.96,.89,.82,.77,.70,.60,.50,.41,.34 G 33
1,.31,.29,.23,.19,0.00/ G 34
DATA (HH(I),I=1,3)/7.24629599E-01,1.57067320E-01,4.53000990E-03/ G 35
DATA (XX(I),I=1,3)/4.36077410E-01,1.33584900E+00,2.35060497E+00/ G 36
DATA (A(I),I=1,42)/0.,1.9999999F-01,0.,-1.8400000F-01,0.,1.5583999 G 37
1F-01,0.,-1.2166400E-01,0.,8.7708159E-02,0.,-5.8514124F-02,0.,3.621 G 38
25730E-02,0.,-2.0849765E-02,0.,1.1196011E-02,0.,-5.6231896E-03,3.,2 G 39
3.6487534E-03,0.,-1.1732570F-03,0.,4.8995199E-04,0.,-1.9336308E-04, G 40
40.,7.2267745F-05,0.,-2.5655512E-05,0.,8.6620736E-06,3.,-2.7876379E G 41
5-06,0.,8.5668736E-07,0.,-2.5184337E-07,0.,7.0936022E-08/ G 42
DATA (HZ1(I),I=1,33)/9.30E-10,1.60E-07,2.10E-06,4.02E-06,8.00E-06, G 43
11.65F-05,3.32E-05,1.50E-04,1.90E-04,2.42E-04,2.96E-04,3.52E-04,4.2 G 44
23E-04,4.92E-04,5.63E-04,6.01E-04,6.41E-04,6.43E-04,6.45E-04,6.22E- G 45
304,6.63E-04,7.14E-04,7.67E-04,9.80E-04,1.41E-03,2.30E-03,3.54E-03, G 46
44.85E-03,6.43F-03,8.19E-03,9.70E-03,2.85E-02,6.95E-02/ G 47
DATA (HZ2(I),I=1,33)/9.30E-10,1.60E-07,2.10E-06,4.02E-06,8.00E-06, G 48
12.45E-05,7.60F-05,4.16E-04,5.15E-04,6.60E-04,8.60E-04,1.09E-03,1.3 G 49
25E-03,1.71F-03,2.10E-03,2.46E-03,2.74E-03,2.92E-03,2.89E-03,2.80E- G 50
303,2.45E-03,2.11E-03,1.85F-03,1.81E-03,3.36E-03,6.22F-03,7.71E-03, G 51
49.30E-03,1.85E-02,3.46E-02,6.21E-02,7.57E-01,7.57E-01/ G 52
DATA (AML(I),I=1,33)/10H 70 -100 ,10H 50 - 70 ,10H 45 - 50 ,10H G 53
1 40 - 45 ,10H 35 - 40 ,10H 30 - 35 ,10H 25 - 30 ,10H 20 - 25 G 54

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|                  |              |              |              |              |       |
|------------------|--------------|--------------|--------------|--------------|-------|
| 2,10H 23 - 24    | ,10H 22 - 23 | ,10H 21 - 22 | ,10H 20 - 21 | ,10H 19 -    | G 55  |
| 320 ,10H 18 - 19 | ,10H 17 - 18 | ,10H 16 - 17 | ,10H 15 - 16 | ,10H 1       | G 56  |
| 44 - 15          | ,10H 14 - 14 | ,10H 12 - 13 | ,10H 11 - 12 | ,10H 10 - 11 | G 57  |
| 50H 9 - 10       | ,10H 8 - 9   | ,10H 7 - 8   | ,10H 6 - 7   | ,10H 5 - 6   | G 58  |
| 3 ,10H 4 - 5     | ,10H 3 - 4   | ,10H 2 - 3   | ,10H 1 - 2   | ,10H 0       | G 59  |
| 7- 1 ,10H 0      | /            |              |              |              | G 60  |
| FND              |              |              |              |              | G 61- |

|            |          |          |          |          |          |          |
|------------|----------|----------|----------|----------|----------|----------|
| 33 1.300 6 |          |          |          |          |          |          |
| 6.36E+22   | 8.08E+20 | 7.03E+16 | 6.85E+17 | 1.84E+17 | 3.92E+18 | 5.13E+23 |
| 4.69E+22   | 8.24E+20 | 7.53E+16 | 6.99E+17 | 1.87E+17 | 4.00E+18 | 5.23E+23 |
| 1.17E+22   | 8.95E+20 | 7.53E+16 | 7.59E+17 | 2.03E+17 | 4.34E+18 | 5.68E+23 |
| 3.05E+22   | 8.42E+20 | 6.15E+16 | 7.14E+17 | 1.91E+17 | 4.08E+18 | 5.35E+23 |
| 4.01E+21   | 9.43E+20 | 5.15E+16 | 8.30E+17 | 2.14E+17 | 4.57E+18 | 5.98E+23 |
| 1.97E+22   | 8.41E+20 | 6.75E+16 | 7.44E+17 | 1.91E+17 | 4.08E+18 | 5.34E+23 |

|                              |           |       |         |         |           |       |
|------------------------------|-----------|-------|---------|---------|-----------|-------|
| TROPICAL MID-LATITUDE SUMMER |           |       |         |         |           |       |
| 0.0                          | 1.013E+03 | 300.0 | 1.9E-01 | 5.6E-05 | 1.013E+03 | 294.0 |
| 1.0                          | 9.040E+02 | 294.0 | 1.3E+01 | 5.6E-05 | 9.020E+02 | 290.0 |
| 2.0                          | 8.050E+02 | 288.0 | 9.3E+00 | 5.4E-05 | 8.020E+02 | 285.0 |
| 3.0                          | 7.150E+02 | 284.0 | 4.7E+00 | 5.1E-05 | 7.100E+02 | 279.0 |
| 4.0                          | 6.330E+02 | 277.0 | 2.2E+00 | 4.7E-05 | 6.200E+02 | 273.0 |
| 5.0                          | 5.590E+02 | 270.0 | 1.5E+00 | 4.5E-05 | 5.540E+02 | 267.0 |
| 6.0                          | 4.920E+02 | 264.0 | 8.5E-01 | 4.3E-05 | 4.870E+02 | 261.0 |
| 7.0                          | 4.320E+02 | 257.0 | 4.7E-01 | 4.1E-05 | 4.260E+02 | 255.0 |
| 8.0                          | 3.780E+02 | 250.0 | 2.5E-01 | 3.9E-05 | 3.720E+02 | 248.0 |
| 9.0                          | 3.290E+02 | 244.0 | 1.2E-01 | 3.9E-05 | 3.240E+02 | 242.0 |
| 10.0                         | 2.860E+02 | 237.0 | 5.0E-02 | 3.9E-05 | 2.810E+02 | 235.0 |
| 11.0                         | 2.470E+02 | 230.0 | 1.7E-02 | 4.1E-05 | 2.430E+02 | 229.0 |
| 12.0                         | 2.139E+02 | 224.0 | 6.0E-03 | 4.3E-05 | 2.090E+02 | 222.0 |
| 13.0                         | 1.820E+02 | 217.0 | 1.8E-03 | 4.5E-05 | 1.790E+02 | 216.0 |
| 14.0                         | 1.560E+02 | 210.0 | 1.0E-03 | 4.5E-05 | 1.530E+02 | 210.0 |
| 15.0                         | 1.320E+02 | 204.0 | 7.6E-04 | 4.7E-05 | 1.300E+02 | 210.0 |
| 16.0                         | 1.110E+02 | 197.0 | 6.4E-04 | 4.7E-05 | 1.110E+02 | 210.0 |
| 17.0                         | 9.370E+01 | 190.0 | 5.6E-04 | 6.4E-05 | 9.500E+01 | 210.0 |
| 18.0                         | 7.890E+01 | 199.0 | 5.0E-04 | 9.0E-05 | 8.120E+01 | 210.0 |
| 19.0                         | 6.660E+01 | 203.0 | 4.9E-04 | 1.4E-04 | 6.950E+01 | 217.0 |
| 20.0                         | 5.650E+01 | 207.0 | 4.5E-04 | 1.9E-04 | 5.490E+01 | 218.0 |
| 21.0                         | 4.880E+01 | 211.0 | 5.1E-04 | 2.4E-04 | 5.100E+01 | 219.0 |
| 22.0                         | 4.098E+01 | 215.0 | 5.1E-04 | 2.8E-04 | 4.370E+01 | 220.0 |
| 23.0                         | 3.500E+01 | 217.0 | 5.4E-04 | 3.2E-04 | 3.760E+01 | 222.0 |
| 24.0                         | 3.000E+01 | 219.0 | 6.0E-04 | 3.4E-04 | 3.220E+01 | 223.0 |
| 25.0                         | 2.570E+01 | 221.0 | 6.7E-04 | 3.4E-04 | 2.770E+01 | 224.0 |
| 30.0                         | 1.220E+01 | 232.0 | 3.6E-04 | 2.4E-04 | 1.320E+01 | 234.0 |
| 35.0                         | 6.000E+00 | 243.0 | 1.1E-04 | 9.2E-05 | 6.520E+00 | 245.0 |
| 40.0                         | 3.050E+00 | 254.0 | 4.3E-05 | 4.1E-05 | 3.330E+00 | 258.0 |
| 45.0                         | 1.590E+00 | 265.0 | 1.9E-05 | 1.3E-05 | 1.760E+00 | 270.0 |
| 50.0                         | 8.540E-01 | 270.0 | 6.3E-06 | 4.3E-06 | 9.510E-01 | 276.0 |
| 70.0                         | 5.790E-02 | 219.0 | 1.4E-07 | 8.6E-08 | 6.710E-02 | 218.0 |
| 100.0                        | 3.000E-04 | 210.0 | 1.0E-09 | 4.3E-11 | 3.000E-04 | 210.0 |

|                                      |           |       |         |         |           |       |
|--------------------------------------|-----------|-------|---------|---------|-----------|-------|
| MID-LATITUDE WINTER SUBARCTIC SUMMER |           |       |         |         |           |       |
| 0.0                                  | 1.018E+03 | 272.2 | 3.5E+00 | 6.0E-05 | 1.010E+03 | 287.0 |
| 1.0                                  | 8.973E+02 | 268.7 | 2.5E+00 | 5.4E-05 | 8.960E+02 | 282.0 |
| 2.0                                  | 7.897E+02 | 265.2 | 1.8E+00 | 4.9E-05 | 7.929E+02 | 276.0 |
| 3.0                                  | 6.939E+02 | 261.7 | 1.2E+00 | 4.9E-05 | 7.000E+02 | 271.0 |
| 4.0                                  | 6.081E+02 | 255.7 | 6.6E-01 | 4.9E-05 | 6.160E+02 | 266.0 |
| 5.0                                  | 5.313E+02 | 249.7 | 3.8E-01 | 5.8E-05 | 5.410E+02 | 260.0 |
| 6.0                                  | 4.627E+02 | 243.7 | 2.1E-01 | 6.4E-05 | 4.730E+02 | 253.0 |
| 7.0                                  | 4.016E+02 | 237.7 | 8.5E-02 | 7.7E-05 | 4.130E+02 | 246.0 |
| 8.0                                  | 3.473E+02 | 231.7 | 3.5E-02 | 9.0E-05 | 3.590E+02 | 239.0 |
| 9.0                                  | 2.992E+02 | 225.7 | 1.6E-02 | 1.2E-04 | 3.107E+02 | 232.0 |
| 10.0                                 | 2.568E+02 | 219.7 | 7.5E-03 | 1.6E-04 | 2.677E+02 | 225.0 |
| 11.0                                 | 2.199E+02 | 214.2 | 6.9E-03 | 2.1E-04 | 2.300E+02 | 220.0 |
| 12.0                                 | 1.852E+02 | 218.7 | 6.0E-03 | 2.6E-04 | 1.977E+02 | 220.0 |
| 13.0                                 | 1.610E+02 | 218.2 | 1.8E-03 | 3.0E-04 | 1.700E+02 | 220.0 |
| 14.0                                 | 1.370E+02 | 217.7 | 1.0E-03 | 3.2E-04 | 1.460E+02 | 220.0 |
| 15.0                                 | 1.178E+02 | 217.2 | 7.6E-04 | 3.4E-04 | 1.250E+02 | 220.0 |
| 16.0                                 | 1.007E+02 | 216.7 | 6.4E-04 | 3.6E-04 | 1.080E+02 | 220.0 |

|                                |           |       |               |         |           |               |         |         |
|--------------------------------|-----------|-------|---------------|---------|-----------|---------------|---------|---------|
| 17.0                           | 4.610E+01 | 216.2 | 5.6E-04       | 3.9E-14 | 9.780E+01 | 225.0         | 5.6E-04 | 3.9E-04 |
| 18.0                           | 7.359E+01 | 215.7 | 5.0E-04       | 4.1E-14 | 7.980E+01 | 225.0         | 5.0E-04 | 4.1E-04 |
| 19.0                           | 6.280E+01 | 215.2 | 4.9E-04       | 4.3E-14 | 6.860E+01 | 225.0         | 4.9E-04 | 4.1E-04 |
| 20.0                           | 5.370E+01 | 215.2 | 4.5E-04       | 4.5E-14 | 5.890E+01 | 225.0         | 4.5E-04 | 3.9E-14 |
| 21.0                           | 4.580E+01 | 215.2 | 5.1E-14       | 4.3E-14 | 5.070E+01 | 225.0         | 5.1E-14 | 3.6E-04 |
| 22.0                           | 3.910E+01 | 215.2 | 5.1E-14       | 4.3E-14 | 4.360E+01 | 225.0         | 5.1E-14 | 3.2E-04 |
| 23.0                           | 3.340E+01 | 215.2 | 5.4E-14       | 3.9E-14 | 3.750E+01 | 225.0         | 5.4E-14 | 3.0E-04 |
| 24.0                           | 2.860E+01 | 215.2 | 6.0E-14       | 3.6E-14 | 3.227E+01 | 226.0         | 6.0E-14 | 2.8E-04 |
| 25.0                           | 2.430E+01 | 215.2 | 6.7E-14       | 3.4E-14 | 2.780E+01 | 228.0         | 6.7E-14 | 2.6E-04 |
| 30.0                           | 1.110E+01 | 217.4 | 3.6E-14       | 1.9E-14 | 1.340E+01 | 235.0         | 3.6E-14 | 1.4E-04 |
| 35.0                           | 5.180E+00 | 227.8 | 1.1E-14       | 9.2E-15 | 6.610E+00 | 247.0         | 1.1E-14 | 9.2E-05 |
| 40.0                           | 2.530E+00 | 243.2 | 4.3E-15       | 4.1E-15 | 3.400E+00 | 262.0         | 4.3E-15 | 4.1E-05 |
| 45.0                           | 1.290E+00 | 258.5 | 1.9E-15       | 1.3E-15 | 1.810E+00 | 274.0         | 1.9E-15 | 1.3E-05 |
| 50.0                           | 6.820E-01 | 265.7 | 6.3E-16       | 4.3E-16 | 9.970E-01 | 277.0         | 6.3E-16 | 4.3E-06 |
| 70.0                           | 4.670E-02 | 230.7 | 1.4E-17       | 8.6E-18 | 7.070E-02 | 216.0         | 1.4E-17 | 8.6E-18 |
| 100.0                          | 3.000E-04 | 210.2 | 1.0E-19       | 4.3E-11 | 3.000E-04 | 210.0         | 1.0E-19 | 4.3E-11 |
| SUBARCTIC WINTER U.S. STANDARD |           |       |               |         |           |               |         |         |
| 0.0                            | 1.013E+03 | 257.1 | 1.2E+00       | 4.1E-15 | 1.013E+03 | 288.1         | 5.9E+00 | 5.4E-05 |
| 1.0                            | 8.879E+02 | 259.1 | 1.2E+00       | 4.1E-15 | 3.986E+02 | 281.6         | 4.2E+00 | 5.4E-05 |
| 2.0                            | 7.775E+02 | 255.9 | 9.4E-01       | 4.1E-15 | 7.950E+02 | 275.1         | 2.9E+00 | 5.4E-05 |
| 3.0                            | 6.798E+02 | 252.7 | 6.8E-01       | 4.3E-15 | 7.012E+02 | 269.7         | 1.8E+00 | 5.0E-05 |
| 4.0                            | 5.932E+02 | 247.7 | 4.1E-01       | 4.5E-15 | 6.166E+02 | 262.2         | 1.1E+00 | 4.6E-05 |
| 5.0                            | 5.158E+02 | 240.9 | 2.0E-01       | 4.7E-15 | 5.405E+02 | 255.7         | 6.4E-01 | 4.6E-05 |
| 6.0                            | 4.467E+02 | 234.1 | 9.8E-02       | 4.9E-15 | 4.722E+02 | 249.2         | 3.8E-01 | 4.5E-05 |
| 7.0                            | 3.853E+02 | 227.3 | 5.4E-02       | 7.1E-15 | 4.111E+02 | 242.7         | 2.1E-01 | 4.9E-05 |
| 8.0                            | 3.308E+02 | 220.6 | 1.1E-02       | 9.0E-15 | 3.565E+02 | 236.2         | 1.2E-01 | 5.2E-05 |
| 9.0                            | 2.829E+02 | 217.2 | 8.4E-03       | 1.6E-14 | 3.080E+02 | 229.7         | 4.6E-02 | 7.1E-05 |
| 10.0                           | 2.418E+02 | 217.2 | 5.5E-03       | 2.4E-14 | 2.650E+02 | 223.2         | 1.9E-02 | 9.0E-05 |
| 11.0                           | 2.067E+02 | 217.2 | 3.8E-03       | 3.2E-14 | 2.270E+02 | 216.8         | 8.2E-03 | 1.3E-04 |
| 12.0                           | 1.766E+02 | 217.2 | 2.6E-03       | 4.3E-14 | 1.940E+02 | 216.6         | 3.7E-03 | 1.6E-04 |
| 13.0                           | 1.510E+02 | 217.2 | 1.9E-03       | 4.7E-14 | 1.659E+02 | 216.6         | 1.3E-03 | 1.7E-04 |
| 14.0                           | 1.291E+02 | 217.2 | 1.0E-03       | 4.9E-14 | 1.417E+02 | 216.6         | 8.4E-04 | 1.9E-04 |
| 15.0                           | 1.103E+02 | 217.2 | 7.6E-04       | 5.6E-14 | 1.211E+02 | 216.6         | 7.2E-04 | 2.1E-04 |
| 16.0                           | 9.431E+01 | 216.6 | 6.4E-04       | 6.2E-14 | 1.035E+02 | 216.6         | 6.1E-04 | 2.4E-04 |
| 17.0                           | 8.058E+01 | 216.9 | 5.6E-04       | 6.7E-14 | 8.950E+01 | 216.6         | 5.2E-04 | 2.4E-04 |
| 18.0                           | 6.882E+01 | 215.4 | 5.0E-04       | 6.2E-14 | 7.565E+01 | 216.6         | 4.4E-04 | 3.2E-04 |
| 19.0                           | 5.875E+01 | 214.8 | 4.9E-04       | 6.0E-14 | 6.467E+01 | 216.6         | 4.4E-04 | 3.5E-04 |
| 20.0                           | 5.014E+01 | 215.1 | 4.5E-04       | 5.6E-14 | 5.529E+01 | 216.6         | 4.4E-04 | 3.8E-04 |
| 21.0                           | 4.277E+01 | 213.6 | 5.1E-04       | 5.1E-14 | 4.729E+01 | 217.6         | 4.8E-04 | 3.8E-04 |
| 22.0                           | 3.647E+01 | 213.0 | 5.1E-04       | 4.7E-14 | 4.047E+01 | 218.6         | 5.2E-04 | 3.9E-04 |
| 23.0                           | 3.109E+01 | 217.4 | 5.4E-04       | 4.3E-14 | 3.467E+01 | 219.6         | 5.7E-04 | 3.9E-04 |
| 24.0                           | 2.649E+01 | 211.8 | 6.0E-04       | 3.6E-14 | 2.972E+01 | 220.6         | 6.1E-04 | 3.6E-04 |
| 25.0                           | 2.256E+01 | 211.2 | 6.7E-14       | 3.2E-14 | 2.549E+01 | 221.6         | 6.6E-14 | 3.4E-04 |
| 30.0                           | 1.020E+01 | 216.0 | 3.6E-14       | 1.5E-14 | 1.197E+01 | 226.5         | 3.8E-14 | 2.6E-04 |
| 35.0                           | 4.701E+00 | 222.2 | 1.1E-14       | 9.2E-15 | 5.746E+00 | 236.5         | 1.6E-14 | 1.1E-04 |
| 40.0                           | 2.243E+00 | 234.7 | 4.3E-15       | 4.1E-15 | 2.871E+00 | 253.4         | 6.7E-15 | 4.9E-05 |
| 45.0                           | 1.113E+00 | 247.0 | 1.9E-15       | 1.3E-15 | 1.491E+00 | 264.2         | 3.2E-15 | 1.7E-05 |
| 50.0                           | 5.719E-01 | 259.3 | 6.3E-16       | 4.3E-16 | 7.978E-01 | 270.6         | 1.2E-15 | 4.0E-06 |
| 70.0                           | 4.016E-02 | 245.7 | 1.4E-17       | 8.6E-18 | 5.528E-02 | 219.7         | 1.5E-17 | 8.6E-18 |
| 100.0                          | 3.000E-04 | 210.0 | 1.0E-19       | 4.3E-11 | 3.000E-04 | 210.0         | 1.0E-19 | 4.3E-11 |
| RURAL                          |           |       |               |         |           |               |         |         |
| 2001.91624                     | .50286    |       | .2501.85556   | .23174  |           | .3001.67281   | .13351  |         |
| .3371.53735                    | .09520    |       | .4001.31665   | .08337  |           | .4881.06805   | .07050  |         |
| .5151.00814                    | .06748    |       | .550 .93072   | .06923  |           | .633 .79000   | .06159  |         |
| .694 .70226                    | .06129    |       | .860 .51221   | .06694  |           | 1.050 .38024  | .06779  |         |
| 1.300 .26969                   | .06247    |       | 1.536 .20573  | .05907  |           | 1.800 .15351  | .04432  |         |
| 2.000 .13121                   | .02753    |       | 2.250 .11397  | .02494  |           | 2.500 .10158  | .02932  |         |
| 2.700 .07835                   | .06559    |       | 3.000 .08330  | .03696  |           | 3.200 .09339  | .02046  |         |
| 3.392 .09251                   | .01379    |       | 3.500 .09598  | .01583  |           | 3.750 .09394  | .01157  |         |
| 4.000 .09001                   | .01465    |       | 4.500 .08011  | .02219  |           | 5.000 .07872  | .02033  |         |
| 5.500 .06904                   | .02455    |       | 6.000 .05870  | .02921  |           | 6.200 .05696  | .03113  |         |
| 6.500 .05488                   | .03354    |       | 7.200 .05216  | .04713  |           | 7.900 .03074  | .03904  |         |
| 8.700 .01340                   | .05110    |       | 8.500 .03319  | .07937  |           | 8.700 .05497  | .07125  |         |
| 9.000 .05719                   | .07649    |       | 9.200 .05289  | .08719  |           | 9.500 .05477  | .06358  |         |
| 9.800 .05774                   | .05266    |       | 10.000 .05722 | .05123  |           | 10.591 .05749 | .04301  |         |
| 11.000 .05977                  | .03607    |       | 11.500 .05823 | .03394  |           | 12.500 .05370 | .03269  |         |

|        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 14.000 | .05164 | .03310 | 14.000 | .04733 | .03407 | 14.800 | .03526 | .03855 |
| 15.000 | .03376 | .05278 | 15.400 | .04353 | .04407 | 17.200 | .04512 | .04857 |
| 18.000 | .04495 | .04387 | 18.500 | .04276 | .04286 | 20.000 | .04175 | .04857 |
| 21.300 | .03988 | .04959 | 22.500 | .03883 | .04856 | 25.000 | .03505 | .04737 |
| 27.900 | .03095 | .04713 | 30.000 | .02807 | .04817 | 35.000 | .02601 | .04885 |
| 40.000 | .02311 | .04972 |        |        |        |        |        |        |

TROPOSPHERIC

|        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| .2002  | .03513 | .50901 | .2501  | .96557 | .21839 | .3001  | .76630 | .11186 |
| .3371  | .61592 | .07429 | .4001  | .36803 | .06144 | .4881  | .10225 | .04884 |
| .5151  | .03650 | .04589 | .550   | .95284 | .04716 | .633   | .79828 | .03985 |
| .694   | .70275 | .03916 | .860   | .49706 | .04326 | 1.060  | .35318 | .04336 |
| 1.300  | .23130 | .03796 | 1.536  | .15033 | .03451 | 1.800  | .09904 | .02200 |
| 2.000  | .06761 | .01992 | 2.250  | .05005 | .01146 | 2.500  | .03797 | .01157 |
| 2.700  | .02650 | .03831 | 3.000  | .02394 | .01589 | 3.200  | .02350 | .00678 |
| 3.392  | .02133 | .00648 | 3.500  | .02174 | .00483 | 3.750  | .01838 | .00402 |
| 4.000  | .01564 | .00434 | 4.500  | .01159 | .00701 | 5.000  | .00849 | .00623 |
| 5.500  | .00611 | .00405 | 6.000  | .00401 | .01080 | 6.200  | .00393 | .01169 |
| 6.500  | .00383 | .01276 | 7.200  | .00294 | .02036 | 7.900  | .00055 | .01881 |
| 8.200  | .00017 | .02929 | 8.500  | .00121 | .04847 | 8.700  | .00785 | .03419 |
| 9.000  | .00447 | .03750 | 9.200  | .00620 | .04812 | 9.500  | .00484 | .02700 |
| 9.800  | .00423 | .01966 | 10.000 | .00375 | .01095 | 10.591 | .00275 | .01445 |
| 11.000 | .00235 | .01108 | 11.500 | .00185 | .01027 | 12.500 | .00122 | .00997 |
| 13.000 | .00104 | .01036 | 14.000 | .00075 | .01076 | 14.800 | .00049 | .01389 |
| 15.000 | .00046 | .02374 | 16.400 | .00068 | .01488 | 17.200 | .00092 | .01578 |
| 18.000 | .00072 | .01324 | 18.500 | .00056 | .01345 | 20.000 | .00061 | .01530 |
| 21.300 | .00049 | .01616 | 22.500 | .00040 | .01563 | 25.000 | .00026 | .01555 |
| 27.900 | .00017 | .01608 | 30.000 | .00012 | .01732 | 35.000 | .00009 | .01730 |
| 40.000 | .00006 | .01807 |        |        |        |        |        |        |

MARITIME

|        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| .2001  | .18445 | .13003 | .2501  | .18060 | .05471 | .3001  | .14150 | .02800 |
| .3371  | .11526 | .01758 | .4001  | .06260 | .01536 | .4881  | .01394 | .01221 |
| .5151  | .99745 | .01147 | .550   | .98821 | .01179 | .633   | .95556 | .00996 |
| .694   | .93959 | .00379 | .860   | .90128 | .01084 | 1.060  | .86817 | .01210 |
| 1.360  | .82883 | .01178 | 1.536  | .79507 | .01207 | 1.800  | .75342 | .00918 |
| 2.000  | .71594 | .01389 | 2.250  | .67716 | .01062 | 2.500  | .60927 | .02125 |
| 2.700  | .43992 | .09134 | 3.000  | .32712 | .33275 | 3.200  | .45940 | .22077 |
| 3.392  | .56701 | .02084 | 3.500  | .58489 | .04164 | 3.750  | .56451 | .01718 |
| 4.000  | .52889 | .01985 | 4.500  | .45201 | .04247 | 5.000  | .40717 | .03660 |
| 5.500  | .34309 | .03207 | 6.000  | .19835 | .14879 | 6.200  | .28863 | .14478 |
| 6.500  | .28792 | .07387 | 7.200  | .24147 | .05965 | 7.900  | .19876 | .05840 |
| 8.200  | .18694 | .06368 | 8.500  | .18482 | .07119 | 8.700  | .19956 | .07051 |
| 9.000  | .19546 | .07045 | 9.200  | .17855 | .07218 | 9.500  | .16085 | .06397 |
| 9.800  | .14392 | .06222 | 10.000 | .13066 | .06245 | 10.591 | .09447 | .06893 |
| 11.000 | .07216 | .08415 | 11.500 | .05652 | .10523 | 12.500 | .04623 | .14900 |
| 13.000 | .04841 | .16294 | 14.000 | .05448 | .17892 | 14.800 | .05801 | .18318 |
| 15.000 | .05950 | .18658 | 16.400 | .06689 | .18760 | 17.200 | .07504 | .18580 |
| 18.000 | .07611 | .17950 | 18.500 | .07484 | .17523 | 20.000 | .07033 | .16056 |
| 21.300 | .06514 | .15090 | 22.500 | .06128 | .14325 | 25.000 | .05367 | .12993 |
| 27.900 | .04611 | .11930 | 30.000 | .04085 | .11231 | 35.000 | .03006 | .11187 |
| 40.000 | .02533 | .13364 |        |        |        |        |        |        |

URBAN

|        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| .2001  | .28721 | .67571 | .2501  | .25108 | .54737 | .3001  | .15409 | .47917 |
| .3371  | .06510 | .44168 | .4001  | .91714 | .40356 | .4881  | .75674 | .35914 |
| .5151  | .71667 | .34824 | .550   | .66572 | .33428 | .633   | .57055 | .30266 |
| .694   | .51096 | .28660 | .860   | .38284 | .25454 | 1.060  | .28960 | .22559 |
| 1.310  | .21311 | .19640 | 1.536  | .16700 | .17528 | 1.800  | .13019 | .15242 |
| 2.000  | .11288 | .13387 | 2.250  | .09833 | .12404 | 2.500  | .08758 | .11565 |
| 2.700  | .07286 | .12875 | 3.000  | .07209 | .10754 | 3.200  | .07572 | .09346 |
| 3.392  | .07383 | .08966 | 3.500  | .07500 | .08610 | 3.750  | .07258 | .08063 |
| 4.000  | .06939 | .07739 | 4.500  | .06220 | .07474 | 5.000  | .05900 | .06824 |
| 5.500  | .05386 | .06613 | 6.000  | .04767 | .06472 | 6.200  | .04834 | .06492 |
| 6.500  | .04496 | .06393 | 7.200  | .04271 | .06784 | 7.900  | .03118 | .06030 |
| 8.200  | .02199 | .06560 | 8.500  | .93205 | .07916 | 8.700  | .04318 | .07418 |
| 9.000  | .04414 | .07610 | 9.200  | .04181 | .08090 | 9.500  | .04262 | .06802 |
| 9.800  | .04400 | .06151 | 10.000 | .04365 | .06037 | 10.591 | .04350 | .05493 |
| 11.000 | .04448 | .05840 | 11.500 | .04350 | .04842 | 12.500 | .04083 | .04604 |

|                          |                      |                      |
|--------------------------|----------------------|----------------------|
| 13.000 .03961 .04562     | 14.000 .03713 .04476 | 14.800 .03275 .04621 |
| 15.000 .02985 .05316     | 16.400 .03457 .04751 | 17.200 .03524 .04911 |
| 18.000 .03499 .04595     | 18.500 .03176 .04505 | 20.000 .03298 .04691 |
| 21.300 .03174 .04672     | 22.500 .03099 .04552 | 25.000 .02861 .04374 |
| 27.900 .02601 .04246     | 30.000 .02422 .04226 | 35.000 .02244 .04112 |
| 40.000 .02037 .04028     |                      |                      |
| BACKGROUND STRATOSPHERIC |                      |                      |
| .2001.445730.00000       | .2501.552710.00000   | .3001.554620.00000   |
| .3371.515090.00000       | .4001.376140.00000   | .4851.150490.00000   |
| .5151.086510.00000       | .5501.000000.00000   | .633 .822440.00000   |
| .694 .706310.00000       | .860 .468510.00000   | 1.060 .288640.00000  |
| 1.330 .16420 .00002      | 1.535 .09972 .00020  | 1.800 .05817 .00064  |
| 2.000 .04055 .00128      | 2.250 .02570 .00157  | 2.500 .01560 .00289  |
| 2.700 .00931 .00403      | 3.000 .00632 .05878  | 3.200 .00600 .07671  |
| 3.392 .00627 .05300      | 3.500 .00623 .07917  | 3.750 .00510 .06019  |
| 4.000 .00403 .05391      | 4.500 .00242 .04522  | 5.000 .00145 .04132  |
| 5.500 .00103 .05704      | 6.000 .00105 .05263  | 6.200 .00088 .04304  |
| 6.500 .00055 .05283      | 7.200 .00019 .04437  | 7.900 .00050 .11817  |
| 8.200 .00077 .14631      | 8.500 .00095 .14476  | 8.700 .00096 .12640  |
| 9.000 .00072 .09217      | 9.200 .00058 .04722  | 9.500 .00071 .09987  |
| 9.800 .00067 .07256      | 10.000 .00049 .04971 | 10.591 .00027 .04041 |
| 11.000 .00026 .05710     | 11.500 .00026 .03549 | 12.500 .00013 .01962 |
| 13.000 .00010 .01930     | 14.000 .00007 .01860 | 14.800 .00005 .01890 |
| 15.000 .00005 .01948     | 16.400 .00004 .03661 | 17.200 .00005 .04147 |
| 18.000 .00005 .02371     | 18.500 .00004 .01710 | 20.000 .00002 .01343 |
| 21.300 .00002 .01617     | 22.500 .00002 .01530 | 25.000 .00001 .00836 |
| 27.900 .00001 .00640     | 30.000 .00001 .00632 | 35.000 .00000 .00580 |
| 40.000 .00000 .00592     |                      |                      |
| AGED VOLCANIC            |                      |                      |
| .200 .70064 .44818       | .250 .90085 .28179   | .3001.07908 .11262   |
| .3371.09515 .08497       | .4001.06762 .07244   | .4881.00303 .05962   |
| .515 .97994 .05651       | .550 .94729 .05271   | .633 .86756 .04532   |
| .694 .80787 .04034       | .860 .65695 .03170   | 1.060 .50565 .02452  |
| 1.330 .36931 .01881      | 1.536 .26480 .01490  | 1.800 .18488 .01191  |
| 2.000 .13533 .01019      | 2.250 .10205 .00867  | 2.500 .07792 .00843  |
| 2.700 .06343 .00842      | 3.000 .05126 .00949  | 3.200 .04262 .00336  |
| 3.392 .03761 .00743      | 3.500 .03435 .00654  | 3.750 .02913 .00468  |
| 4.000 .02394 .00349      | 4.500 .01775 .00319  | 5.000 .01204 .00335  |
| 5.500 .00969 .00306      | 6.000 .00570 .00451  | 6.200 .00467 .00525  |
| 6.500 .00378 .00665      | 7.200 .00250 .01112  | 7.900 .00136 .01652  |
| 8.200 .00099 .02170      | 8.500 .00257 .02218  | 8.700 .00081 .02438  |
| 9.000 .00602 .02506      | 9.200 .00573 .02658  | 9.500 .00518 .02871  |
| 9.800 .00475 .02979      | 10.000 .00449 .03009 | 10.591 .00322 .02859 |
| 11.000 .00260 .02511     | 11.500 .00191 .02242 | 12.500 .00090 .01623 |
| 13.000 .00071 .01530     | 14.000 .00046 .01447 | 14.800 .00033 .01532 |
| 15.000 .00032 .01635     | 16.400 .00025 .01620 | 17.200 .00029 .01706 |
| 18.000 .00031 .01826     | 18.500 .00031 .01741 | 20.000 .00026 .01390 |
| 21.300 .00023 .01054     | 22.500 .00020 .01104 | 25.000 .00014 .01038 |
| 27.900 .00008 .01072     | 30.000 .00005 .01124 | 35.000 .00003 .01192 |
| 40.000 .00002 .01378     |                      |                      |
| METEORIC DUST            |                      |                      |
| .2001.04956 .00063       | .2501.05670 .00099   | .3001.05726 .00152   |
| .3371.05976 .00181       | .4001.04063 .00260   | .4881.01617 .00387   |
| .5151.00724 .00431       | .550 .98494 .00506   | .633 .96565 .00664   |
| .694 .94158 .00763       | .860 .87556 .01212   | 1.060 .79629 .01827  |
| 1.330 .70574 .02716      | 1.536 .62325 .03725  | 1.800 .53895 .04998  |
| 2.000 .44221 .06161      | 2.250 .41596 .07539  | 2.500 .35737 .08943  |
| 2.700 .31622 .10050      | 3.000 .26452 .11612  | 3.200 .23667 .12539  |
| 3.392 .21466 .13311      | 3.500 .20421 .13682  | 3.750 .18453 .14349  |
| 4.000 .17001 .14722      | 4.500 .15088 .14632  | 5.000 .13773 .13728  |
| 5.500 .12619 .12463      | 6.000 .11435 .11183  | 6.200 .10943 .10712  |
| 6.500 .10177 .10075      | 7.200 .08264 .09004  | 7.900 .06170 .08737  |
| 8.200 .05237 .08909      | 8.500 .04325 .09618  | 8.700 .03775 .10105  |
| 9.000 .03151 .11987      | 9.200 .02962 .13439  | 9.500 .03129 .16307  |
| 9.800 .03697 .18824      | 10.000 .04059 .19548 | 10.591 .04385 .20096 |
| 11.000 .05296 .22496     | 11.500 .06657 .18417 | 12.500 .05990 .09282 |
| 13.000 .05084 .08076     | 14.000 .03968 .07476 | 14.800 .02937 .06666 |
| 15.000 .02633 .06923     | 16.400 .02245 .12330 | 17.200 .01822 .10549 |
| 18.000 .01767 .13433     | 18.500 .02167 .16181 | 20.000 .02886 .13154 |
| 21.300 .02356 .09446     | 22.500 .01847 .10425 | 25.000 .02339 .10584 |
| 27.900 .01851 .07749     | 30.000 .01783 .06758 | 35.000 .01360 .03695 |
| 40.000 .00864 .03245     |                      |                      |

## Appendix B

### Extinction Coefficient Charts for Selected Laser Frequencies

Extinction Coefficients are provided for a selected list of the laser emission frequencies identified in Table 7. Results are provided for six geographical models and two aerosol models. The total extinction coefficient ( $\gamma$ ) for a given atmospheric layer is determined by summing the four quantities  $k_m$ ,  $\sigma_m$ ,  $k_a$  and  $\sigma_a$  as indicated in Eq. (1) of this report. The units of all quantities are  $\text{km}^{-1}$ . Therefore, the total transmission for a horizontal path is obtained by application of Eq. (6) to the total extinction coefficient as obtained from the chart. For sea level conditions, if the Rural aerosol model is not appropriate to a specific application, results are provided at the bottom of each chart for three additional boundary layer aerosol models. However, it should be noted that results are not provided for the "Clear" (50 km Met. Range) Urban model as the model is simply not applicable to very clear situations. Similarly, results are not provided for the "Hazy" (5 km Met. Range) Tropospheric model as this model is not to be used under limited visibility conditions. It is suggested that linear interpolation be used to obtain extinction coefficients for Meteorological Ranges between 5 and 50 km.

For vertical or slant atmospheric paths, extinction coefficients can be obtained by summation of extinction coefficients in appropriate columns, excluding the first row of the chart. All values are provided in the unit,  $\text{km}^{-1}$ , and entries are made for each 1-km interval from the surface to 25-km altitude, thus reducing the problem to this simple summation. For altitudes above 25 km, it is necessary

to multiply the values read from the chart by the height increment corresponding to the layer. For slant path calculations, the total extinction value for the vertical path must be multiplied by the secant of the zenith angle before application of Eq. (7).

$$\tau = \exp \left[ -\sec \theta \sum_j \gamma_j \right] \quad (7)$$

WAVELENGTH = 10.411103 MICROMETERS  
FREQUENCY = 974.375 WAVENUMBER

| ht(km) | U.S. STANDARD                 |                                | TROPICAL                      |                                | MIDLAT SUMMER                 |                                | MIDLAT WINTER                 |                                | SUBARCTIC SUMMER              |                                | SUBARCTIC WINTER              |                                | CLEAR                         |                                | AEROSOL                       |                                |
|--------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|        | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0      | 1.09E+00                      | 0.                             | 3.95E+00                      | 2.76E+00                       | 5.35E-01                      | 1.67E+00                       | 5.35E-01                      | 1.67E+00                       | 1.50E-01                      | 1.50E-01                       | 1.50E-01                      | 1.50E-01                       | 2.73E-03                      | 4.03E-03                       | 2.97E-02                      | 4.44E-02                       |
| 1      | 9.31E-01                      | 0.                             | 3.33E+00                      | 2.31E+00                       | 4.66E-01                      | 1.39E+00                       | 4.66E-01                      | 1.39E+00                       | 1.61E-01                      | 1.61E-01                       | 1.61E-01                      | 1.61E-01                       | 1.80E-03                      | 2.70E-03                       | 2.97E-02                      | 4.44E-02                       |
| 2      | 6.57E-01                      | 0.                             | 2.34E+00                      | 1.54E+00                       | 3.53E-01                      | 9.64E-01                       | 3.53E-01                      | 9.64E-01                       | 1.57E-01                      | 1.57E-01                       | 1.57E-01                      | 1.57E-01                       | 2.28E-04                      | 4.41E-05                       | 3.50E-03                      | 7.03E-04                       |
| 3      | 4.46E-01                      | 0.                             | 1.51E+00                      | 9.55E-01                       | 2.59E-01                      | 6.70E-01                       | 2.59E-01                      | 6.70E-01                       | 1.26E-01                      | 1.26E-01                       | 1.26E-01                      | 1.26E-01                       | 1.12E-04                      | 2.26E-05                       | 5.93E-04                      | 1.13E-04                       |
| 4      | 2.79E-01                      | 0.                             | 7.61E-01                      | 5.60E-01                       | 1.64E-01                      | 4.40E-01                       | 1.64E-01                      | 4.40E-01                       | 6.74E-02                      | 6.74E-02                       | 6.74E-02                      | 6.74E-02                       | 9.17E-05                      | 1.94E-05                       | 3.24E-04                      | 6.51E-05                       |
| 5      | 1.68E-01                      | 0.                             | 4.25E-01                      | 3.15E-01                       | 9.34E-02                      | 2.74E-01                       | 9.34E-02                      | 2.74E-01                       | 4.84E-02                      | 4.84E-02                       | 4.84E-02                      | 4.84E-02                       | 7.05E-05                      | 1.42E-05                       | 1.69E-04                      | 3.39E-05                       |
| 6      | 9.84E-02                      | 0.                             | 2.67E-01                      | 1.79E-01                       | 5.33E-02                      | 1.55E-01                       | 5.33E-02                      | 1.55E-01                       | 2.40E-02                      | 2.40E-02                       | 2.40E-02                      | 2.40E-02                       | 5.25E-05                      | 1.05E-05                       | 1.07E-04                      | 2.15E-05                       |
| 7      | 5.61E-02                      | 0.                             | 1.49E-01                      | 1.10E-01                       | 2.62E-02                      | 9.21E-02                       | 2.62E-02                      | 9.21E-02                       | 1.24E-02                      | 1.24E-02                       | 1.24E-02                      | 1.24E-02                       | 7.62E-05                      | 7.29E-06                       | 8.75E-05                      | 1.75E-05                       |
| 8      | 3.10E-02                      | 0.                             | 7.97E-02                      | 6.37E-02                       | 1.12E-02                      | 3.99E-02                       | 1.12E-02                      | 3.99E-02                       | 4.84E-03                      | 4.84E-03                       | 4.84E-03                      | 4.84E-03                       | 2.29E-05                      | 4.60E-06                       | 5.85E-05                      | 1.13E-05                       |
| 9      | 1.47E-02                      | 0.                             | 4.00E-02                      | 3.55E-02                       | 5.22E-03                      | 1.54E-02                       | 5.22E-03                      | 1.54E-02                       | 2.13E-03                      | 2.13E-03                       | 2.13E-03                      | 2.13E-03                       | 5.65E-05                      | 0.                             | 6.69E-05                      | 7.22E-06                       |
| 10     | 5.90E-03                      | 0.                             | 1.60E-02                      | 1.91E-02                       | 2.67E-03                      | 5.62E-03                       | 2.67E-03                      | 5.62E-03                       | 1.64E-03                      | 1.64E-03                       | 1.64E-03                      | 1.64E-03                       | 4.36E-05                      | 0.                             | 4.88E-05                      | 5.27E-06                       |
| 11     | 2.65E-03                      | 0.                             | 7.25E-03                      | 8.49E-03                       | 1.88E-03                      | 3.03E-03                       | 1.88E-03                      | 3.03E-03                       | 1.39E-03                      | 1.39E-03                       | 1.39E-03                      | 1.39E-03                       | 3.72E-05                      | 0.                             | 5.24E-05                      | 5.70E-06                       |
| 12     | 1.50E-03                      | 0.                             | 2.98E-03                      | 3.12E-03                       | 1.74E-03                      | 2.34E-03                       | 1.74E-03                      | 2.34E-03                       | 1.19E-03                      | 1.19E-03                       | 1.19E-03                      | 1.19E-03                       | 3.41E-05                      | 0.                             | 6.07E-05                      | 6.56E-06                       |
| 13     | 1.09E-03                      | 0.                             | 1.44E-03                      | 1.33E-03                       | 1.29E-03                      | 1.70E-03                       | 1.29E-03                      | 1.70E-03                       | 1.04E-03                      | 1.04E-03                       | 1.04E-03                      | 1.04E-03                       | 3.19E-05                      | 0.                             | 6.99E-05                      | 7.55E-06                       |
| 14     | 9.04E-04                      | 0.                             | 7.71E-04                      | 8.92E-04                       | 9.74E-04                      | 1.34E-03                       | 9.74E-04                      | 1.34E-03                       | 9.38E-04                      | 9.38E-04                       | 9.38E-04                      | 9.38E-04                       | 3.14E-05                      | 0.                             | 7.59E-05                      | 8.19E-06                       |
| 15     | 8.39E-04                      | 0.                             | 5.23E-04                      | 8.52E-04                       | 8.39E-04                      | 1.32E-03                       | 8.39E-04                      | 1.32E-03                       | 8.75E-04                      | 8.75E-04                       | 8.75E-04                      | 8.75E-04                       | 3.19E-05                      | 0.                             | 7.75E-05                      | 8.37E-06                       |
| 16     | 8.19E-04                      | 0.                             | 3.46E-04                      | 8.03E-04                       | 8.37E-04                      | 1.22E-03                       | 8.37E-04                      | 1.22E-03                       | 8.30E-04                      | 8.30E-04                       | 8.30E-04                      | 8.30E-04                       | 3.18E-05                      | 0.                             | 7.55E-05                      | 8.15E-06                       |
| 17     | 7.69E-04                      | 0.                             | 2.45E-04                      | 7.75E-04                       | 7.96E-04                      | 1.24E-03                       | 7.96E-04                      | 1.24E-03                       | 7.90E-04                      | 7.90E-04                       | 7.90E-04                      | 7.90E-04                       | 3.08E-05                      | 0.                             | 6.93E-05                      | 7.43E-06                       |
| 18     | 7.81E-04                      | 0.                             | 2.56E-04                      | 7.63E-04                       | 7.63E-04                      | 1.23E-03                       | 7.63E-04                      | 1.23E-03                       | 7.54E-04                      | 7.54E-04                       | 7.54E-04                      | 7.54E-04                       | 2.89E-05                      | 0.                             | 6.07E-05                      | 6.55E-06                       |
| 19     | 7.76E-04                      | 0.                             | 3.23E-04                      | 7.77E-04                       | 7.36E-04                      | 1.22E-03                       | 7.36E-04                      | 1.22E-03                       | 7.23E-04                      | 7.23E-04                       | 7.23E-04                      | 7.23E-04                       | 2.61E-05                      | 0.                             | 5.07E-05                      | 5.47E-06                       |
| 20     | 7.05E-04                      | 0.                             | 4.01E-04                      | 8.15E-04                       | 7.16E-04                      | 1.22E-03                       | 7.16E-04                      | 1.22E-03                       | 6.94E-04                      | 6.94E-04                       | 6.94E-04                      | 6.94E-04                       | 2.26E-05                      | 0.                             | 4.06E-05                      | 4.39E-06                       |
| 21     | 8.38E-04                      | 0.                             | 5.09E-04                      | 8.53E-04                       | 7.24E-04                      | 1.19E-03                       | 7.24E-04                      | 1.19E-03                       | 6.66E-04                      | 6.66E-04                       | 6.66E-04                      | 6.66E-04                       | 1.91E-05                      | 0.                             | 3.24E-05                      | 3.59E-06                       |
| 22     | 8.40E-04                      | 0.                             | 6.37E-04                      | 9.03E-04                       | 7.17E-04                      | 1.20E-03                       | 7.17E-04                      | 1.20E-03                       | 6.49E-04                      | 6.49E-04                       | 6.49E-04                      | 6.49E-04                       | 1.60E-05                      | 0.                             | 2.59E-05                      | 2.80E-06                       |
| 23     | 9.26E-04                      | 0.                             | 7.39E-04                      | 9.55E-04                       | 7.12E-04                      | 1.19E-03                       | 7.12E-04                      | 1.19E-03                       | 5.19E-04                      | 5.19E-04                       | 5.19E-04                      | 5.19E-04                       | 1.33E-05                      | 0.                             | 2.02E-05                      | 2.14E-06                       |
| 24     | 9.76E-04                      | 0.                             | 8.21E-04                      | 1.07E-03                       | 7.00E-04                      | 1.23E-03                       | 7.00E-04                      | 1.23E-03                       | 5.97E-04                      | 5.97E-04                       | 5.97E-04                      | 5.97E-04                       | 1.07E-05                      | 0.                             | 1.56E-05                      | 1.64E-06                       |
| 25     | 1.07E-03                      | 0.                             | 9.23E-04                      | 1.11E-03                       | 7.33E-04                      | 1.34E-03                       | 7.33E-04                      | 1.34E-03                       | 5.77E-04                      | 5.77E-04                       | 5.77E-04                      | 5.77E-04                       | 8.36E-05                      | 0.                             | 1.23E-05                      | 1.33E-06                       |
| 30     | 1.02E-03                      | 0.                             | 1.35E-03                      | 1.34E-03                       | 1.59E-03                      | 1.59E-03                       | 1.59E-03                      | 1.59E-03                       | 6.10E-04                      | 6.10E-04                       | 6.10E-04                      | 6.10E-04                       | 1.66E-05                      | 3.79E-06                       | 4.24E-05                      | 9.63E-06                       |
| 35     | 1.19E-03                      | 0.                             | 1.67E-03                      | 1.67E-03                       | 6.38E-04                      | 2.41E-03                       | 6.38E-04                      | 2.41E-03                       | 5.11E-04                      | 5.11E-04                       | 5.11E-04                      | 5.11E-04                       | 5.11E-06                      | 1.17E-06                       | 9.74E-06                      | 2.22E-06                       |
| 40     | 1.17E-03                      | 0.                             | 1.26E-03                      | 1.58E-03                       | 7.85E-04                      | 1.84E-03                       | 7.85E-04                      | 1.84E-03                       | 4.75E-04                      | 4.75E-04                       | 4.75E-04                      | 4.75E-04                       | 1.24E-06                      | 0.                             | 1.24E-06                      | 0.                             |
| 45     | 8.74E-04                      | 0.                             | 1.22E-03                      | 1.22E-03                       | 6.40E-04                      | 1.35E-03                       | 6.40E-04                      | 1.35E-03                       | 4.09E-04                      | 4.09E-04                       | 4.09E-04                      | 4.09E-04                       | 0.                            | 0.                             | 0.                            | 0.                             |
| 50     | 1.04E-04                      | 0.                             | 1.09E-04                      | 1.33E-04                       | 1.02E-04                      | 1.35E-04                       | 1.02E-04                      | 1.35E-04                       | 1.02E-04                      | 1.02E-04                       | 1.02E-04                      | 1.02E-04                       | 0.                            | 0.                             | 0.                            | 0.                             |
| 70     | 1.21E-06                      | 0.                             | 1.25E-06                      | 1.41E-06                       | 1.39E-06                      | 1.40E-06                       | 1.39E-06                      | 1.40E-06                       | 1.75E-06                      | 1.75E-06                       | 1.75E-06                      | 1.75E-06                       | 0.                            | 0.                             | 0.                            | 0.                             |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|             | CLEAR                         |                                | HAZY                          |                                |
|-------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|             | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| UPPER       | *****                         | *****                          | 3.77E-02                      | 3.33E-02                       |
| MARITIME    | 5.37E-03                      | 5.72E-03                       | 5.95E-02                      | 6.23E-02                       |
| TOPOSPHERIC | 1.76E-04                      | 1.76E-04                       | *****                         | *****                          |

WAVELENGTH = 10.611386 MICROMETERS  
FREQUENCY = 942.384 WAVENUMBER

| ht(km) | U.S. STANDARD             |                                | TROPICAL                  |                                | MIDLAT   |          | SUBARCTIC |          | SUBARCTIC |          | AEROSOL  |          |
|--------|---------------------------|--------------------------------|---------------------------|--------------------------------|----------|----------|-----------|----------|-----------|----------|----------|----------|
|        | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | WINTER   | SUMMER   | WINTER    | SUMMER   | WINTER    | SUMMER   | CLEAR    | HAZY     |
| 0      | 1.15E-01                  | 0.                             | 4.60E-01                  | 7.05E-02                       | 1.78E-01 | 3.53E-02 | 3.53E-02  | 3.53E-02 | 2.96E-03  | 4.00E-03 | 2.96E-03 | 4.00E-03 |
| 1      | 1.00E-01                  | 0.                             | 3.55E-01                  | 5.23E-02                       | 1.41E-01 | 2.34E-02 | 1.41E-01  | 2.34E-02 | 1.96E-03  | 2.65E-03 | 1.96E-03 | 2.65E-03 |
| 2      | 7.47E-02                  | 0.                             | 2.21E-01                  | 3.44E-02                       | 9.55E-02 | 1.41E-01 | 9.55E-02  | 1.41E-01 | 1.49E-04  | 4.76E-05 | 1.49E-04 | 4.76E-05 |
| 3      | 5.61E-02                  | 0.                             | 1.26E-01                  | 8.93E-02                       | 6.19E-02 | 6.19E-02 | 6.19E-02  | 6.19E-02 | 1.27E-04  | 2.44E-05 | 1.27E-04 | 2.44E-05 |
| 4      | 4.31E-02                  | 0.                             | 7.36E-02                  | 3.42E-02                       | 4.16E-02 | 2.58E-02 | 4.16E-02  | 2.58E-02 | 1.04E-04  | 1.99E-05 | 1.04E-04 | 1.99E-05 |
| 5      | 3.40E-02                  | 0.                             | 5.34E-02                  | 2.76E-02                       | 4.01E-02 | 2.09E-02 | 4.01E-02  | 2.09E-02 | 8.00E-05  | 1.53E-05 | 8.00E-05 | 1.53E-05 |
| 6      | 2.73E-02                  | 0.                             | 4.27E-02                  | 2.25E-02                       | 3.27E-02 | 1.65E-02 | 3.27E-02  | 1.65E-02 | 5.94E-05  | 1.14E-05 | 5.94E-05 | 1.14E-05 |
| 7      | 2.19E-02                  | 0.                             | 3.42E-02                  | 1.83E-02                       | 2.45E-02 | 1.29E-02 | 2.45E-02  | 1.29E-02 | 4.11E-05  | 7.45E-06 | 4.11E-05 | 7.45E-06 |
| 8      | 1.75E-02                  | 0.                             | 2.74E-02                  | 1.48E-02                       | 1.94E-02 | 9.97E-03 | 1.94E-02  | 9.97E-03 | 2.60E-05  | 4.95E-06 | 2.60E-05 | 4.95E-06 |
| 9      | 1.39E-02                  | 0.                             | 2.25E-02                  | 1.19E-02                       | 1.52E-02 | 8.16E-03 | 1.52E-02  | 8.16E-03 | 1.88E-05  | 0.       | 1.88E-05 | 0.       |
| 10     | 1.09E-02                  | 0.                             | 1.78E-02                  | 9.45E-03                       | 1.13E-02 | 7.56E-03 | 1.13E-02  | 7.56E-03 | 1.63E-05  | 0.       | 1.63E-05 | 0.       |
| 11     | 8.49E-03                  | 0.                             | 1.42E-02                  | 8.30E-03                       | 9.04E-03 | 7.57E-03 | 9.04E-03  | 7.57E-03 | 1.10E-05  | 0.       | 1.10E-05 | 0.       |
| 12     | 7.41E-03                  | 0.                             | 1.10E-02                  | 6.14E-03                       | 1.03E-02 | 7.56E-03 | 1.03E-02  | 7.56E-03 | 8.47E-05  | 0.       | 8.47E-05 | 0.       |
| 13     | 7.37E-03                  | 0.                             | 8.82E-03                  | 7.99E-03                       | 1.03E-02 | 7.56E-03 | 1.03E-02  | 7.56E-03 | 7.45E-05  | 0.       | 7.45E-05 | 0.       |
| 14     | 7.37E-03                  | 0.                             | 6.25E-03                  | 7.77E-03                       | 1.04E-02 | 7.56E-03 | 1.04E-02  | 7.56E-03 | 6.61E-05  | 0.       | 6.61E-05 | 0.       |
| 15     | 7.37E-03                  | 0.                             | 4.92E-03                  | 7.65E-03                       | 1.06E-02 | 7.56E-03 | 1.06E-02  | 7.56E-03 | 5.94E-05  | 0.       | 5.94E-05 | 0.       |
| 16     | 7.37E-03                  | 0.                             | 3.63E-03                  | 7.21E-03                       | 9.94E-03 | 7.45E-03 | 9.94E-03  | 7.45E-03 | 5.25E-05  | 0.       | 5.25E-05 | 0.       |
| 17     | 7.35E-03                  | 0.                             | 2.76E-03                  | 7.15E-03                       | 1.03E-02 | 7.28E-03 | 1.03E-02  | 7.28E-03 | 4.04E-05  | 0.       | 4.04E-05 | 0.       |
| 18     | 7.35E-03                  | 0.                             | 2.97E-03                  | 7.16E-03                       | 1.03E-02 | 7.14E-03 | 1.03E-02  | 7.14E-03 | 3.88E-05  | 0.       | 3.88E-05 | 0.       |
| 19     | 7.35E-03                  | 0.                             | 3.64E-03                  | 7.27E-03                       | 1.03E-02 | 6.92E-03 | 1.03E-02  | 6.92E-03 | 3.46E-05  | 0.       | 3.46E-05 | 0.       |
| 20     | 7.35E-03                  | 0.                             | 4.37E-03                  | 7.60E-03                       | 1.04E-02 | 6.72E-03 | 1.04E-02  | 6.72E-03 | 3.33E-05  | 0.       | 3.33E-05 | 0.       |
| 21     | 7.51E-03                  | 0.                             | 5.11E-03                  | 7.89E-03                       | 1.02E-02 | 6.56E-03 | 1.02E-02  | 6.56E-03 | 3.45E-05  | 0.       | 3.45E-05 | 0.       |
| 22     | 7.83E-03                  | 0.                             | 6.34E-03                  | 8.28E-03                       | 1.03E-02 | 6.40E-03 | 1.03E-02  | 6.40E-03 | 2.76E-05  | 0.       | 2.76E-05 | 0.       |
| 23     | 8.14E-03                  | 0.                             | 7.11E-03                  | 8.63E-03                       | 1.03E-02 | 6.23E-03 | 1.03E-02  | 6.23E-03 | 2.15E-05  | 0.       | 2.15E-05 | 0.       |
| 24     | 8.48E-03                  | 0.                             | 7.72E-03                  | 9.45E-03                       | 1.05E-02 | 6.07E-03 | 1.05E-02  | 6.07E-03 | 1.66E-05  | 0.       | 1.66E-05 | 0.       |
| 25     | 8.84E-03                  | 0.                             | 8.48E-03                  | 9.63E-03                       | 1.11E-02 | 5.92E-03 | 1.11E-02  | 5.92E-03 | 1.31E-05  | 0.       | 1.31E-05 | 0.       |
| 30     | 9.47E-03                  | 0.                             | 1.04E-02                  | 1.15E-02                       | 1.25E-02 | 6.16E-03 | 1.25E-02  | 6.16E-03 | 1.57E-05  | 3.43E-06 | 1.57E-05 | 3.43E-06 |
| 35     | 8.54E-03                  | 0.                             | 1.05E-02                  | 1.15E-02                       | 1.25E-02 | 6.16E-03 | 1.25E-02  | 6.16E-03 | 4.83E-06  | 1.06E-06 | 4.83E-06 | 1.06E-06 |
| 40     | 7.40E-03                  | 0.                             | 9.80E-03                  | 1.13E-02                       | 1.25E-02 | 6.16E-03 | 1.25E-02  | 6.16E-03 | 2.37E-06  | 0.       | 2.37E-06 | 0.       |
| 45     | 7.40E-03                  | 0.                             | 7.99E-03                  | 9.58E-03                       | 1.04E-02 | 3.64E-03 | 1.04E-02  | 3.64E-03 | 1.17E-06  | 0.       | 1.17E-06 | 0.       |
| 50     | 5.17E-03                  | 0.                             | 5.47E-03                  | 3.98E-03                       | 7.42E-03 | 2.77E-03 | 7.42E-03  | 2.77E-03 | 0.        | 0.       | 0.       | 0.       |
| 50-70  | 7.68E-04                  | 0.                             | 8.04E-04                  | 7.28E-04                       | 9.81E-04 | 6.98E-04 | 9.81E-04  | 6.98E-04 | 0.        | 0.       | 0.       | 0.       |
| 70-100 | 1.29E-05                  | 0.                             | 1.53E-05                  | 1.53E-05                       | 1.53E-05 | 1.57E-05 | 1.53E-05  | 1.57E-05 | 0.        | 0.       | 0.       | 0.       |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|             | CLEAR                     |                                | HAZY                      |                                |
|-------------|---------------------------|--------------------------------|---------------------------|--------------------------------|
|             | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| UPPER       | *****                     | *****                          | 4.14E-02                  | 3.30E-02                       |
| MARITIME    | 4.85E-03                  | 6.49E-03                       | 5.28E-02                  | 7.06E-02                       |
| TRPOSPHERIC | 9.92E-04                  | 1.90E-04                       | *****                     | *****                          |

WAVELENGTH = 10.591033 MICROMETERS  
FREQUENCY = 344.155 WAVENUMBER

| ht(km) | U.S. STANDARD             |                                | TROPICAL                  |                                | MIDLAT SUMMER             |                                | MIDLAT WINTER             |                                | SUBARCTIC SUMMER          |                                | SUBARCTIC WINTER          |                                | CLEAR                     |                                | AEROSOL                   |                                | HAZY                      |                                |
|--------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|
|        | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0      | 1.25E-01                  | 0.                             | 4.80E-01                  | 3.19E-01                       | 7.58E-02                  | 1.83E-01                       | 3.66E-02                  | 1.83E-01                       | 1.83E-01                  | 1.83E-01                       | 3.66E-02                  | 1.83E-01                       | 2.99E-03                  | 4.00E-03                       | 3.26E-02                  | 4.39E-02                       | 3.26E-02                  | 4.39E-02                       |
| 1      | 1.04E-01                  | 0.                             | 3.71E-01                  | 2.44E-01                       | 6.73E-02                  | 1.50E-01                       | 3.92E-02                  | 1.50E-01                       | 1.50E-01                  | 1.50E-01                       | 3.92E-02                  | 1.50E-01                       | 1.98E-03                  | 2.64E-03                       | 1.98E-03                  | 2.64E-03                       | 1.98E-03                  | 2.64E-03                       |
| 2      | 8.07E-02                  | 0.                             | 2.32E-01                  | 1.50E-01                       | 5.47E-02                  | 1.02E-01                       | 3.77E-02                  | 1.02E-01                       | 1.02E-01                  | 1.02E-01                       | 3.77E-02                  | 1.02E-01                       | 2.52E-04                  | 4.80E-05                       | 2.52E-04                  | 4.80E-05                       | 2.52E-04                  | 4.80E-05                       |
| 3      | 6.10E-02                  | 0.                             | 1.34E-01                  | 9.59E-02                       | 4.57E-02                  | 7.37E-02                       | 3.32E-02                  | 7.37E-02                       | 7.37E-02                  | 7.37E-02                       | 3.32E-02                  | 7.37E-02                       | 1.29E-04                  | 2.45E-05                       | 1.29E-04                  | 2.45E-05                       | 1.29E-04                  | 2.45E-05                       |
| 4      | 4.71E-02                  | 0.                             | 7.07E-02                  | 6.69E-02                       | 3.75E-02                  | 5.60E-02                       | 2.05E-02                  | 5.60E-02                       | 5.60E-02                  | 5.60E-02                       | 2.05E-02                  | 5.60E-02                       | 1.05E-04                  | 2.08E-05                       | 1.05E-04                  | 2.08E-05                       | 1.05E-04                  | 2.08E-05                       |
| 5      | 3.74E-02                  | 0.                             | 5.23E-02                  | 5.14E-02                       | 3.89E-02                  | 4.39E-02                       | 2.32E-02                  | 4.39E-02                       | 4.39E-02                  | 4.39E-02                       | 2.32E-02                  | 4.39E-02                       | 8.10E-05                  | 1.54E-05                       | 8.10E-05                  | 1.54E-05                       | 8.10E-05                  | 1.54E-05                       |
| 6      | 3.01E-02                  | 0.                             | 4.64E-02                  | 4.20E-02                       | 3.49E-02                  | 3.49E-02                       | 1.84E-02                  | 3.49E-02                       | 3.49E-02                  | 3.49E-02                       | 1.84E-02                  | 3.49E-02                       | 6.01E-05                  | 1.14E-05                       | 6.01E-05                  | 1.14E-05                       | 6.01E-05                  | 1.14E-05                       |
| 7      | 2.43E-02                  | 0.                             | 3.76E-02                  | 3.54E-02                       | 2.03E-02                  | 2.71E-02                       | 1.44E-02                  | 2.71E-02                       | 2.71E-02                  | 2.71E-02                       | 1.44E-02                  | 2.71E-02                       | 4.16E-05                  | 7.91E-06                       | 4.16E-05                  | 7.91E-06                       | 4.16E-05                  | 7.91E-06                       |
| 8      | 1.96E-02                  | 0.                             | 3.03E-02                  | 2.86E-02                       | 1.65E-02                  | 2.16E-02                       | 1.12E-02                  | 2.16E-02                       | 2.16E-02                  | 2.16E-02                       | 1.12E-02                  | 2.16E-02                       | 2.63E-05                  | 5.00E-06                       | 2.63E-05                  | 5.00E-06                       | 2.63E-05                  | 5.00E-06                       |
| 9      | 1.56E-02                  | 0.                             | 2.50E-02                  | 2.31E-02                       | 1.34E-02                  | 1.70E-02                       | 9.83E-03                  | 1.70E-02                       | 1.70E-02                  | 1.70E-02                       | 9.83E-03                  | 1.70E-02                       | 1.56E-05                  | 3.00E-06                       | 1.56E-05                  | 3.00E-06                       | 1.56E-05                  | 3.00E-06                       |
| 10     | 1.23E-02                  | 0.                             | 1.99E-02                  | 1.88E-02                       | 1.06E-02                  | 1.32E-02                       | 8.56E-03                  | 1.32E-02                       | 1.32E-02                  | 1.32E-02                       | 8.56E-03                  | 1.32E-02                       | 9.56E-05                  | 0.                             | 9.56E-05                  | 0.                             | 9.56E-05                  | 0.                             |
| 11     | 9.54E-03                  | 0.                             | 1.59E-02                  | 1.49E-02                       | 9.37E-03                  | 1.17E-02                       | 8.56E-03                  | 1.17E-02                       | 1.17E-02                  | 1.17E-02                       | 8.56E-03                  | 1.17E-02                       | 3.03E-05                  | 0.                             | 3.03E-05                  | 0.                             | 3.03E-05                  | 0.                             |
| 12     | 8.34E-03                  | 0.                             | 1.24E-02                  | 1.14E-02                       | 9.19E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.76E-05                  | 0.                             | 2.76E-05                  | 0.                             | 2.76E-05                  | 0.                             |
| 13     | 8.34E-03                  | 0.                             | 9.94E-03                  | 9.17E-03                       | 9.01E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.60E-05                  | 0.                             | 2.60E-05                  | 0.                             | 2.60E-05                  | 0.                             |
| 14     | 8.33E-03                  | 0.                             | 7.09E-03                  | 6.41E-03                       | 6.64E-03                  | 1.17E-02                       | 8.56E-03                  | 1.17E-02                       | 1.17E-02                  | 1.17E-02                       | 8.56E-03                  | 1.17E-02                       | 2.56E-05                  | 0.                             | 2.56E-05                  | 0.                             | 2.56E-05                  | 0.                             |
| 15     | 8.32E-03                  | 0.                             | 4.16E-03                  | 3.15E-03                       | 3.44E-03                  | 1.12E-02                       | 8.56E-03                  | 1.12E-02                       | 1.12E-02                  | 1.12E-02                       | 8.56E-03                  | 1.12E-02                       | 2.59E-05                  | 0.                             | 2.59E-05                  | 0.                             | 2.59E-05                  | 0.                             |
| 16     | 8.29E-03                  | 0.                             | 3.19E-03                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 17     | 8.30E-03                  | 0.                             | 3.41E-03                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 18     | 8.29E-03                  | 0.                             | 4.17E-03                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 19     | 8.29E-03                  | 0.                             | 4.93E-03                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 20     | 8.44E-03                  | 0.                             | 6.02E-03                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 21     | 8.44E-03                  | 0.                             | 7.15E-03                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 22     | 8.44E-03                  | 0.                             | 8.30E-03                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 23     | 8.44E-03                  | 0.                             | 9.45E-03                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 24     | 8.44E-03                  | 0.                             | 1.06E-02                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 25     | 8.44E-03                  | 0.                             | 1.16E-02                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 30     | 9.47E-03                  | 0.                             | 1.16E-02                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 35     | 9.53E-03                  | 0.                             | 1.06E-02                  | 2.02E-03                       | 2.24E-03                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 1.16E-02                  | 1.16E-02                       | 8.56E-03                  | 1.16E-02                       | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             | 2.51E-05                  | 0.                             |
| 40     | 8.14E-03                  | 0.                             | 9.73E-03                  | 1.04E-02                       | 5.96E-03                  | 1.17E-02                       | 4.04E-03                  | 1.17E-02                       | 1.17E-02                  | 1.17E-02                       | 4.04E-03                  | 1.17E-02                       | 1.16E-06                  | 0.                             | 1.16E-06                  | 0.                             | 1.16E-06                  | 0.                             |
| 45     | 5.63E-03                  | 0.                             | 5.95E-03                  | 7.45E-03                       | 4.34E-03                  | 8.03E-04                       | 1.03E-03                  | 8.03E-04                       | 1.03E-03                  | 1.03E-03                       | 3.04E-03                  | 9.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             |
| 50     | 5.50E-04                  | 0.                             | 5.91E-04                  | 1.04E-03                       | 8.03E-04                  | 1.03E-03                       | 7.66E-04                  | 1.03E-03                       | 1.03E-03                  | 1.03E-03                       | 7.66E-04                  | 1.03E-03                       | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             |
| 70     | 1.47E-05                  | 0.                             | 1.52E-05                  | 1.73E-05                       | 1.56E-05                  | 1.74E-05                       | 1.77E-05                  | 1.74E-05                       | 1.74E-05                  | 1.74E-05                       | 1.77E-05                  | 1.74E-05                       | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|             | CLEAR                     |                                | HAZY                      |                                |
|-------------|---------------------------|--------------------------------|---------------------------|--------------------------------|
|             | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN       | *****                     | *****                          | 4.16E-02                  | 3.29E-02                       |
| WARTIME     | 4.75E-03                  | 6.57E-03                       | 5.22E-02                  | 7.15E-02                       |
| TCPOSPHERIC | 1.00E-03                  | 1.91E-04                       | *****                     | *****                          |



|        |                  | 10.551364 MICROMETERS<br>947.743 HAVENUMBER |                                |                                     |                                     |                                     |                                     |                                    |                                |                                   |                                |
|--------|------------------|---------------------------------------------|--------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|------------------------------------|--------------------------------|-----------------------------------|--------------------------------|
|        |                  | WAVELENGTH =<br>FREQUENCY =                 |                                |                                     |                                     |                                     |                                     |                                    |                                |                                   |                                |
| ht(km) | U.S.<br>STANDARD | TROPICAL                                    |                                | MIDLAT                              |                                     | SUBARCTIC                           |                                     | SUBARCTIC                          |                                | AEROSOL                           |                                |
|        |                  | $L_a$ (km <sup>-1</sup> )                   | $\sigma_a$ (km <sup>-1</sup> ) | SUMMER<br>$L_m$ (km <sup>-1</sup> ) | WINTER<br>$L_m$ (km <sup>-1</sup> ) | SUMMER<br>$L_a$ (km <sup>-1</sup> ) | WINTER<br>$L_m$ (km <sup>-1</sup> ) | CLEAR<br>$L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | HAZY<br>$L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0      | 1.38E-01         | 5.23E-01                                    | 3.49E-01                       | 9.37E-02                            | 2.07E-01                            | 4.26E-02                            | 4.31E-02                            | 7.03E-03                           | 3.99E-03                       | 3.30E-02                          | 4.35E-02                       |
| 1      | 1.18E-01         | 4.04E-01                                    | 2.69E-01                       | 7.40E-02                            | 1.64E-01                            | 4.31E-02                            | 4.31E-02                            | 2.00E-03                           | 2.64E-03                       | 3.30E-02                          | 4.35E-02                       |
| 2      | 8.75E-02         | 2.52E-01                                    | 1.64E-01                       | 5.97E-02                            | 1.11E-01                            | 4.12E-02                            | 4.12E-02                            | 7.57E-04                           | 4.91E-05                       | 4.09E-03                          | 7.82E-04                       |
| 3      | 6.61E-02         | 1.45E-01                                    | 1.04E-01                       | 4.97E-02                            | 8.01E-02                            | 3.63E-02                            | 3.63E-02                            | 1.31E-04                           | 2.51E-05                       | 6.93E-04                          | 1.32E-04                       |
| 4      | 5.09E-02         | 1.07E-01                                    | 7.10E-02                       | 4.07E-02                            | 6.05E-02                            | 2.72E-02                            | 2.72E-02                            | 1.07E-04                           | 2.05E-05                       | 3.79E-04                          | 7.24E-05                       |
| 5      | 4.05E-02         | 8.24E-02                                    | 5.51E-02                       | 3.31E-02                            | 4.73E-02                            | 2.55E-02                            | 2.55E-02                            | 8.26E-05                           | 1.59E-05                       | 1.97E-04                          | 3.76E-05                       |
| 6      | 3.27E-02         | 6.02E-02                                    | 4.50E-02                       | 2.73E-02                            | 3.79E-02                            | 2.04E-02                            | 2.04E-02                            | 6.13E-05                           | 1.17E-05                       | 1.25E-04                          | 2.39E-05                       |
| 7      | 2.66E-02         | 4.05E-02                                    | 3.81E-02                       | 2.25E-02                            | 2.96E-02                            | 1.62E-02                            | 1.62E-02                            | 4.24E-05                           | 8.09E-06                       | 1.02E-04                          | 1.95E-05                       |
| 8      | 2.17E-02         | 3.28E-02                                    | 3.11E-02                       | 1.85E-02                            | 2.38E-02                            | 1.24E-02                            | 1.24E-02                            | 2.66E-05                           | 5.12E-06                       | 6.84E-05                          | 1.31E-05                       |
| 9      | 1.74E-02         | 2.73E-02                                    | 2.54E-02                       | 1.51E-02                            | 1.99E-02                            | 1.06E-02                            | 1.06E-02                            | 4.45E-05                           | 0.                             | 7.19E-05                          | 8.27E-06                       |
| 10     | 1.39E-02         | 2.19E-02                                    | 2.08E-02                       | 1.21E-02                            | 1.49E-02                            | 8.77E-03                            | 8.77E-03                            | 3.61E-05                           | 0.                             | 5.25E-05                          | 6.04E-06                       |
| 11     | 1.10E-02         | 1.67E-02                                    | 1.67E-02                       | 1.07E-02                            | 1.32E-02                            | 7.46E-03                            | 7.46E-03                            | 3.07E-05                           | 0.                             | 5.67E-05                          | 6.53E-06                       |
| 12     | 9.66E-03         | 1.40E-02                                    | 1.34E-02                       | 1.06E-02                            | 1.32E-02                            | 6.99E-03                            | 6.99E-03                            | 2.82E-05                           | 0.                             | 6.53E-05                          | 7.51E-06                       |
| 13     | 9.62E-03         | 1.14E-02                                    | 1.05E-02                       | 1.04E-02                            | 1.31E-02                            | 6.44E-03                            | 6.44E-03                            | 2.63E-05                           | 0.                             | 7.45E-05                          | 8.65E-06                       |
| 14     | 9.62E-03         | 1.21E-02                                    | 9.35E-03                       | 1.01E-02                            | 1.32E-02                            | 6.95E-03                            | 6.95E-03                            | 2.60E-05                           | 0.                             | 8.15E-05                          | 9.39E-06                       |
| 15     | 9.62E-03         | 6.60E-03                                    | 9.71E-03                       | 1.35E-02                            | 1.35E-02                            | 9.89E-03                            | 9.89E-03                            | 2.64E-05                           | 0.                             | 8.33E-05                          | 9.59E-06                       |
| 16     | 9.61E-03         | 4.97E-03                                    | 9.42E-03                       | 9.75E-03                            | 1.27E-02                            | 9.71E-03                            | 9.71E-03                            | 2.63E-05                           | 0.                             | 8.12E-05                          | 9.34E-06                       |
| 17     | 9.59E-03         | 3.84E-03                                    | 9.28E-03                       | 9.53E-03                            | 1.32E-02                            | 9.51E-03                            | 9.51E-03                            | 2.55E-05                           | 0.                             | 7.45E-05                          | 8.57E-06                       |
| 18     | 9.60E-03         | 4.11E-03                                    | 9.36E-03                       | 9.41E-03                            | 1.31E-02                            | 9.24E-03                            | 9.24E-03                            | 2.39E-05                           | 0.                             | 5.53E-05                          | 7.51E-06                       |
| 19     | 9.60E-03         | 4.98E-03                                    | 9.42E-03                       | 9.16E-03                            | 1.33E-02                            | 9.07E-03                            | 9.07E-03                            | 2.16E-05                           | 0.                             | 5.45E-05                          | 6.27E-06                       |
| 20     | 9.59E-03         | 5.50E-03                                    | 9.49E-03                       | 9.01E-03                            | 1.33E-02                            | 8.43E-03                            | 8.43E-03                            | 1.87E-05                           | 0.                             | 4.37E-05                          | 5.03E-06                       |
| 21     | 9.74E-03         | 7.18E-03                                    | 1.02E-02                       | 9.16E-03                            | 1.30E-02                            | 8.82E-03                            | 8.82E-03                            | 1.58E-05                           | 0.                             | 3.69E-05                          | 4.01E-06                       |
| 22     | 1.02E-02         | 8.35E-03                                    | 1.07E-02                       | 9.11E-03                            | 1.34E-02                            | 8.43E-03                            | 8.43E-03                            | 1.33E-05                           | 0.                             | 2.76E-05                          | 3.23E-06                       |
| 23     | 1.05E-02         | 9.29E-03                                    | 1.11E-02                       | 9.07E-03                            | 1.34E-02                            | 8.22E-03                            | 8.22E-03                            | 1.10E-05                           | 0.                             | 2.17E-05                          | 2.43E-06                       |
| 24     | 1.10E-02         | 1.00E-02                                    | 1.22E-02                       | 8.93E-03                            | 1.33E-02                            | 8.02E-03                            | 8.02E-03                            | 8.81E-06                           | 0.                             | 1.66E-05                          | 1.93E-06                       |
| 25     | 1.14E-02         | 1.10E-02                                    | 1.23E-02                       | 9.38E-03                            | 1.41E-02                            | 7.83E-03                            | 7.83E-03                            | 6.94E-06                           | 0.                             | 1.32E-05                          | 1.32E-06                       |
| 26     | 1.32E-02         | 1.45E-02                                    | 1.45E-02                       | 9.01E-03                            | 1.57E-02                            | 8.11E-03                            | 8.11E-03                            | 1.55E-05                           | 1.38E-06                       | 3.94E-05                          | 8.65E-06                       |
| 27     | 1.04E-02         | 1.34E-02                                    | 1.44E-02                       | 7.69E-03                            | 2.16E-02                            | 6.92E-03                            | 6.92E-03                            | 4.79E-06                           | 1.04E-06                       | 9.13E-06                          | 1.95E-06                       |
| 28     | 1.20E-02         | 1.32E-02                                    | 1.32E-02                       | 7.50E-03                            | 1.51E-02                            | 5.61E-03                            | 5.61E-03                            | 2.36E-06                           | 0.                             | 2.96E-06                          | 0.                             |
| 29     | 9.68E-03         | 1.14E-02                                    | 1.14E-02                       | 6.62E-03                            | 1.27E-02                            | 4.56E-03                            | 4.56E-03                            | 1.16E-06                           | 0.                             | 1.16E-06                          | 0.                             |
| 30     | 6.49E-03         | 4.77E-03                                    | 4.77E-03                       | 4.77E-03                            | 1.27E-02                            | 3.38E-03                            | 3.38E-03                            | 0.                                 | 0.                             | 0.                                | 0.                             |
| 31     | 1.00E-03         | 1.19E-03                                    | 1.19E-03                       | 8.98E-04                            | 1.21E-03                            | 8.53E-04                            | 8.53E-04                            | 0.                                 | 0.                             | 0.                                | 0.                             |
| 32     | 1.79E-05         | 2.04E-05                                    | 2.04E-05                       | 1.81E-05                            | 2.06E-05                            | 2.06E-05                            | 2.06E-05                            | 0.                                 | 0.                             | 0.                                | 0.                             |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

| U.S. B&N | CLEAR<br>$L_a$ (km <sup>-1</sup> ) | HAZY                      |                                |
|----------|------------------------------------|---------------------------|--------------------------------|
|          |                                    | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| *****    | *****                              | 4.16E-02                  | 3.29E-02                       |
| *****    | *****                              | 5.10E-02                  | 7.33E-02                       |
| *****    | *****                              | 1.02E-03                  | 1.96E-04                       |

WAVELENGTH = 10.423257 MICROMETERS  
FREQUENCY = 959.391 WAVENUMBERS

| ht(km) | U.S. STANDARD                 |                                | TROPICAL                      |                                | MIDLAT SUMMER                 |                                | MIDLAT WINTER                 |                                | SUBARCTIC SUMMER              |                                | SUBARCTIC WINTER              |                                | CLEAR                         |                                | AEROSOL                       |                                | HAZY     |          |
|--------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|----------|----------|
|        | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |          |          |
| 0      | 7.42E-02                      | 0.                             | 4.32E-01                      | 2.69E-01                       | 3.45E-02                      | 1.40E-01                       | 1.33E-02                      | 3.14E-03                       | 3.99E-03                      | 3.43E-02                       | 4.35E-02                      | 3.43E-02                       | 4.35E-02                      | 3.43E-02                       | 4.35E-02                      | 3.43E-02                       | 4.35E-02 |          |
| 1      | 5.92E-02                      | 0.                             | 3.21E-01                      | 1.95E-01                       | 3.15E-02                      | 1.03E-01                       | 1.33E-02                      | 2.08E-03                       | 2.64E-03                      | 3.43E-02                       | 4.35E-02                      | 3.43E-02                       | 4.35E-02                      | 3.43E-02                       | 4.35E-02                      | 3.43E-02                       | 4.35E-02 |          |
| 2      | 3.77E-02                      | 0.                             | 1.82E-01                      | 1.01E-01                       | 2.18E-02                      | 5.88E-02                       | 1.21E-02                      | 2.73E-04                       | 5.27E-05                      | 7.37E-05                       | 1.42E-04                      | 7.37E-05                       | 1.42E-04                      | 7.37E-05                       | 1.42E-04                      | 7.37E-05                       | 1.42E-04 |          |
| 3      | 2.36E-02                      | 0.                             | 8.92E-02                      | 4.92E-02                       | 1.56E-02                      | 3.52E-02                       | 9.90E-03                      | 1.40E-04                       | 2.70E-05                      | 6.03E-05                       | 1.42E-04                      | 7.77E-05                       | 6.03E-05                      | 1.42E-04                       | 7.77E-05                      | 6.03E-05                       | 1.42E-04 |          |
| 4      | 1.52E-02                      | 0.                             | 3.40E-02                      | 2.55E-02                       | 1.10E-02                      | 2.14E-02                       | 7.88E-03                      | 1.14E-04                       | 2.20E-05                      | 8.74E-05                       | 1.69E-05                      | 1.33E-04                       | 2.56E-05                      | 1.33E-04                       | 2.56E-05                      | 1.33E-04                       | 2.56E-05 |          |
| 5      | 1.06E-02                      | 0.                             | 1.33E-02                      | 1.57E-02                       | 8.11E-03                      | 1.39E-02                       | 6.12E-03                      | 9.74E-05                       | 1.63E-05                      | 4.52E-05                       | 1.26E-05                      | 1.33E-04                       | 4.46E-05                      | 1.33E-04                       | 4.46E-05                      | 1.33E-04                       | 4.46E-05 |          |
| 6      | 7.99E-03                      | 0.                             | 8.93E-03                      | 8.93E-03                       | 5.19E-03                      | 7.10E-03                       | 4.76E-03                      | 7.10E-03                       | 4.76E-03                      | 6.52E-05                       | 1.26E-05                      | 1.33E-04                       | 4.46E-05                      | 1.33E-04                       | 4.46E-05                      | 1.33E-04                       | 4.46E-05 |          |
| 7      | 6.27E-03                      | 0.                             | 7.59E-03                      | 7.13E-03                       | 4.26E-03                      | 5.52E-03                       | 3.03E-03                      | 4.51E-05                       | 8.69E-06                      | 2.65E-05                       | 5.50E-06                      | 7.28E-05                       | 1.40E-05                      | 7.28E-05                       | 1.40E-05                      | 7.28E-05                       | 1.40E-05 |          |
| 8      | 5.04E-03                      | 0.                             | 5.79E-03                      | 5.79E-03                       | 3.51E-03                      | 4.37E-03                       | 2.54E-03                      | 5.08E-05                       | 5.50E-06                      | 7.28E-05                       | 1.40E-05                      | 7.28E-05                       | 1.40E-05                      | 7.28E-05                       | 1.40E-05                      | 7.28E-05                       | 1.40E-05 |          |
| 9      | 3.26E-03                      | 0.                             | 4.99E-03                      | 4.76E-03                       | 2.87E-03                      | 3.44E-03                       | 2.38E-03                      | 3.76E-05                       | 5.0E-06                       | 5.31E-05                       | 6.51E-06                      | 5.31E-05                       | 6.51E-06                      | 5.31E-05                       | 6.51E-06                      | 5.31E-05                       | 6.51E-06 |          |
| 10     | 2.62E-03                      | 0.                             | 4.09E-03                      | 3.85E-03                       | 2.57E-03                      | 3.11E-03                       | 2.37E-03                      | 3.22E-05                       | 5.0E-06                       | 5.73E-05                       | 7.05E-06                      | 5.73E-05                       | 7.05E-06                      | 5.73E-05                       | 7.05E-06                      | 5.73E-05                       | 7.05E-06 |          |
| 11     | 2.33E-03                      | 0.                             | 3.26E-03                      | 3.14E-03                       | 2.52E-03                      | 3.03E-03                       | 2.38E-03                      | 2.98E-05                       | 5.0E-06                       | 6.60E-05                       | 8.11E-06                      | 6.60E-05                       | 8.11E-06                      | 6.60E-05                       | 8.11E-06                      | 6.60E-05                       | 8.11E-06 |          |
| 12     | 2.32E-03                      | 0.                             | 2.71E-03                      | 2.52E-03                       | 2.48E-03                      | 3.04E-03                       | 2.38E-03                      | 2.76E-05                       | 5.0E-06                       | 7.60E-05                       | 9.35E-06                      | 7.60E-05                       | 9.35E-06                      | 7.60E-05                       | 9.35E-06                      | 7.60E-05                       | 9.35E-06 |          |
| 13     | 2.31E-03                      | 0.                             | 2.00E-03                      | 2.66E-03                       | 2.42E-03                      | 3.11E-03                       | 2.38E-03                      | 2.76E-05                       | 5.0E-06                       | 8.25E-05                       | 1.01E-05                      | 8.25E-05                       | 1.01E-05                      | 8.25E-05                       | 1.01E-05                      | 8.25E-05                       | 1.01E-05 |          |
| 14     | 2.31E-03                      | 0.                             | 1.64E-03                      | 2.34E-03                       | 2.39E-03                      | 3.17E-03                       | 2.38E-03                      | 2.77E-05                       | 5.0E-06                       | 8.42E-05                       | 1.04E-05                      | 8.42E-05                       | 1.04E-05                      | 8.42E-05                       | 1.04E-05                      | 8.42E-05                       | 1.04E-05 |          |
| 15     | 2.31E-03                      | 0.                             | 1.26E-03                      | 2.27E-03                       | 2.34E-03                      | 2.33E-03                       | 2.38E-03                      | 2.76E-05                       | 5.0E-06                       | 9.20E-05                       | 1.01E-05                      | 9.20E-05                       | 1.01E-05                      | 9.20E-05                       | 1.01E-05                      | 9.20E-05                       | 1.01E-05 |          |
| 16     | 2.30E-03                      | 0.                             | 9.92E-04                      | 2.23E-03                       | 2.29E-03                      | 3.09E-03                       | 2.28E-03                      | 2.67E-05                       | 5.0E-06                       | 7.53E-05                       | 9.26E-06                      | 7.53E-05                       | 9.26E-06                      | 7.53E-05                       | 9.26E-06                      | 7.53E-05                       | 9.26E-06 |          |
| 17     | 2.30E-03                      | 0.                             | 1.06E-03                      | 2.25E-03                       | 2.26E-03                      | 3.07E-03                       | 2.28E-03                      | 2.50E-05                       | 5.0E-06                       | 6.60E-05                       | 8.11E-06                      | 6.60E-05                       | 8.11E-06                      | 6.60E-05                       | 8.11E-06                      | 6.60E-05                       | 8.11E-06 |          |
| 18     | 2.30E-03                      | 0.                             | 1.26E-03                      | 2.26E-03                       | 2.20E-03                      | 3.08E-03                       | 2.18E-03                      | 2.26E-05                       | 5.0E-06                       | 5.50E-05                       | 6.77E-06                      | 5.50E-05                       | 6.77E-06                      | 5.50E-05                       | 6.77E-06                      | 5.50E-05                       | 6.77E-06 |          |
| 19     | 2.30E-03                      | 0.                             | 1.47E-03                      | 2.36E-03                       | 2.17E-03                      | 3.10E-03                       | 2.18E-03                      | 1.96E-05                       | 5.0E-06                       | 4.62E-05                       | 5.43E-06                      | 4.62E-05                       | 5.43E-06                      | 4.62E-05                       | 5.43E-06                      | 4.62E-05                       | 5.43E-06 |          |
| 20     | 2.34E-03                      | 0.                             | 1.74E-03                      | 2.44E-03                       | 2.20E-03                      | 3.05E-03                       | 2.08E-03                      | 1.66E-05                       | 5.0E-06                       | 3.52E-05                       | 4.33E-06                      | 3.52E-05                       | 4.33E-06                      | 3.52E-05                       | 4.33E-06                      | 3.52E-05                       | 4.33E-06 |          |
| 21     | 2.42E-03                      | 0.                             | 2.02E-03                      | 2.54E-03                       | 2.19E-03                      | 3.04E-03                       | 2.04E-03                      | 1.39E-05                       | 5.0E-06                       | 2.81E-05                       | 3.46E-06                      | 2.81E-05                       | 3.46E-06                      | 2.81E-05                       | 3.46E-06                      | 2.81E-05                       | 3.46E-06 |          |
| 22     | 2.50E-03                      | 0.                             | 2.23E-03                      | 2.62E-03                       | 2.14E-03                      | 3.05E-03                       | 1.98E-03                      | 1.15E-05                       | 5.0E-06                       | 2.19E-05                       | 2.63E-06                      | 2.19E-05                       | 2.63E-06                      | 2.19E-05                       | 2.63E-06                      | 2.19E-05                       | 2.63E-06 |          |
| 23     | 2.59E-03                      | 0.                             | 2.59E-03                      | 2.86E-03                       | 2.15E-03                      | 3.11E-03                       | 1.95E-03                      | 9.27E-06                       | 5.0E-06                       | 1.83E-05                       | 2.03E-06                      | 1.83E-05                       | 2.03E-06                      | 1.83E-05                       | 2.03E-06                      | 1.83E-05                       | 2.03E-06 |          |
| 24     | 2.59E-03                      | 0.                             | 2.59E-03                      | 2.86E-03                       | 2.25E-03                      | 3.12E-03                       | 1.94E-03                      | 7.27E-06                       | 5.0E-06                       | 1.34E-05                       | 1.64E-06                      | 1.34E-05                       | 1.64E-06                      | 1.34E-05                       | 1.64E-06                      | 1.34E-05                       | 1.64E-06 |          |
| 25     | 2.83E-03                      | 0.                             | 3.06E-03                      | 3.34E-03                       | 2.16E-03                      | 3.63E-03                       | 1.94E-03                      | 1.54E-05                       | 5.0E-06                       | 9.07E-06                       | 1.35E-06                      | 9.07E-06                       | 1.35E-06                      | 9.07E-06                       | 1.35E-06                      | 9.07E-06                       | 1.35E-06 |          |
| 30     | 2.51E-03                      | 0.                             | 2.99E-03                      | 3.28E-03                       | 1.84E-03                      | 4.85E-03                       | 1.54E-03                      | 4.76E-06                       | 5.0E-06                       | 2.94E-06                       | 0.                            | 2.94E-06                       | 0.                            | 2.94E-06                       | 0.                            | 2.94E-06                       | 0.       | 2.94E-06 |
| 35     | 2.42E-03                      | 0.                             | 2.70E-03                      | 3.05E-03                       | 1.75E-03                      | 4.34E-03                       | 1.38E-03                      | 2.36E-06                       | 5.0E-06                       | 1.15E-06                       | 0.                            | 1.15E-06                       | 0.                            | 1.15E-06                       | 0.                            | 1.15E-06                       | 0.       | 1.15E-06 |
| 40     | 1.99E-03                      | 0.                             | 2.12E-03                      | 2.45E-03                       | 1.49E-03                      | 2.76E-03                       | 1.05E-03                      | 0.                             | 5.0E-06                       | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.       | 0.       |
| 45     | 1.34E-03                      | 0.                             | 1.41E-03                      | 1.74E-03                       | 1.05E-03                      | 1.86E-03                       | 7.59E-04                      | 0.                             | 5.0E-06                       | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.       | 0.       |
| 50     | 2.19E-04                      | 0.                             | 2.30E-04                      | 2.72E-04                       | 2.05E-04                      | 2.74E-04                       | 1.94E-04                      | 0.                             | 5.0E-06                       | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.       | 0.       |
| 70     | 4.34E-06                      | 0.                             | 4.49E-06                      | 5.11E-06                       | 4.47E-06                      | 5.19E-06                       | 4.90E-06                      | 0.                             | 5.0E-06                       | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.       | 0.       |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|             | CLEAR                         |                                | HAZY                          |                                |
|-------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|             | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| UPPER       | *****                         | *****                          | 4.27E-02                      | 3.30E-02                       |
| MARITIME    | 4.67E-03                      | 7.25E-03                       | 5.49E-02                      | 7.90E-02                       |
| TRCOSPHERIC | 1.09E-03                      | 2.10E-04                       | *****                         | *****                          |

WAVELENGTH =  
FREQUENCY =

| h'(km) | U.S.                          |                                | TROPICAL                      |                               | MIDLAT                        |                               | SUBARCTIC                     |                               | SUBARCTIC                     |                               | CLEAR                         |                                | AEROSOL                       |                                | HAZY |  |
|--------|-------------------------------|--------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|------|--|
|        | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |      |  |
| 0      | 1.44F-01                      | 0.                             | 5.23E-01                      | 3.50E-01                      | 6.70E-02                      | 2.11E-01                      | 4.54E-02                      | 2.19E-03                      | 3.99F-03                      | 3.50E-02                      | 4.34F-02                      |                                |                               |                                |      |  |
| 0      | 1.24F-01                      | 0.                             | 4.05F-01                      | 2.71E-01                      | 7.74E-02                      | 1.64E-01                      | 4.56E-02                      | 2.18E-03                      | 2.64F-03                      | 3.58E-02                      | 4.34F-02                      |                                |                               |                                |      |  |
| 1      | 9.26F-02                      | 0.                             | 2.54F-01                      | 1.68E-01                      | 6.32E-02                      | 1.15F-01                      | 4.42E-02                      | 2.93E-04                      | 5.71F-05                      | 4.67E-03                      | 9.03E-04                      |                                |                               |                                |      |  |
| 2      | 7.02E-02                      | 0.                             | 1.50E-01                      | 1.05E-01                      | 5.31F-02                      | 8.38E-02                      | 3.52E-02                      | 1.50E-04                      | 2.92F-05                      | 7.50E-04                      | 1.54F-04                      |                                |                               |                                |      |  |
| 3      | 5.47E-02                      | 0.                             | 9.09E-02                      | 7.65E-02                      | 4.43F-02                      | 5.43E-02                      | 3.38E-02                      | 1.22E-04                      | 2.94E-05                      | 4.83E-04                      | 8.41E-05                      |                                |                               |                                |      |  |
| 4      | 4.37E-02                      | 0.                             | 5.94E-02                      | 5.04E-02                      | 3.59F-02                      | 5.09E-02                      | 2.73E-02                      | 9.41E-05                      | 1.83E-05                      | 2.25E-04                      | 4.34F-05                      |                                |                               |                                |      |  |
| 5      | 3.56F-02                      | 0.                             | 4.85E-02                      | 4.05E-02                      | 2.97E-02                      | 4.26E-02                      | 2.43E-02                      | 6.99E-05                      | 1.36E-05                      | 1.42E-04                      | 2.77E-05                      |                                |                               |                                |      |  |
| 6      | 2.90E-02                      | 0.                             | 4.40E-02                      | 4.15E-02                      | 2.45E-02                      | 3.22E-02                      | 1.77E-02                      | 4.83F-05                      | 9.41E-06                      | 1.17E-04                      | 2.27E-05                      |                                |                               |                                |      |  |
| 7      | 2.36F-02                      | 0.                             | 3.95E-02                      | 3.35E-02                      | 2.02E-02                      | 2.59E-02                      | 1.59E-02                      | 3.05E-05                      | 5.35E-06                      | 7.80E-05                      | 1.57E-05                      |                                |                               |                                |      |  |
| 8      | 1.91E-02                      | 0.                             | 2.94E-02                      | 2.77E-02                      | 1.65E-02                      | 2.07E-02                      | 1.16E-02                      | 5.35E-05                      | 0.                            | 7.42E-05                      | 9.73E-06                      |                                |                               |                                |      |  |
| 9      | 1.52E-02                      | 1.                             | 2.40E-02                      | 2.27E-02                      | 1.33E-02                      | 1.63E-02                      | 1.08E-02                      | 3.98E-05                      | 0.                            | 5.37E-05                      | 7.40E-06                      |                                |                               |                                |      |  |
| 10     | 1.20E-02                      | 1.                             | 1.94E-02                      | 1.85E-02                      | 1.10E-02                      | 1.45E-02                      | 1.06E-02                      | 3.39E-05                      | 0.                            | 5.01E-05                      | 7.68E-06                      |                                |                               |                                |      |  |
| 11     | 1.06E-02                      | 0.                             | 1.55E-02                      | 1.47E-02                      | 1.15E-02                      | 1.44E-02                      | 1.08E-02                      | 3.11E-05                      | 0.                            | 5.68E-05                      | 8.83E-06                      |                                |                               |                                |      |  |
| 12     | 1.05E-02                      | 0.                             | 1.24E-02                      | 1.15E-02                      | 1.13E-02                      | 1.44E-02                      | 1.04E-02                      | 2.91E-05                      | 0.                            | 7.40E-05                      | 1.02E-05                      |                                |                               |                                |      |  |
| 13     | 1.05E-02                      | 0.                             | 9.01E-03                      | 1.02E-02                      | 1.10E-02                      | 1.45E-02                      | 1.03E-02                      | 2.87E-05                      | 0.                            | 8.36E-05                      | 1.40F-05                      |                                |                               |                                |      |  |
| 14     | 1.05F-02                      | 0.                             | 7.22E-03                      | 1.05E-02                      | 1.09E-02                      | 1.44E-02                      | 1.04E-02                      | 2.91E-05                      | 0.                            | 8.53E-05                      | 1.13E-05                      |                                |                               |                                |      |  |
| 15     | 1.05E-02                      | 0.                             | 5.43E-03                      | 1.03E-02                      | 1.07E-02                      | 1.39F-02                      | 1.06E-02                      | 2.91E-05                      | 0.                            | 9.53E-05                      | 1.10E-05                      |                                |                               |                                |      |  |
| 16     | 1.05F-02                      | 0.                             | 4.20E-03                      | 1.02E-02                      | 1.04E-02                      | 1.44E-02                      | 1.04E-02                      | 2.86E-05                      | 0.                            | 7.63E-05                      | 1.01F-05                      |                                |                               |                                |      |  |
| 17     | 1.05E-02                      | 0.                             | 4.49E-03                      | 1.02E-02                      | 1.03E-02                      | 1.44E-02                      | 1.02E-02                      | 2.68E-05                      | 0.                            | 6.46E-05                      | 8.83E-06                      |                                |                               |                                |      |  |
| 18     | 1.05E-02                      | 0.                             | 5.45E-03                      | 1.04E-02                      | 1.00E-02                      | 1.44E-02                      | 9.91E-03                      | 2.38E-05                      | 0.                            | 5.56E-05                      | 7.37E-06                      |                                |                               |                                |      |  |
| 19     | 1.05F-02                      | 0.                             | 6.45E-03                      | 1.08E-02                      | 9.95E-03                      | 1.45F-02                      | 9.65E-03                      | 2.07E-05                      | 0.                            | 4.47E-05                      | 5.91F-06                      |                                |                               |                                |      |  |
| 20     | 1.07E-02                      | 0.                             | 7.74E-03                      | 1.15E-02                      | 1.00E-02                      | 1.43E-02                      | 9.42E-03                      | 1.75E-05                      | 0.                            | 3.57E-05                      | 4.72E-06                      |                                |                               |                                |      |  |
| 21     | 1.11E-02                      | 0.                             | 9.13E-03                      | 1.17E-02                      | 9.95E-03                      | 1.43E-02                      | 9.21E-03                      | 1.46E-05                      | 0.                            | 2.65E-05                      | 3.77E-06                      |                                |                               |                                |      |  |
| 22     | 1.15F-02                      | 0.                             | 1.02F-02                      | 1.21E-02                      | 9.91E-03                      | 1.43E-02                      | 8.94E-03                      | 1.24E-05                      | 0.                            | 2.22E-05                      | 2.93F-06                      |                                |                               |                                |      |  |
| 23     | 1.20F-02                      | 0.                             | 1.10E-02                      | 1.33E-02                      | 9.76E-03                      | 1.46F-02                      | 8.77E-03                      | 1.21E-05                      | 0.                            | 1.72E-05                      | 2.27E-06                      |                                |                               |                                |      |  |
| 24     | 1.24E-02                      | 0.                             | 1.20E-02                      | 1.35E-02                      | 1.02E-02                      | 1.54F-02                      | 8.56E-03                      | 7.66E-06                      | 0.                            | 1.35E-05                      | 1.79E-06                      |                                |                               |                                |      |  |
| 25     | 1.32E-02                      | 0.                             | 1.44E-02                      | 1.55E-02                      | 9.87E-03                      | 1.72E-02                      | 8.86E-03                      | 1.53E-05                      | 3.26E-06                      | 3.93E-05                      | 8.55E-06                      |                                |                               |                                |      |  |
| 30     | 1.16F-02                      | 0.                             | 1.41F-02                      | 1.55E-02                      | 9.40E-03                      | 2.83E-02                      | 7.80E-03                      | 4.73F-06                      | 1.01F-06                      | 9.91E-06                      | 1.92E-06                      |                                |                               |                                |      |  |
| 40     | 1.14F-02                      | 0.                             | 1.24E-02                      | 1.44E-02                      | 8.04E-03                      | 1.62E-02                      | 6.02E-03                      | 2.33E-06                      | 0.                            | 2.92E-06                      | 0.                            |                                |                               |                                |      |  |
| 45     | 9.62F-03                      | 0.                             | 1.03E-02                      | 1.22E-02                      | 7.08E-03                      | 1.31E-02                      | 4.87E-03                      | 1.15E-06                      | 0.                            | 1.15E-06                      | 0.                            |                                |                               |                                |      |  |
| 50     | 6.54E-03                      | 0.                             | 6.32E-03                      | 8.61E-03                      | 5.08F-03                      | 9.25F-03                      | 3.60E-03                      | 0.                            | 0.                            | 0.                            | 0.                            |                                |                               |                                |      |  |
| 55     | 4.82E-03                      | 0.                             | 4.45E-03                      | 6.16E-03                      | 4.96E-04                      | 1.29E-03                      | 9.40E-04                      | 0.                            | 0.                            | 0.                            | 0.                            |                                |                               |                                |      |  |
| 60     | 1.02E-03                      | 0.                             | 1.27E-03                      | 1.70E-03                      | 1.33E-05                      | 2.21E-05                      | 2.17E-05                      | 0.                            | 0.                            | 0.                            | 0.                            |                                |                               |                                |      |  |
| 70     | 1.84E-05                      | 9.                             | 1.90E-05                      | 2.27E-05                      | 1.84E-05                      | 2.21E-05                      | 2.19E-05                      | 0.                            | 0.                            | 0.                            | 0.                            |                                |                               |                                |      |  |
| 100    | 1.84E-05                      | 9.                             | 1.90E-05                      | 2.27E-05                      | 1.84E-05                      | 2.21E-05                      | 2.19E-05                      | 0.                            | 0.                            | 0.                            | 0.                            |                                |                               |                                |      |  |

## ALTERNATE BOUNDARY LAYER AEROSOL MODFLS

|             | CLEAR                           | HAZY                            |
|-------------|---------------------------------|---------------------------------|
| UN-RAN      | $\lambda_a$ (km <sup>-1</sup> ) | $\lambda_a$ (km <sup>-1</sup> ) |
| NGR-TIME    | $\sigma_a$ (km <sup>-1</sup> )  | $\sigma_a$ (km <sup>-1</sup> )  |
| TRQOSPHERIC | *****                           | *****                           |
|             | 4.56E-03                        | 4.37E-02                        |
|             | 7.88E-03                        | 3.30E-02                        |
|             | 1.11E-03                        | 4.95E-02                        |
|             | 2.27E-04                        | 4.58E-02                        |

WAVELENGTH = 10.260378 MICROMETERS  
FREQUENCY = 974.523 WAVENUMBER

| Alt(km) | U.S. STANDARD                 |                                | TROPICAL                      |                                | MIDLAT SUMMER                 |                                | MIDLAT WINTER                 |                                | SUBARCTIC SUMMER              |                                | SUBARCTIC WINTER              |                                | CLEAR                         |                                | AEROSOL                       |                                | HAZY                          |                                |
|---------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|         | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0       | 1.79E-01                      | 0.                             | 4.52E-01                      | 3.05E-01                       | 8.02E-02                      | 1.86E-01                       | 4.32E-02                      | 4.32E-02                       | 7.30F-03                      | 3.99F-03                       | 3.60E-02                      | 4.34E-02                       | 3.60E-02                      | 4.34E-02                       | 3.60E-02                      | 4.34E-02                       | 3.60E-02                      | 4.34E-02                       |
| 1       | 1.12E-01                      | 0.                             | 3.53E-01                      | 2.39E-01                       | 7.20E-02                      | 1.50E-01                       | 4.36E-02                      | 4.36E-02                       | 2.16F-03                      | 2.64E-03                       | 3.60E-02                      | 4.34E-02                       | 2.16F-03                      | 2.64E-03                       | 3.60E-02                      | 4.34E-02                       | 2.16F-03                      | 2.64E-03                       |
| 2       | 8.58E-02                      | 0.                             | 2.26E-01                      | 1.51E-01                       | 5.97E-02                      | 1.09E-01                       | 4.23E-02                      | 4.23E-02                       | 2.95E-04                      | 5.75E-05                       | 3.60E-02                      | 4.34E-02                       | 2.95E-04                      | 5.75E-05                       | 3.60E-02                      | 4.34E-02                       | 2.95E-04                      | 5.75E-05                       |
| 3       | 6.64E-02                      | 0.                             | 1.76E-01                      | 1.01E-01                       | 5.07E-02                      | 7.94E-02                       | 3.76E-02                      | 3.76E-02                       | 1.51E-04                      | 2.934E-05                      | 3.60E-02                      | 4.34E-02                       | 1.51E-04                      | 2.934E-05                      | 3.60E-02                      | 4.34E-02                       | 1.51E-04                      | 2.934E-05                      |
| 4       | 5.24E-02                      | 0.                             | 1.36E-01                      | 7.26E-02                       | 4.23E-02                      | 6.12E-02                       | 3.26E-02                      | 3.26E-02                       | 9.47E-05                      | 1.85E-05                       | 3.60E-02                      | 4.34E-02                       | 9.47E-05                      | 1.85E-05                       | 3.60E-02                      | 4.34E-02                       | 9.47E-05                      | 1.85E-05                       |
| 5       | 4.22E-02                      | 0.                             | 1.01E-01                      | 5.24E-02                       | 3.47E-02                      | 4.89E-02                       | 2.68E-02                      | 2.68E-02                       | 7.03E-05                      | 1.37E-05                       | 3.60E-02                      | 4.34E-02                       | 7.03E-05                      | 1.37E-05                       | 3.60E-02                      | 4.34E-02                       | 7.03E-05                      | 1.37E-05                       |
| 6       | 3.44E-02                      | 0.                             | 7.75E-02                      | 4.73E-02                       | 2.87E-02                      | 3.95E-02                       | 2.14E-02                      | 2.14E-02                       | 4.86E-05                      | 9.43E-06                       | 3.60E-02                      | 4.34E-02                       | 4.86E-05                      | 9.43E-06                       | 3.60E-02                      | 4.34E-02                       | 4.86E-05                      | 9.43E-06                       |
| 7       | 2.80E-02                      | 0.                             | 6.42E-02                      | 4.03E-02                       | 2.36E-02                      | 3.11E-02                       | 1.69E-02                      | 1.69E-02                       | 3.07E-05                      | 5.99E-06                       | 3.60E-02                      | 4.34E-02                       | 3.07E-05                      | 5.99E-06                       | 3.60E-02                      | 4.34E-02                       | 3.07E-05                      | 5.99E-06                       |
| 8       | 2.28E-02                      | 0.                             | 5.24E-02                      | 3.25E-02                       | 1.94E-02                      | 2.50E-02                       | 1.33E-02                      | 1.33E-02                       | 2.39E-05                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 2.39E-05                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 2.39E-05                      | 0.                             |
| 9       | 1.83E-02                      | 0.                             | 4.26E-02                      | 2.68E-02                       | 1.57E-02                      | 1.99E-02                       | 1.10E-02                      | 1.10E-02                       | 1.83E-05                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.83E-05                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.83E-05                      | 0.                             |
| 10      | 1.45E-02                      | 0.                             | 3.46E-02                      | 2.15E-02                       | 1.26E-02                      | 1.56E-02                       | 1.03E-02                      | 1.03E-02                       | 1.45E-05                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.45E-05                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.45E-05                      | 0.                             |
| 11      | 1.14E-02                      | 0.                             | 2.86E-02                      | 1.75E-02                       | 1.02E-02                      | 1.33E-02                       | 1.02E-02                      | 1.02E-02                       | 1.14E-05                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.14E-05                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.14E-05                      | 0.                             |
| 12      | 9.07E-03                      | 0.                             | 2.31E-02                      | 1.46E-02                       | 8.02E-03                      | 1.09E-02                       | 1.02E-02                      | 1.02E-02                       | 9.07E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 9.07E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 9.07E-06                      | 0.                             |
| 13      | 7.45E-03                      | 0.                             | 1.86E-02                      | 1.18E-02                       | 6.50E-03                      | 8.37E-03                       | 1.02E-02                      | 1.02E-02                       | 7.45E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 7.45E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 7.45E-06                      | 0.                             |
| 14      | 6.15E-03                      | 0.                             | 1.56E-02                      | 9.75E-03                       | 5.37E-03                      | 7.15E-03                       | 1.01E-02                      | 1.01E-02                       | 6.15E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 6.15E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 6.15E-06                      | 0.                             |
| 15      | 5.07E-03                      | 0.                             | 1.31E-02                      | 8.15E-03                       | 4.53E-03                      | 6.05E-03                       | 1.01E-02                      | 1.01E-02                       | 5.07E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 5.07E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 5.07E-06                      | 0.                             |
| 16      | 4.19E-03                      | 0.                             | 1.09E-02                      | 6.65E-03                       | 3.76E-03                      | 5.05E-03                       | 1.01E-02                      | 1.01E-02                       | 4.19E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 4.19E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 4.19E-06                      | 0.                             |
| 17      | 3.49E-03                      | 0.                             | 9.05E-03                      | 5.45E-03                       | 3.13E-03                      | 4.15E-03                       | 1.01E-02                      | 1.01E-02                       | 3.49E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 3.49E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 3.49E-06                      | 0.                             |
| 18      | 2.95E-03                      | 0.                             | 7.75E-03                      | 4.65E-03                       | 2.76E-03                      | 3.65E-03                       | 1.01E-02                      | 1.01E-02                       | 2.95E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 2.95E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 2.95E-06                      | 0.                             |
| 19      | 2.50E-03                      | 0.                             | 6.64E-03                      | 3.95E-03                       | 2.36E-03                      | 3.15E-03                       | 1.01E-02                      | 1.01E-02                       | 2.50E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 2.50E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 2.50E-06                      | 0.                             |
| 20      | 2.11E-03                      | 0.                             | 5.64E-03                      | 3.35E-03                       | 2.02E-03                      | 2.75E-03                       | 1.01E-02                      | 1.01E-02                       | 2.11E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 2.11E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 2.11E-06                      | 0.                             |
| 21      | 1.79E-03                      | 0.                             | 4.81E-03                      | 2.85E-03                       | 1.71E-03                      | 2.35E-03                       | 1.01E-02                      | 1.01E-02                       | 1.79E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.79E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.79E-06                      | 0.                             |
| 22      | 1.55E-03                      | 0.                             | 4.15E-03                      | 2.45E-03                       | 1.47E-03                      | 2.05E-03                       | 1.01E-02                      | 1.01E-02                       | 1.55E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.55E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.55E-06                      | 0.                             |
| 23      | 1.36E-03                      | 0.                             | 3.64E-03                      | 2.15E-03                       | 1.29E-03                      | 1.85E-03                       | 1.01E-02                      | 1.01E-02                       | 1.36E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.36E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.36E-06                      | 0.                             |
| 24      | 1.21E-03                      | 0.                             | 3.21E-03                      | 1.95E-03                       | 1.14E-03                      | 1.65E-03                       | 1.01E-02                      | 1.01E-02                       | 1.21E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.21E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.21E-06                      | 0.                             |
| 25      | 1.09E-03                      | 0.                             | 2.85E-03                      | 1.75E-03                       | 1.02E-03                      | 1.45E-03                       | 1.01E-02                      | 1.01E-02                       | 1.09E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.09E-06                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.09E-06                      | 0.                             |
| 30      | 7.45E-04                      | 0.                             | 1.95E-03                      | 1.25E-03                       | 7.04E-04                      | 1.05E-03                       | 1.01E-02                      | 1.01E-02                       | 7.45E-07                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 7.45E-07                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 7.45E-07                      | 0.                             |
| 40      | 4.95E-04                      | 0.                             | 1.05E-03                      | 6.55E-04                       | 4.05E-04                      | 5.65E-04                       | 1.01E-02                      | 1.01E-02                       | 4.95E-07                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 4.95E-07                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 4.95E-07                      | 0.                             |
| 45      | 3.32E-04                      | 0.                             | 6.65E-04                      | 4.05E-04                       | 2.65E-04                      | 3.85E-04                       | 1.01E-02                      | 1.01E-02                       | 3.32E-07                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 3.32E-07                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 3.32E-07                      | 0.                             |
| 50      | 2.15E-04                      | 0.                             | 4.25E-04                      | 2.65E-04                       | 1.75E-04                      | 2.55E-04                       | 1.01E-02                      | 1.01E-02                       | 2.15E-07                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 2.15E-07                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 2.15E-07                      | 0.                             |
| 70      | 1.71E-05                      | 0.                             | 3.45E-05                      | 2.15E-05                       | 1.45E-05                      | 2.05E-05                       | 1.01E-02                      | 1.01E-02                       | 1.71E-08                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.71E-08                      | 0.                             | 3.60E-02                      | 4.34E-02                       | 1.71E-08                      | 0.                             |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

| Alt(km)     | CLEAR                         |                                | HAZY                          |                                |
|-------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|             | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN       | *****                         | *****                          | 4.38E-02                      | 3.30E-02                       |
| WILDLIFE    | 4.55E-03                      | 7.94E-03                       | 4.95E-02                      | 8.65E-02                       |
| TOPOGRAPHIC | 1.17E-03                      | 2.29E-04                       | *****                         | *****                          |

|        |                                                                                  | 10.246624 MICROMETERS<br>975.931 WAVENUMBER |                                |                                         |                                         |                                         |                                         |                                        |                                |                               |                                        |
|--------|----------------------------------------------------------------------------------|---------------------------------------------|--------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|----------------------------------------|--------------------------------|-------------------------------|----------------------------------------|
|        |                                                                                  | WAVELENGTH =<br>FREQUENCY =                 |                                |                                         |                                         |                                         |                                         |                                        |                                |                               |                                        |
| ht(km) | U.S.<br>STANDARD<br>$\beta_m$ (km <sup>-1</sup> ) $\sigma_m$ (km <sup>-1</sup> ) | TROPICAL                                    |                                | MIDLAT                                  |                                         | SUBARCTIC                               |                                         | SUBARCTIC                              |                                | AEROSOL                       |                                        |
|        |                                                                                  | $\beta_a$ (km <sup>-1</sup> )               | $\sigma_a$ (km <sup>-1</sup> ) | SUMMER<br>$\beta_m$ (km <sup>-1</sup> ) | WINTER<br>$\beta_m$ (km <sup>-1</sup> ) | SUMMER<br>$\beta_m$ (km <sup>-1</sup> ) | WINTER<br>$\beta_m$ (km <sup>-1</sup> ) | CLEAR<br>$\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | HAZY<br>$\sigma_a$ (km <sup>-1</sup> ) |
| 0      |                                                                                  | 1.32E+00                                    | 8.63E-01                       | 1.82E-01                                | 4.93E-01                                | 6.02E-02                                | 3.31E-03                                | 3.98E-03                               | 3.61E-02                       | 4.34E-02                      |                                        |
| 1      | 1                                                                                | 1.00E+00                                    | 6.61E-01                       | 1.35E-01                                | 3.74E-01                                | 5.07E-02                                | 2.19E-03                                | 2.64E-03                               | 3.61E-02                       | 4.34E-02                      |                                        |
| 2      | 2                                                                                | 5.95E-01                                    | 3.75E-01                       | 9.70E-02                                | 2.30E-01                                | 5.54E-02                                | 2.97E-04                                | 5.79E-05                               | 4.73E-03                       | 5.22E-04                      |                                        |
| 3      | 3                                                                                | 3.19E-01                                    | 2.09E-01                       | 7.13E-02                                | 1.45E-01                                | 4.50E-02                                | 1.52E-04                                | 2.96E-05                               | 8.00E-04                       | 1.56E-04                      |                                        |
| 4      | 4                                                                                | 1.55E-01                                    | 1.20E-01                       | 5.11E-02                                | 9.37E-02                                | 3.55E-02                                | 1.24E-04                                | 2.41E-05                               | 4.37E-04                       | 8.53E-05                      |                                        |
| 5      | 5                                                                                | 9.22E-02                                    | 7.59E-02                       | 3.73E-02                                | 6.31E-02                                | 2.70E-02                                | 9.53E-05                                | 1.86E-05                               | 2.28E-04                       | 4.44E-05                      |                                        |
| 6      | 6                                                                                | 6.44E-02                                    | 5.40E-02                       | 2.87E-02                                | 4.43E-02                                | 2.85E-02                                | 7.02E-05                                | 1.38E-05                               | 1.44E-04                       | 2.81E-05                      |                                        |
| 7      | 7                                                                                | 4.63E-02                                    | 4.21E-02                       | 2.26E-02                                | 3.18E-02                                | 2.41E-02                                | 4.89E-05                                | 9.54E-06                               | 1.18E-04                       | 2.30E-05                      |                                        |
| 8      | 8                                                                                | 3.48E-02                                    | 3.25E-02                       | 1.90E-02                                | 2.41E-02                                | 1.22E-02                                | 3.09E-05                                | 6.04E-06                               | 7.30E-05                       | 1.54E-05                      |                                        |
| 9      | 9                                                                                | 2.77E-02                                    | 2.56E-02                       | 1.44E-02                                | 1.85E-02                                | 9.98E-03                                | 5.40E-05                                | 0.                                     | 5.39E-05                       | 9.88E-06                      |                                        |
| 10     | 10                                                                               | 2.16E-02                                    | 2.05E-02                       | 1.15E-02                                | 1.47E-02                                | 9.27E-03                                | 4.02E-05                                | 0.                                     | 5.39E-05                       | 7.21E-06                      |                                        |
| 11     | 11                                                                               | 1.77E-02                                    | 1.61E-02                       | 8.81E-03                                | 1.26E-02                                | 9.26E-03                                | 3.43E-05                                | 0.                                     | 5.02E-05                       | 7.79E-06                      |                                        |
| 12     | 12                                                                               | 1.33E-02                                    | 1.28E-02                       | 9.93E-03                                | 1.25E-02                                | 9.29E-03                                | 3.14E-05                                | 0.                                     | 6.70E-05                       | 8.97E-06                      |                                        |
| 13     | 13                                                                               | 1.07E-02                                    | 9.90E-03                       | 9.74E-03                                | 1.25E-02                                | 9.24E-03                                | 2.94E-05                                | 0.                                     | 7.72E-05                       | 1.03E-05                      |                                        |
| 14     | 14                                                                               | 7.66E-03                                    | 8.76E-03                       | 9.49E-03                                | 1.25E-02                                | 9.24E-03                                | 2.89E-05                                | 0.                                     | 8.38E-05                       | 1.12E-05                      |                                        |
| 15     | 15                                                                               | 6.07E-03                                    | 9.09E-03                       | 9.34E-03                                | 1.28E-02                                | 9.26E-03                                | 2.94E-05                                | 0.                                     | 8.55E-05                       | 1.15E-05                      |                                        |
| 16     | 16                                                                               | 4.51E-03                                    | 8.81E-03                       | 9.14E-03                                | 1.21E-02                                | 9.11E-03                                | 2.93E-05                                | 0.                                     | 8.33E-05                       | 1.12E-05                      |                                        |
| 17     | 17                                                                               | 3.45E-03                                    | 9.64E-03                       | 8.92E-03                                | 1.25E-02                                | 8.90E-03                                | 2.84E-05                                | 0.                                     | 7.65E-05                       | 1.02E-05                      |                                        |
| 18     | 18                                                                               | 3.70E-03                                    | 8.75E-03                       | 8.80E-03                                | 1.25E-02                                | 8.66E-03                                | 2.66E-05                                | 0.                                     | 6.70E-05                       | 8.97E-06                      |                                        |
| 19     | 19                                                                               | 4.53E-03                                    | 8.87E-03                       | 8.56E-03                                | 1.25E-02                                | 8.47E-03                                | 2.41E-05                                | 0.                                     | 5.59E-05                       | 7.48E-06                      |                                        |
| 20     | 20                                                                               | 5.40E-03                                    | 9.27E-03                       | 8.41E-03                                | 1.26E-02                                | 8.23E-03                                | 2.09E-05                                | 0.                                     | 4.48E-05                       | 6.00E-06                      |                                        |
| 21     | 21                                                                               | 6.52E-03                                    | 9.62E-03                       | 8.59E-03                                | 1.24E-02                                | 8.03E-03                                | 1.77E-05                                | 0.                                     | 3.58E-05                       | 4.79E-06                      |                                        |
| 22     | 22                                                                               | 7.77E-03                                    | 1.01E-02                       | 8.50E-03                                | 1.25E-02                                | 7.84E-03                                | 1.48E-05                                | 0.                                     | 2.86E-05                       | 3.83E-06                      |                                        |
| 23     | 23                                                                               | 9.40E-03                                    | 1.05E-02                       | 8.47E-03                                | 1.24E-02                                | 7.64E-03                                | 1.23E-05                                | 0.                                     | 2.22E-05                       | 2.90E-06                      |                                        |
| 24     | 24                                                                               | 1.03E-02                                    | 1.15E-02                       | 8.34E-03                                | 1.27E-02                                | 7.45E-03                                | 9.22E-06                                | 0.                                     | 1.72E-05                       | 2.30E-06                      |                                        |
| 25     | 25                                                                               | 1.25E-02                                    | 1.38E-02                       | 8.44E-03                                | 1.51E-02                                | 7.54E-03                                | 7.73E-06                                | 0.                                     | 1.36E-05                       | 1.82E-06                      |                                        |
| 26     | 26                                                                               | 1.24E-02                                    | 1.37E-02                       | 7.13E-03                                | 2.10E-02                                | 5.99E-03                                | 1.53E-05                                | 3.25E-06                               | 3.92E-05                       | 8.32E-06                      |                                        |
| 27     | 27                                                                               | 1.15E-02                                    | 1.32E-02                       | 7.02E-03                                | 1.45E-02                                | 5.19E-03                                | 2.32E-06                                | 0.                                     | 9.00E-06                       | 1.91E-06                      |                                        |
| 28     | 28                                                                               | 9.23E-03                                    | 1.10E-02                       | 5.29E-03                                | 1.24E-02                                | 4.27E-03                                | 1.14E-06                                | 0.                                     | 1.14E-06                       | 0.                            |                                        |
| 29     | 29                                                                               | 8.28E-03                                    | 7.85E-03                       | 4.58E-03                                | 8.47E-03                                | 3.28E-03                                | 0.                                      | 0.                                     | 0.                             | 0.                            |                                        |
| 30     | 30                                                                               | 9.38E-04                                    | 1.12E-03                       | 8.45E-04                                | 1.14E-03                                | 8.08E-04                                | 0.                                      | 0.                                     | 0.                             | 0.                            |                                        |
| 31     | 31                                                                               | 1.60E-05                                    | 1.81E-05                       | 1.64E-05                                | 1.93E-05                                | 1.86E-05                                | 0.                                      | 0.                                     | 0.                             | 0.                            |                                        |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|              | CLEAR<br>$\beta_a$ (km <sup>-1</sup> ) $\sigma_a$ (km <sup>-1</sup> ) | HAZY<br>$\beta_a$ (km <sup>-1</sup> ) $\sigma_a$ (km <sup>-1</sup> ) |
|--------------|-----------------------------------------------------------------------|----------------------------------------------------------------------|
| UPBAN        | *****                                                                 | 4.39E-02 3.30E-02                                                    |
| MARITIME     | 4.53E-03 8.00E-03                                                     | 4.94E-02 8.71E-02                                                    |
| TROPOSPHERIC | 1.10E-03 2.31E-04                                                     | *****                                                                |



|       |     | 9.552430 MICROMETERS<br>1046.954 WAVENUMBER |                                |                           |                                |                           |                                |                           |                                |                           |                                |
|-------|-----|---------------------------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|
|       |     | WAVELENGTH =<br>FREQUENCY =                 |                                |                           |                                |                           |                                |                           |                                |                           |                                |
| h(km) |     | U.S. STANDARD                               |                                | TROPICAL                  |                                | MIDLAT SUMMER             |                                | MIDLAT WINTER             |                                | SUBARCTIC WINTER          |                                |
|       |     | $L_m$ (km <sup>-1</sup> )                   | $\sigma_m$ (km <sup>-1</sup> ) | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) |
| 0     | 1   | 1.42E-01                                    | 0.                             | 4.09E-01                  | 9.75E-02                       | 1.87E-01                  | 5.88E-02                       | 4.26E-03                  | 3.94E-03                       | 4.66E-02                  | 4.19E-02                       |
| 0     | 2   | 1.27E-01                                    | 0.                             | 3.28E-01                  | 8.96E-02                       | 1.57E-01                  | 5.98E-02                       | 2.83E-03                  | 2.54E-03                       | 4.66E-02                  | 4.19E-02                       |
| 1     | 2   | 1.03E-01                                    | 0.                             | 2.22E-01                  | 7.74E-02                       | 1.20E-01                  | 5.81E-02                       | 4.49E-04                  | 8.25E-05                       | 7.14E-03                  | 1.31E-03                       |
| 2     | 3   | 8.47E-02                                    | 0.                             | 1.47E-01                  | 6.84E-02                       | 9.59E-02                  | 5.35E-02                       | 2.29E-04                  | 4.22E-05                       | 1.21E-03                  | 2.22E-04                       |
| 3     | 4   | 7.02E-02                                    | 0.                             | 1.03E-01                  | 5.99E-02                       | 8.05E-02                  | 4.84E-02                       | 1.87E-04                  | 3.44E-05                       | 6.60E-04                  | 1.22E-04                       |
| 4     | 5   | 5.92E-02                                    | 0.                             | 8.22E-02                  | 7.85E-02                       | 6.90E-02                  | 4.24E-02                       | 1.44E-04                  | 2.55E-05                       | 3.44E-04                  | 6.33E-05                       |
| 5     | 6   | 5.06E-02                                    | 0.                             | 6.97E-02                  | 6.88E-02                       | 6.03E-02                  | 3.66E-02                       | 1.07E-04                  | 1.67E-05                       | 2.18E-04                  | 4.01E-05                       |
| 6     | 7   | 4.16E-02                                    | 0.                             | 5.80E-02                  | 6.19E-02                       | 5.19E-02                  | 3.35E-02                       | 7.39E-05                  | 1.36E-05                       | 1.78E-04                  | 3.23E-05                       |
| 7     | 8   | 3.81E-02                                    | 0.                             | 4.96E-02                  | 4.05E-02                       | 4.56E-02                  | 3.31E-02                       | 4.67E-05                  | 8.60E-06                       | 1.19E-04                  | 2.20E-05                       |
| 8     | 9   | 3.45E-02                                    | 0.                             | 4.27E-02                  | 3.97E-02                       | 4.24E-02                  | 3.76E-02                       | 1.12E-04                  | 0.                             | 7.24E-05                  | 1.23E-05                       |
| 9     | 10  | 3.31E-02                                    | 0.                             | 4.16E-02                  | 4.16E-02                       | 4.15E-02                  | 4.91E-02                       | 8.36E-05                  | 0.                             | 5.29E-05                  | 9.34E-06                       |
| 10    | 11  | 3.37E-02                                    | 0.                             | 3.04E-02                  | 4.59E-02                       | 4.34E-02                  | 5.97E-02                       | 7.12E-05                  | 0.                             | 5.71E-05                  | 1.01E-05                       |
| 11    | 12  | 3.64E-02                                    | 0.                             | 2.55E-02                  | 5.08E-02                       | 4.80E-02                  | 6.97E-02                       | 6.54E-05                  | 0.                             | 6.58E-05                  | 1.16E-05                       |
| 12    | 13  | 3.71E-02                                    | 0.                             | 2.21E-02                  | 5.34E-02                       | 5.07E-02                  | 7.47E-02                       | 6.10E-05                  | 0.                             | 7.58E-05                  | 1.34E-05                       |
| 13    | 14  | 3.64E-02                                    | 0.                             | 1.76E-02                  | 5.27E-02                       | 5.19E-02                  | 7.10E-02                       | 6.02E-05                  | 0.                             | 8.22E-05                  | 1.45E-05                       |
| 14    | 15  | 3.60E-02                                    | 0.                             | 1.51E-02                  | 5.07E-02                       | 5.17E-02                  | 6.84E-02                       | 6.12E-05                  | 0.                             | 8.40E-05                  | 1.44E-05                       |
| 15    | 16  | 3.57E-02                                    | 0.                             | 1.25E-02                  | 4.75E-02                       | 4.97E-02                  | 6.77E-02                       | 6.10E-05                  | 0.                             | 8.19E-05                  | 1.44E-05                       |
| 16    | 17  | 3.58E-02                                    | 0.                             | 1.14E-02                  | 4.50E-02                       | 4.94E-02                  | 6.23E-02                       | 5.90E-05                  | 0.                             | 7.51E-05                  | 1.33E-05                       |
| 17    | 18  | 3.50E-02                                    | 0.                             | 1.29E-02                  | 4.25E-02                       | 4.73E-02                  | 5.60E-02                       | 5.53E-05                  | 0.                             | 6.58E-05                  | 1.16E-05                       |
| 18    | 19  | 3.51E-02                                    | 0.                             | 1.54E-02                  | 3.95E-02                       | 4.47E-02                  | 4.93E-02                       | 5.00E-05                  | 0.                             | 5.49E-05                  | 9.69E-06                       |
| 19    | 20  | 3.37E-02                                    | 0.                             | 1.84E-02                  | 3.67E-02                       | 4.07E-02                  | 4.23E-02                       | 4.34E-05                  | 0.                             | 4.48E-05                  | 7.77E-06                       |
| 20    | 21  | 3.17E-02                                    | 0.                             | 2.09E-02                  | 3.35E-02                       | 3.61E-02                  | 3.58E-02                       | 3.67E-05                  | 0.                             | 3.51E-05                  | 6.20E-06                       |
| 21    | 22  | 2.90E-02                                    | 0.                             | 2.27E-02                  | 3.00E-02                       | 3.22E-02                  | 3.05E-02                       | 3.07E-05                  | 0.                             | 2.80E-05                  | 4.95E-06                       |
| 22    | 23  | 2.79E-02                                    | 0.                             | 2.36E-02                  | 2.85E-02                       | 2.91E-02                  | 2.62E-02                       | 2.55E-05                  | 0.                             | 2.18E-05                  | 3.86E-06                       |
| 23    | 24  | 2.60E-02                                    | 0.                             | 2.38E-02                  | 2.71E-02                       | 2.72E-02                  | 2.22E-02                       | 2.04E-05                  | 0.                             | 1.69E-05                  | 2.98E-06                       |
| 24    | 25  | 2.45E-02                                    | 0.                             | 2.34E-02                  | 2.52E-02                       | 2.18E-02                  | 1.90E-02                       | 1.61E-05                  | 0.                             | 1.33E-05                  | 2.35E-06                       |
| 25    | 30  | 2.09E-02                                    | 0.                             | 2.27E-02                  | 2.16E-02                       | 2.46E-02                  | 1.47E-02                       | 1.30E-05                  | 2.50E-06                       | 3.32E-05                  | 6.40E-06                       |
| 30    | 35  | 1.69E-02                                    | 0.                             | 1.77E-02                  | 1.09E-02                       | 2.95E-02                  | 9.21E-03                       | 4.00E-06                  | 0.                             | 7.62E-06                  | 1.47E-06                       |
| 35    | 40  | 1.35E-02                                    | 0.                             | 1.48E-02                  | 9.44E-03                       | 1.89E-02                  | 7.13E-03                       | 1.97E-06                  | 0.                             | 0.                        | 0.                             |
| 40    | 45  | 1.07E-02                                    | 0.                             | 1.14E-02                  | 7.92E-03                       | 1.50E-02                  | 5.51E-03                       | 0.                        | 0.                             | 0.                        | 0.                             |
| 45    | 50  | 7.15E-03                                    | 0.                             | 7.56E-03                  | 5.57E-03                       | 1.00E-02                  | 3.98E-03                       | 0.                        | 0.                             | 0.                        | 0.                             |
| 50    | 70  | 1.13E-03                                    | 0.                             | 1.18E-03                  | 1.06E-03                       | 1.44E-03                  | 1.00E-03                       | 0.                        | 0.                             | 0.                        | 0.                             |
| 70    | 100 | 2.11E-05                                    | 0.                             | 2.19E-05                  | 2.20E-05                       | 2.53E-05                  | 2.45E-05                       | 0.                        | 0.                             | 0.                        | 0.                             |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|              |  | U.S. STANDARD             |                                | TROPICAL                  |                                | MIDLAT SUMMER             |                                | MIDLAT WINTER             |                                | SUBARCTIC WINTER          |                                |
|--------------|--|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|
|              |  | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $L_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) |
| UPBAN        |  | *****                     | *****                          | *****                     | *****                          | *****                     | *****                          | *****                     | *****                          | *****                     | *****                          |
| MARITIME     |  | *****                     | *****                          | *****                     | *****                          | *****                     | *****                          | *****                     | *****                          | *****                     | *****                          |
| TROPOSPHERIC |  | *****                     | *****                          | *****                     | *****                          | *****                     | *****                          | *****                     | *****                          | *****                     | *****                          |

| 9.535978 MICROMETERS<br>1049.661 WAVENUMBER |                               |                               |                               |                               |                               |                               |                               |                               |                                |
|---------------------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|
| WAVELENGTH =<br>FREQUENCY =                 | MIDLAT                        |                               | MIDLAT                        |                               | SUBARCTIC                     |                               | SUBARCTIC                     |                               | HAZY                           |
|                                             | TROPICAL                      | SUMMER                        | WINTER                        | WINTER                        | SUMMER                        | WINTER                        | CLEAR                         | AEROSOL                       |                                |
| h(km)                                       | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_2$ (km <sup>-1</sup> ) |
| 0                                           | 1.52E-01                      | 3.06E-01                      | 1.07E-01                      | 1.09E-01                      | 6.50E-02                      | 6.50E-02                      | 4.33E-03                      | 4.71E-02                      | 4.17E-02                       |
| 0 - 1                                       | 1.37E-01                      | 2.45E-01                      | 9.84E-02                      | 1.64E-01                      | 6.59E-02                      | 6.59E-02                      | 2.86E-03                      | 4.71E-02                      | 4.17E-02                       |
| 1 - 2                                       | 1.12E-01                      | 2.35E-01                      | 8.53E-02                      | 1.29E-01                      | 6.45E-02                      | 6.45E-02                      | 4.55E-04                      | 7.25E-03                      | 1.32E-03                       |
| 2 - 3                                       | 9.31E-02                      | 1.72E-01                      | 7.60E-02                      | 1.05E-01                      | 6.00E-02                      | 6.00E-02                      | 2.33E-04                      | 1.23E-03                      | 2.24E-04                       |
| 3 - 4                                       | 7.79E-02                      | 1.12E-01                      | 6.74E-02                      | 8.96E-02                      | 5.52E-02                      | 5.52E-02                      | 1.90E-04                      | 3.47E-05                      | 6.71E-04                       |
| 4 - 5                                       | 6.67E-02                      | 8.03E-02                      | 6.07E-02                      | 7.84E-02                      | 4.96E-02                      | 4.96E-02                      | 1.46E-04                      | 3.49E-05                      | 6.37E-05                       |
| 5 - 6                                       | 5.82E-02                      | 7.91E-02                      | 5.66E-02                      | 7.05E-02                      | 4.42E-02                      | 4.42E-02                      | 1.09E-04                      | 1.94E-05                      | 2.21E-04                       |
| 6 - 7                                       | 5.16E-02                      | 7.32E-02                      | 5.41E-02                      | 6.32E-02                      | 4.30E-02                      | 4.30E-02                      | 7.50E-05                      | 1.37E-05                      | 1.81E-04                       |
| 7 - 8                                       | 4.70E-02                      | 6.69E-02                      | 5.80E-02                      | 5.81E-02                      | 4.62E-02                      | 4.62E-02                      | 4.75E-05                      | 8.67E-06                      | 1.21E-04                       |
| 8 - 9                                       | 4.55E-02                      | 6.21E-02                      | 5.75E-02                      | 5.83E-02                      | 5.89E-02                      | 5.89E-02                      | 1.14E-04                      | 0.                            | 7.23E-05                       |
| 9 - 10                                      | 4.81E-02                      | 5.89E-02                      | 6.70E-02                      | 6.30E-02                      | 8.60E-02                      | 8.60E-02                      | 8.49E-05                      | 0.                            | 5.24E-05                       |
| 10 - 11                                     | 5.53E-02                      | 5.83E-02                      | 8.22E-02                      | 7.36E-02                      | 1.16E-01                      | 1.16E-01                      | 7.24E-05                      | 0.                            | 5.70E-05                       |
| 11 - 12                                     | 6.79E-02                      | 6.03E-02                      | 1.01E-01                      | 8.85E-02                      | 1.51E-01                      | 1.51E-01                      | 6.64E-05                      | 0.                            | 6.56E-05                       |
| 12 - 13                                     | 7.49E-02                      | 6.44E-02                      | 1.17E-01                      | 1.02E-01                      | 1.77E-01                      | 1.77E-01                      | 6.20E-05                      | 0.                            | 7.56E-05                       |
| 13 - 14                                     | 8.43E-02                      | 7.34E-02                      | 1.26E-01                      | 1.14E-01                      | 1.85E-01                      | 1.85E-01                      | 6.21E-05                      | 0.                            | 8.21E-05                       |
| 14 - 15                                     | 8.43E-02                      | 8.04E-02                      | 1.29E-01                      | 1.22E-01                      | 1.93E-01                      | 1.93E-01                      | 6.21E-05                      | 0.                            | 8.30E-05                       |
| 15 - 16                                     | 8.98E-02                      | 8.26E-02                      | 1.30E-01                      | 1.27E-01                      | 2.05E-01                      | 2.05E-01                      | 6.20E-05                      | 0.                            | 8.16E-05                       |
| 16 - 17                                     | 9.60E-02                      | 8.63E-02                      | 1.31E-01                      | 1.32E-01                      | 2.01E-01                      | 2.01E-01                      | 5.99E-05                      | 0.                            | 7.49E-05                       |
| 17 - 18                                     | 1.03E-01                      | 9.27E-02                      | 1.29E-01                      | 1.34E-01                      | 1.86E-01                      | 1.86E-01                      | 5.61E-05                      | 0.                            | 6.56E-05                       |
| 18 - 19                                     | 1.01E-01                      | 9.73E-02                      | 1.24E-01                      | 1.28E-01                      | 1.67E-01                      | 1.67E-01                      | 5.08E-05                      | 0.                            | 5.48E-05                       |
| 19 - 20                                     | 1.01E-01                      | 9.73E-02                      | 1.24E-01                      | 1.15E-01                      | 1.44E-01                      | 1.44E-01                      | 4.41E-05                      | 0.                            | 4.39E-05                       |
| 20 - 21                                     | 9.50E-02                      | 9.31E-02                      | 1.06E-01                      | 9.93E-02                      | 1.19E-01                      | 1.19E-01                      | 3.73E-05                      | 0.                            | 3.51E-05                       |
| 21 - 22                                     | 8.66E-02                      | 8.63E-02                      | 9.24E-02                      | 8.37E-02                      | 9.82E-02                      | 9.82E-02                      | 3.12E-05                      | 0.                            | 2.80E-05                       |
| 22 - 23                                     | 7.74E-02                      | 7.63E-02                      | 7.91E-02                      | 7.11E-02                      | 8.09E-02                      | 8.09E-02                      | 2.59E-05                      | 0.                            | 2.18E-05                       |
| 23 - 24                                     | 6.80E-02                      | 6.70E-02                      | 6.55E-02                      | 6.19E-02                      | 6.41E-02                      | 6.41E-02                      | 2.07E-05                      | 0.                            | 1.69E-05                       |
| 24 - 25                                     | 5.91E-02                      | 5.80E-02                      | 5.60E-02                      | 5.46E-02                      | 5.06E-02                      | 5.06E-02                      | 1.63E-05                      | 0.                            | 1.33E-05                       |
| 25 - 30                                     | 3.94E-02                      | 4.25E-02                      | 3.44E-02                      | 3.94E-02                      | 2.93E-02                      | 2.93E-02                      | 1.29E-05                      | 2.48E-06                      | 3.29E-05                       |
| 30 - 35                                     | 2.09E-02                      | 2.51E-02                      | 1.57E-02                      | 3.51E-02                      | 1.32E-02                      | 1.32E-02                      | 3.97E-06                      | 0.                            | 7.56E-06                       |
| 35 - 40                                     | 1.53E-02                      | 1.91E-02                      | 1.10E-02                      | 2.80E-02                      | 8.52E-03                      | 8.52E-03                      | 1.95E-06                      | 0.                            | 2.45E-06                       |
| 40 - 45                                     | 1.19E-02                      | 1.49E-02                      | 8.62E-03                      | 1.51E-02                      | 6.07E-03                      | 6.07E-03                      | 0.                            | 0.                            | 0.                             |
| 45 - 50                                     | 7.60E-03                      | 9.91E-03                      | 5.94E-03                      | 1.06E-02                      | 4.27E-03                      | 4.27E-03                      | 0.                            | 0.                            | 0.                             |
| 50 - 70                                     | 1.22E-03                      | 1.51E-03                      | 1.14E-03                      | 1.54E-03                      | 1.07E-03                      | 1.07E-03                      | 0.                            | 0.                            | 0.                             |
| 70 - 100                                    | 2.33E-05                      | 2.79E-05                      | 2.42E-05                      | 2.79E-05                      | 2.67E-05                      | 2.67E-05                      | 0.                            | 0.                            | 0.                             |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|             | CLEAR                         |                                | HAZY                          |                                |
|-------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|             | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN       | *****                         | *****                          | 5.09E-02                      | 3.24E-02                       |
| MARITIME    | 4.43E-03                      | 1.10E-02                       | 4.39E-02                      | 1.20E-01                       |
| TPCOSPHERIC | 1.81E-03                      | 3.31E-04                       | *****                         | *****                          |

|        |                                                                                  | WAVELENGTH = 9.519511 MICROMETERS<br>FREQUENCY = 1050.441 WAVENUMBER |                                |                               |                                |                               |                                |                               |                                |                               |                                |                               |                                |
|--------|----------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
| ht(km) | U.S.<br>STANDARD<br>$\beta_m$ (km <sup>-1</sup> ) $\sigma_m$ (km <sup>-1</sup> ) | TROPICAL                                                             |                                | MIDLAT                        |                                | WINTER                        |                                | SUBARCTIC                     |                                | WINTER                        |                                | SUBARCTIC                     |                                |
|        |                                                                                  | $\beta_m$ (km <sup>-1</sup> )                                        | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) |
| 0      | 1.64E-01 0.                                                                      | 4.52E-11                                                             | 3.23E-01                       | 1.19E-01                      | 2.11E-01                       | 7.35E-02                      | 4.37E-03                       | 3.82E-03                      | 4.76E-02                       | 4.16E-02                      | 4.76E-02                       | 4.16E-02                      | 4.76E-02                       |
| 1      | 1.64E-01 0.                                                                      | 2.63E-01                                                             | 2.63E-01                       | 1.09E-01                      | 1.90E-01                       | 7.43E-02                      | 2.09E-03                       | 2.53E-03                      | 4.76E-02                       | 4.16E-02                      | 4.76E-02                       | 4.16E-02                      | 4.76E-02                       |
| 2      | 1.23E-01 0.                                                                      | 1.84E-01                                                             | 1.84E-01                       | 9.50E-02                      | 1.40E-01                       | 7.27E-02                      | 4.82E-04                       | 8.37E-04                      | 7.36E-03                       | 1.31E-03                      | 7.36E-03                       | 1.31E-03                      | 7.36E-03                       |
| 3      | 1.03E-01 0.                                                                      | 1.60E-01                                                             | 1.39E-01                       | 8.49E-02                      | 1.19E-01                       | 6.79E-02                      | 2.36E-04                       | 4.28E-05                      | 1.25E-03                       | 2.26E-04                      | 1.25E-03                       | 2.26E-04                      | 1.25E-03                       |
| 4      | 8.61E-02 0.                                                                      | 1.20E-01                                                             | 1.13E-01                       | 7.58E-02                      | 9.93E-02                       | 6.29E-02                      | 1.93E-04                       | 3.49E-05                      | 6.81E-04                       | 1.23E-04                      | 6.81E-04                       | 1.23E-04                      | 6.81E-04                       |
| 5      | 7.41E-02 0.                                                                      | 9.77E-02                                                             | 9.77E-02                       | 6.91E-02                      | 8.76E-02                       | 5.79E-02                      | 1.40E-04                       | 2.69E-05                      | 3.54E-04                       | 6.42E-05                      | 3.54E-04                       | 6.42E-05                      | 3.54E-04                       |
| 6      | 6.49E-02 0.                                                                      | 8.41E-02                                                             | 8.00E-02                       | 6.50E-02                      | 7.93E-02                       | 5.12E-02                      | 1.10E-04                       | 2.00E-05                      | 2.25E-04                       | 4.07E-05                      | 2.25E-04                       | 4.07E-05                      | 2.25E-04                       |
| 7      | 5.77E-02 0.                                                                      | 7.23E-02                                                             | 7.42E-02                       | 6.19E-02                      | 6.59E-02                       | 5.03E-02                      | 7.62E-05                       | 1.38E-05                      | 1.84E-04                       | 3.33E-05                      | 1.84E-04                       | 3.33E-05                      | 1.84E-04                       |
| 8      | 5.04E-02 0.                                                                      | 6.43E-02                                                             | 6.01E-02                       | 6.47E-02                      | 6.59E-02                       | 6.69E-02                      | 4.82E-05                       | 8.73E-06                      | 1.23E-04                       | 2.23E-05                      | 1.23E-04                       | 2.23E-05                      | 1.23E-04                       |
| 9      | 5.21E-02 0.                                                                      | 4.68E-02                                                             | 6.33E-02                       | 7.25E-02                      | 6.84E-02                       | 9.13E-02                      | 8.52E-05                       | 0.                            | 5.27E-05                       | 1.23E-05                      | 5.27E-05                       | 1.23E-05                      | 5.27E-05                       |
| 10     | 5.72E-02 0.                                                                      | 4.18E-02                                                             | 6.04E-02                       | 8.34E-02                      | 7.56E-02                       | 1.14E-01                      | 7.55E-05                       | 0.                            | 5.69E-05                       | 1.02E-05                      | 5.69E-05                       | 1.02E-05                      | 5.69E-05                       |
| 11     | 5.47E-02 0.                                                                      | 3.57E-02                                                             | 5.96E-02                       | 9.39E-02                      | 8.42E-02                       | 1.35E-01                      | 6.75E-05                       | 0.                            | 6.55E-05                       | 1.17E-05                      | 6.55E-05                       | 1.17E-05                      | 6.55E-05                       |
| 12     | 5.60E-02 0.                                                                      | 3.19E-02                                                             | 5.95E-02                       | 9.93E-02                      | 8.97E-02                       | 1.44E-01                      | 6.30E-05                       | 0.                            | 7.54E-05                       | 1.35E-05                      | 7.54E-05                       | 1.35E-05                      | 7.54E-05                       |
| 13     | 6.45E-02 0.                                                                      | 2.67E-02                                                             | 6.28E-02                       | 9.82E-02                      | 9.20E-02                       | 1.37E-01                      | 6.21E-05                       | 0.                            | 8.19E-05                       | 1.47E-05                      | 8.19E-05                       | 1.47E-05                      | 8.19E-05                       |
| 14     | 6.35E-02 0.                                                                      | 2.36E-02                                                             | 6.31E-02                       | 9.32E-02                      | 9.11E-02                       | 1.32E-01                      | 6.31E-05                       | 0.                            | 8.36E-05                       | 1.50E-05                      | 8.36E-05                       | 1.50E-05                      | 8.36E-05                       |
| 15     | 6.28E-02 0.                                                                      | 2.02E-02                                                             | 6.01E-02                       | 8.76E-02                      | 8.74E-02                       | 1.30E-01                      | 6.29E-05                       | 0.                            | 8.14E-05                       | 1.46E-05                      | 8.14E-05                       | 1.46E-05                      | 8.14E-05                       |
| 16     | 6.30E-02 0.                                                                      | 1.95E-02                                                             | 5.90E-02                       | 8.26E-02                      | 8.64E-02                       | 1.20E-01                      | 6.04E-05                       | 0.                            | 7.48E-05                       | 1.34E-05                      | 7.48E-05                       | 1.34E-05                      | 7.48E-05                       |
| 17     | 6.31E-02 0.                                                                      | 2.27E-02                                                             | 5.93E-02                       | 7.75E-02                      | 8.35E-02                       | 1.06E-01                      | 5.70E-05                       | 0.                            | 6.55E-05                       | 1.17E-05                      | 6.55E-05                       | 1.17E-05                      | 6.55E-05                       |
| 18     | 6.14E-02 0.                                                                      | 2.64E-02                                                             | 5.93E-02                       | 7.14E-02                      | 7.68E-02                       | 9.21E-02                      | 5.16E-05                       | 0.                            | 5.46E-05                       | 9.74E-06                      | 5.46E-05                       | 9.74E-06                      | 5.46E-05                       |
| 19     | 5.46E-02 0.                                                                      | 3.14E-02                                                             | 5.74E-02                       | 6.57E-02                      | 6.89E-02                       | 7.74E-02                      | 4.46E-05                       | 0.                            | 4.38E-05                       | 7.84E-06                      | 4.38E-05                       | 7.84E-06                      | 4.38E-05                       |
| 20     | 5.42E-02 0.                                                                      | 3.50E-02                                                             | 5.41E-02                       | 5.87E-02                      | 5.87E-02                       | 6.44E-02                      | 3.79E-05                       | 0.                            | 3.50E-05                       | 6.26E-06                      | 3.50E-05                       | 6.26E-06                      | 3.50E-05                       |
| 21     | 4.95E-02 0.                                                                      | 3.71E-02                                                             | 5.02E-02                       | 5.14E-02                      | 5.85E-02                       | 5.74E-02                      | 3.17E-05                       | 0.                            | 2.79E-05                       | 5.00E-06                      | 2.79E-05                       | 5.00E-06                      | 2.79E-05                       |
| 22     | 4.51E-02 0.                                                                      | 3.77E-02                                                             | 4.50E-02                       | 4.46E-02                      | 4.46E-02                       | 4.46E-02                      | 2.63E-05                       | 0.                            | 2.17E-05                       | 3.89E-06                      | 2.17E-05                       | 3.89E-06                      | 2.17E-05                       |
| 23     | 4.02E-02 0.                                                                      | 3.72E-02                                                             | 4.12E-02                       | 3.79E-02                      | 3.97E-02                       | 3.65E-02                      | 2.11E-05                       | 0.                            | 1.68E-05                       | 3.01E-06                      | 1.68E-05                       | 3.01E-06                      | 1.68E-05                       |
| 24     | 3.7E-02 0.                                                                       | 3.58E-02                                                             | 3.77E-02                       | 3.38E-02                      | 3.64E-02                       | 3.00E-02                      | 1.66E-05                       | 0.                            | 1.33E-05                       | 2.37E-06                      | 1.33E-05                       | 2.37E-06                      | 1.33E-05                       |
| 25     | 3.06E-02 0.                                                                      | 3.06E-02                                                             | 3.15E-02                       | 2.36E-02                      | 3.11E-02                       | 2.06E-02                      | 1.28E-05                       | 0.                            | 1.03E-05                       | 6.23E-06                      | 1.03E-05                       | 6.23E-06                      | 1.03E-05                       |
| 30     | 2.11E-02 0.                                                                      | 2.28E-02                                                             | 2.28E-02                       | 1.35E-02                      | 3.39E-02                       | 1.15E-02                      | 3.94E-06                       | 0.                            | 7.50E-06                       | 1.44E-06                      | 7.50E-06                       | 1.44E-06                      | 7.50E-06                       |
| 35     | 1.51E-02 0.                                                                      | 1.67E-02                                                             | 1.61E-02                       | 1.09E-02                      | 2.07E-02                       | 8.39E-03                      | 1.93E-06                       | 0.                            | 2.13E-06                       | 0.                            | 2.13E-06                       | 0.                            | 2.13E-06                       |
| 40     | 1.14E-02 0.                                                                      | 1.26E-02                                                             | 1.40E-02                       | 8.85E-03                      | 1.64E-02                       | 6.25E-03                      | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 45     | 7.89E-03 0.                                                                      | 8.25E-03                                                             | 1.02E-02                       | 6.12E-03                      | 1.09E-02                       | 4.42E-03                      | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 50     | 4.27E-03 0.                                                                      | 1.33E-03                                                             | 1.58E-03                       | 1.19E-03                      | 1.61E-03                       | 1.11E-03                      | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 70     | 2.49E-05 0.                                                                      | 2.56E-05                                                             | 2.94E-05                       | 2.57E-05                      | 2.99E-05                       | 2.86E-05                      | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|             | U.S.<br>STANDARD<br>$\beta_m$ (km <sup>-1</sup> ) $\sigma_m$ (km <sup>-1</sup> ) | TROPICAL                      |                                | MIDLAT                        |                                | WINTER                        |                                | SUBARCTIC                     |                                | WINTER                        |                                | SUBARCTIC                     |                                |
|-------------|----------------------------------------------------------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|             |                                                                                  | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) |
| UPPER       | *****                                                                            | *****                         | *****                          | *****                         | *****                          | *****                         | *****                          | *****                         | *****                          | *****                         | *****                          | *****                         | *****                          |
| MARITIME    | 4.44E-03                                                                         | 1.11E-02                      | 4.93E-02                       | 1.21E-01                      | *****                          | *****                         | *****                          | *****                         | *****                          | *****                         | *****                          | *****                         | *****                          |
| POPOSPHERIC | 1.64E-03                                                                         | 3.33E-04                      | *****                          | *****                         | *****                          | *****                         | *****                          | *****                         | *****                          | *****                         | *****                          | *****                         | *****                          |

| WAVELENGTH =<br>FREQUENCY = |                  | 9.293784 MICROMETERS<br>1975.988 WAVENUMBER |                                |                               |                                |                               |                                |                               |                                |                               |                                |                               |                                |                               |                                |
|-----------------------------|------------------|---------------------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
| ht(km)                      | U.S.<br>STANDARD | TROPICAL                                    |                                | MIDLAT                        |                                | MIDLAT                        |                                | WINTER                        |                                | SUMMER                        |                                | SUBARCTIC                     |                                | SUBARCTIC                     |                                |
|                             |                  | $\beta_m$ (km <sup>-1</sup> )               | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) |
| 0                           | 1                | 1.62E-01                                    | 0.                             | 4.73E-01                      | 3.32E-01                       | 1.04E-01                      | 2.14E-01                       | 6.14E-02                      | 5.54E-03                       | 3.72E-03                      | 6.03E-02                       | 4.05E-02                      | 5.54E-03                       | 3.72E-03                      | 6.03E-02                       |
| 1                           | 2                | 1.43E-01                                    | 0.                             | 3.76E-01                      | 2.66E-01                       | 9.53E-02                      | 1.78E-01                       | 6.34E-02                      | 3.86E-03                       | 2.46E-03                      | 6.03E-02                       | 4.05E-02                      | 3.86E-03                       | 2.46E-03                      | 6.03E-02                       |
| 2                           | 3                | 1.12E-01                                    | 0.                             | 2.51E-01                      | 1.79E-01                       | 6.14E-02                      | 1.31E-01                       | 6.05E-02                      | 7.22E-04                       | 1.01E-04                      | 1.15E-02                       | 2.60E-03                      | 7.22E-04                       | 1.01E-04                      | 1.15E-02                       |
| 3                           | 4                | 8.99E-02                                    | 0.                             | 1.64E-01                      | 1.28E-01                       | 7.09E-02                      | 1.02E-01                       | 5.46E-02                      | 3.69E-04                       | 5.14E-05                      | 1.95E-03                       | 2.71E-04                      | 3.69E-04                       | 5.14E-05                      | 1.95E-03                       |
| 4                           | 5                | 7.32E-02                                    | 0.                             | 1.12E-01                      | 9.73E-02                       | 6.06E-02                      | 8.31E-02                       | 4.80E-02                      | 3.01E-04                       | 4.13E-05                      | 1.06E-03                       | 1.44E-04                      | 3.01E-04                       | 4.13E-05                      | 1.06E-03                       |
| 5                           | 6                | 5.05E-02                                    | 0.                             | 7.79E-02                      | 7.93E-02                       | 5.10E-02                      | 6.26E-02                       | 4.05E-02                      | 2.32E-04                       | 3.23E-05                      | 5.53E-04                       | 7.71E-05                      | 2.32E-04                       | 3.23E-05                      | 5.53E-04                       |
| 6                           | 7                | 4.21E-02                                    | 0.                             | 7.35E-02                      | 5.73E-02                       | 4.30E-02                      | 5.71E-02                       | 3.31E-02                      | 1.72E-04                       | 2.40E-05                      | 3.51E-04                       | 4.89E-05                      | 1.72E-04                       | 2.40E-05                      | 3.51E-04                       |
| 7                           | 8                | 3.49E-02                                    | 0.                             | 6.12E-02                      | 5.84E-02                       | 3.62E-02                      | 4.62E-02                       | 2.69E-02                      | 1.19E-04                       | 1.66E-05                      | 2.87E-04                       | 4.00E-05                      | 1.19E-04                       | 1.66E-05                      | 2.87E-04                       |
| 8                           | 9                | 2.87E-02                                    | 0.                             | 4.32E-02                      | 4.66E-02                       | 2.52E-02                      | 3.10E-02                       | 1.82E-02                      | 1.08E-04                       | 1.05E-05                      | 1.92E-04                       | 2.68E-05                      | 1.08E-04                       | 1.05E-05                      | 1.92E-04                       |
| 9                           | 10               | 2.34E-02                                    | 0.                             | 3.54E-02                      | 3.37E-02                       | 2.85E-02                      | 2.49E-02                       | 1.71E-02                      | 8.03E-05                       | 0.                            | 4.99E-05                       | 1.02E-05                      | 8.03E-05                       | 0.                            | 4.99E-05                       |
| 10                          | 11               | 1.88E-02                                    | 0.                             | 2.92E-02                      | 2.75E-02                       | 1.85E-02                      | 2.24E-02                       | 1.71E-02                      | 6.84E-05                       | 0.                            | 5.39E-05                       | 1.10E-05                      | 6.84E-05                       | 0.                            | 5.39E-05                       |
| 11                          | 12               | 1.60E-02                                    | 0.                             | 2.34E-02                      | 2.26E-02                       | 1.82E-02                      | 2.23E-02                       | 1.72E-02                      | 6.28E-05                       | 0.                            | 6.20E-05                       | 1.26E-05                      | 6.28E-05                       | 0.                            | 6.20E-05                       |
| 12                          | 13               | 1.67E-02                                    | 0.                             | 1.95E-02                      | 1.81E-02                       | 1.79E-02                      | 2.22E-02                       | 1.71E-02                      | 5.86E-05                       | 0.                            | 7.15E-05                       | 1.46E-05                      | 5.86E-05                       | 0.                            | 7.15E-05                       |
| 13                          | 14               | 1.67E-02                                    | 0.                             | 1.44E-02                      | 1.63E-02                       | 1.75E-02                      | 2.24E-02                       | 1.71E-02                      | 5.78E-05                       | 0.                            | 7.76E-05                       | 1.58E-05                      | 5.78E-05                       | 0.                            | 7.76E-05                       |
| 14                          | 15               | 1.67E-02                                    | 0.                             | 1.18E-02                      | 1.69E-02                       | 1.73E-02                      | 2.29E-02                       | 1.72E-02                      | 5.86E-05                       | 0.                            | 7.93E-05                       | 1.61E-05                      | 5.86E-05                       | 0.                            | 7.93E-05                       |
| 15                          | 16               | 1.67E-02                                    | 0.                             | 9.38E-03                      | 1.64E-02                       | 1.69E-02                      | 2.15E-02                       | 1.69E-02                      | 5.86E-05                       | 0.                            | 7.71E-05                       | 1.57E-05                      | 5.86E-05                       | 0.                            | 7.71E-05                       |
| 16                          | 17               | 1.66E-02                                    | 0.                             | 7.14E-03                      | 1.61E-02                       | 1.69E-02                      | 2.23E-02                       | 1.66E-02                      | 5.67E-05                       | 0.                            | 7.88E-05                       | 1.44E-05                      | 5.67E-05                       | 0.                            | 7.88E-05                       |
| 17                          | 18               | 1.67E-02                                    | 0.                             | 7.61E-03                      | 1.63E-02                       | 1.84E-02                      | 2.22E-02                       | 1.62E-02                      | 5.31E-05                       | 0.                            | 6.20E-05                       | 1.26E-05                      | 5.31E-05                       | 0.                            | 6.20E-05                       |
| 18                          | 19               | 1.66E-02                                    | 0.                             | 9.10E-03                      | 1.64E-02                       | 1.59E-02                      | 2.22E-02                       | 1.58E-02                      | 4.81E-05                       | 0.                            | 5.17E-05                       | 1.05E-05                      | 4.81E-05                       | 0.                            | 5.17E-05                       |
| 19                          | 20               | 1.66E-02                                    | 0.                             | 1.06E-02                      | 1.71E-02                       | 1.57E-02                      | 2.24E-02                       | 1.54E-02                      | 4.17E-05                       | 0.                            | 4.15E-05                       | 8.46E-06                      | 4.17E-05                       | 0.                            | 4.15E-05                       |
| 20                          | 21               | 1.26E-02                                    | 0.                             | 1.76E-02                      | 1.76E-02                       | 1.60E-02                      | 2.28E-02                       | 1.51E-02                      | 3.53E-05                       | 0.                            | 3.31E-05                       | 6.75E-06                      | 3.53E-05                       | 0.                            | 3.31E-05                       |
| 21                          | 22               | 1.75E-02                                    | 0.                             | 1.46E-02                      | 1.84E-02                       | 1.58E-02                      | 2.22E-02                       | 1.48E-02                      | 2.95E-05                       | 0.                            | 2.86E-05                       | 5.39E-06                      | 2.95E-05                       | 0.                            | 2.86E-05                       |
| 22                          | 23               | 1.61E-02                                    | 0.                             | 1.61E-02                      | 1.90E-02                       | 1.58E-02                      | 2.21E-02                       | 1.44E-02                      | 2.45E-05                       | 0.                            | 2.06E-05                       | 4.20E-06                      | 2.45E-05                       | 0.                            | 2.06E-05                       |
| 23                          | 24               | 1.84E-02                                    | 0.                             | 1.73E-02                      | 2.07E-02                       | 1.55E-02                      | 2.29E-02                       | 1.41E-02                      | 1.96E-05                       | 0.                            | 1.59E-05                       | 3.25E-06                      | 1.96E-05                       | 0.                            | 1.59E-05                       |
| 24                          | 25               | 1.88E-02                                    | 0.                             | 1.88E-02                      | 2.09E-02                       | 1.63E-02                      | 2.36E-02                       | 1.38E-02                      | 1.54E-05                       | 0.                            | 1.26E-05                       | 2.56E-06                      | 1.54E-05                       | 0.                            | 1.26E-05                       |
| 25                          | 30               | 2.05E-02                                    | 0.                             | 2.21E-02                      | 2.41E-02                       | 1.56E-02                      | 2.60E-02                       | 1.42E-02                      | 1.11E-05                       | 2.34E-06                      | 2.84E-05                       | 5.98E-06                      | 1.11E-05                       | 2.34E-06                      | 2.84E-05                       |
| 30                          | 35               | 1.68E-02                                    | 0.                             | 2.00E-02                      | 2.20E-02                       | 1.23E-02                      | 3.48E-02                       | 1.05E-02                      | 3.43E-06                       | 0.                            | 6.53E-06                       | 1.37E-06                      | 3.43E-06                       | 0.                            | 6.53E-06                       |
| 35                          | 40               | 1.56E-02                                    | 0.                             | 1.74E-02                      | 1.99E-02                       | 1.12E-02                      | 2.15E-02                       | 8.54E-03                      | 1.69E-06                       | 0.                            | 0.                             | 0.                            | 1.69E-06                       | 0.                            | 0.                             |
| 40                          | 45               | 1.33E-02                                    | 0.                             | 1.33E-02                      | 1.57E-02                       | 9.36E-03                      | 1.74E-02                       | 6.59E-03                      | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 45                          | 50               | 1.25E-02                                    | 0.                             | 1.08E-02                      | 1.08E-02                       | 6.51E-03                      | 1.16E-02                       | 4.70E-03                      | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 50                          | 78               | 1.42E-03                                    | 0.                             | 1.42E-03                      | 1.68E-03                       | 1.26E-03                      | 1.71E-03                       | 1.18E-03                      | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 70                          | 100              | 2.65E-05                                    | 0.                             | 2.74E-05                      | 2.73E-05                       | 2.73E-05                      | 3.17E-05                       | 3.00E-05                      | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|              | CLEAR                         |                                | HAZY                          |                                |
|--------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|              | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN        | *****                         | *****                          | 5.81E-02                      | 3.18E-02                       |
| MARITIME     | 6.83E-03                      | 1.20E-02                       | 5.27E-02                      | 1.31E-01                       |
| TROPOSPHERIC | 2.88E-03                      | 4.01E-04                       | *****                         | *****                          |

|        |     | 9.282440 MICROMETERS<br>FREQUENCY = 1077.303 WAVENUMBER |                               |                               |                               |                               |                               |                               |                                |                               |                                |
|--------|-----|---------------------------------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
| ht(km) |     | U.S.                                                    |                               | MIDLAT                        |                               | MIDLAT                        |                               | SUBARCTIC                     |                                | SUBARCTIC                     |                                |
|        |     | STANDARD                                                | TROPICAL                      | SUMMER                        | WINTER                        | SUMMER                        | WINTER                        | SUMMER                        | WINTER                         | CLEAR                         | HAZY                           |
|        |     | $\beta_m$ (km <sup>-1</sup> )                           | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0      | 1   | 1.44E-01                                                | 4.03E-01                      | 2.85E-01                      | 9.57E-02                      | 1.87E-01                      | 5.81E-02                      | 5.60E-03                      | 3.71E-03                       | 6.10E-02                      | 4.04E-02                       |
| 0      | 2   | 1.29E-01                                                | 3.24E-01                      | 2.32E-01                      | 8.82E-02                      | 1.58E-01                      | 5.91E-02                      | 3.70E-03                      | 2.46E-03                       | 6.10E-02                      | 4.04E-02                       |
| 1      | 2   | 1.04E-01                                                | 2.21E-01                      | 1.60E-01                      | 7.65E-02                      | 1.20E-01                      | 5.76E-02                      | 7.36E-04                      | 1.01E-04                       | 1.17E-02                      | 1.62E-03                       |
| 2      | 3   | 8.44E-02                                                | 1.88E-01                      | 1.14E-01                      | 6.74E-02                      | 9.50E-02                      | 5.22E-02                      | 3.76E-04                      | 5.19E-05                       | 1.98E-03                      | 2.74E-04                       |
| 3      | 4   | 6.99E-02                                                | 1.05E-01                      | 9.50E-02                      | 5.82E-02                      | 7.88E-02                      | 4.61E-02                      | 3.07E-04                      | 4.23E-05                       | 1.08E-03                      | 1.50E-04                       |
| 4      | 5   | 5.82E-02                                                | 8.40E-02                      | 7.62E-02                      | 4.91E-02                      | 6.88E-02                      | 3.89E-02                      | 2.36E-04                      | 3.26E-05                       | 5.84E-04                      | 7.78E-05                       |
| 5      | 6   | 4.87E-02                                                | 7.04E-02                      | 6.51E-02                      | 4.14E-02                      | 5.51E-02                      | 3.10E-02                      | 1.75E-04                      | 2.42E-05                       | 3.58E-04                      | 4.93E-05                       |
| 6      | 7   | 4.05E-02                                                | 5.92E-02                      | 5.65E-02                      | 3.48E-02                      | 4.45E-02                      | 2.57E-02                      | 1.21E-04                      | 1.67E-05                       | 2.93E-04                      | 4.04E-05                       |
| 7      | 8   | 3.36E-02                                                | 4.92E-02                      | 4.70E-02                      | 2.90E-02                      | 3.66E-02                      | 2.05E-02                      | 7.67E-05                      | 1.06E-05                       | 1.96E-04                      | 2.70E-05                       |
| 8      | 9   | 2.75E-02                                                | 4.17E-02                      | 3.90E-02                      | 2.40E-02                      | 2.97E-02                      | 1.73E-02                      | 1.07E-04                      | 0.                             | 6.81E-05                      | 1.40E-05                       |
| 9      | 10  | 2.23E-02                                                | 3.41E-02                      | 3.24E-02                      | 1.96E-02                      | 2.38E-02                      | 1.62E-02                      | 7.99E-05                      | 0.                             | 4.37E-05                      | 1.02E-05                       |
| 10     | 11  | 1.78E-02                                                | 2.80E-02                      | 2.64E-02                      | 1.75E-02                      | 2.13E-02                      | 1.62E-02                      | 6.81E-05                      | 0.                             | 5.37E-05                      | 1.10E-05                       |
| 11     | 12  | 1.59E-02                                                | 2.32E-02                      | 2.15E-02                      | 1.72E-02                      | 2.12E-02                      | 1.63E-02                      | 6.25E-05                      | 0.                             | 6.19E-05                      | 1.27E-05                       |
| 12     | 13  | 1.58E-02                                                | 1.85E-02                      | 1.72E-02                      | 1.69E-02                      | 2.12E-02                      | 1.62E-02                      | 5.83E-05                      | 0.                             | 7.12E-05                      | 1.46E-05                       |
| 13     | 14  | 1.58E-02                                                | 1.76E-02                      | 1.64E-02                      | 1.65E-02                      | 2.13E-02                      | 1.62E-02                      | 5.75E-05                      | 0.                             | 7.33E-05                      | 1.59E-05                       |
| 14     | 15  | 1.58E-02                                                | 1.66E-02                      | 1.54E-02                      | 1.63E-02                      | 2.13E-02                      | 1.63E-02                      | 5.83E-05                      | 0.                             | 7.30E-05                      | 1.62E-05                       |
| 15     | 16  | 1.58E-02                                                | 1.57E-02                      | 1.55E-02                      | 1.60E-02                      | 2.05E-02                      | 1.60E-02                      | 5.83E-05                      | 0.                             | 7.69E-05                      | 1.58E-05                       |
| 16     | 17  | 1.57E-02                                                | 1.48E-02                      | 1.52E-02                      | 1.56E-02                      | 2.13E-02                      | 1.57E-02                      | 5.64E-05                      | 0.                             | 7.06E-05                      | 1.45E-05                       |
| 17     | 18  | 1.58E-02                                                | 1.39E-02                      | 1.54E-02                      | 1.55E-02                      | 2.11E-02                      | 1.53E-02                      | 5.28E-05                      | 0.                             | 6.18E-05                      | 1.27E-05                       |
| 18     | 19  | 1.57E-02                                                | 1.30E-02                      | 1.56E-02                      | 1.51E-02                      | 2.12E-02                      | 1.50E-02                      | 4.78E-05                      | 0.                             | 5.16E-05                      | 1.06E-05                       |
| 19     | 20  | 1.57E-02                                                | 1.22E-02                      | 1.62E-02                      | 1.48E-02                      | 2.13E-02                      | 1.46E-02                      | 4.15E-05                      | 0.                             | 4.14E-05                      | 0.49E-06                       |
| 20     | 21  | 1.60E-02                                                | 1.18E-02                      | 1.67E-02                      | 1.51E-02                      | 2.10E-02                      | 1.42E-02                      | 3.51E-05                      | 0.                             | 3.30E-05                      | 6.78E-06                       |
| 21     | 22  | 1.66E-02                                                | 1.38E-02                      | 1.74E-02                      | 1.50E-02                      | 2.11E-02                      | 1.39E-02                      | 2.93E-05                      | 0.                             | 2.84E-05                      | 5.41E-06                       |
| 22     | 23  | 1.72E-02                                                | 1.62E-02                      | 1.83E-02                      | 1.49E-02                      | 2.11E-02                      | 1.36E-02                      | 2.43E-05                      | 0.                             | 2.05E-05                      | 4.21E-06                       |
| 23     | 24  | 1.78E-02                                                | 1.84E-02                      | 1.97E-02                      | 1.47E-02                      | 2.14E-02                      | 1.33E-02                      | 1.95E-05                      | 0.                             | 1.59E-05                      | 3.26E-06                       |
| 24     | 25  | 1.85E-02                                                | 1.78E-02                      | 1.99E-02                      | 1.54E-02                      | 2.25E-02                      | 1.30E-02                      | 1.54E-05                      | 0.                             | 1.25E-05                      | 2.57E-06                       |
| 25     | 30  | 1.95E-02                                                | 2.31E-02                      | 2.31E-02                      | 1.43E-02                      | 2.49E-02                      | 1.34E-02                      | 1.10E-05                      | 2.33E-06                       | 2.82E-05                      | 5.96E-06                       |
| 30     | 35  | 1.60E-02                                                | 2.11E-02                      | 2.11E-02                      | 1.16E-02                      | 3.35E-02                      | 9.86E-03                      | 3.40E-06                      | 0.                             | 6.89E-06                      | 1.37E-06                       |
| 35     | 40  | 1.49E-02                                                | 1.67E-02                      | 1.91E-02                      | 1.06E-02                      | 2.09E-02                      | 8.07E-03                      | 1.67E-06                      | 0.                             | 2.10E-06                      | 0.                             |
| 40     | 45  | 1.20E-02                                                | 1.24E-02                      | 1.52E-02                      | 8.97E-03                      | 1.69E-02                      | 6.27E-03                      | 0.                            | 0.                             | 0.                            | 0.                             |
| 45     | 50  | 8.01E-03                                                | 1.05E-02                      | 1.05E-02                      | 1.12E-02                      | 4.50E-03                      | 0.                            | 0.                            | 0.                             | 0.                            | 0.                             |
| 50     | 70  | 1.28E-03                                                | 1.60E-03                      | 1.60E-03                      | 1.63E-03                      | 1.13E-03                      | 0.                            | 0.                            | 0.                             | 0.                            | 0.                             |
| 70     | 100 | 2.47E-05                                                | 2.91E-05                      | 2.91E-05                      | 2.95E-05                      | 2.95E-05                      | 2.82E-05                      | 0.                            | 0.                             | 0.                            | 0.                             |

ALTERNATE SOUNDING LAYER AEROSOL MODELS

|    |     | U.S.                          |                               | MIDLAT                        |                               | MIDLAT                        |                               | SUBARCTIC                     |                                | SUBARCTIC                     |                                |
|----|-----|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|    |     | STANDARD                      | TROPICAL                      | SUMMER                        | WINTER                        | SUMMER                        | WINTER                        | SUMMER                        | WINTER                         | CLEAR                         | HAZY                           |
|    |     | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0  | 1   | 1.44E-01                      | 4.03E-01                      | 2.85E-01                      | 9.57E-02                      | 1.87E-01                      | 5.81E-02                      | 5.60E-03                      | 3.71E-03                       | 6.10E-02                      | 4.04E-02                       |
| 0  | 2   | 1.29E-01                      | 3.24E-01                      | 2.32E-01                      | 8.82E-02                      | 1.58E-01                      | 5.91E-02                      | 3.70E-03                      | 2.46E-03                       | 6.10E-02                      | 4.04E-02                       |
| 1  | 2   | 1.04E-01                      | 2.21E-01                      | 1.60E-01                      | 7.65E-02                      | 1.20E-01                      | 5.76E-02                      | 7.36E-04                      | 1.01E-04                       | 1.17E-02                      | 1.62E-03                       |
| 2  | 3   | 8.44E-02                      | 1.88E-01                      | 1.14E-01                      | 6.74E-02                      | 9.50E-02                      | 5.22E-02                      | 3.76E-04                      | 5.19E-05                       | 1.98E-03                      | 2.74E-04                       |
| 3  | 4   | 6.99E-02                      | 1.05E-01                      | 9.50E-02                      | 5.82E-02                      | 7.88E-02                      | 4.61E-02                      | 3.07E-04                      | 4.23E-05                       | 1.08E-03                      | 1.50E-04                       |
| 4  | 5   | 5.82E-02                      | 8.40E-02                      | 7.62E-02                      | 4.91E-02                      | 6.88E-02                      | 3.89E-02                      | 2.36E-04                      | 3.26E-05                       | 5.84E-04                      | 7.78E-05                       |
| 5  | 6   | 4.87E-02                      | 7.04E-02                      | 6.51E-02                      | 4.14E-02                      | 5.51E-02                      | 3.10E-02                      | 1.75E-04                      | 2.42E-05                       | 3.58E-04                      | 4.93E-05                       |
| 6  | 7   | 4.05E-02                      | 5.92E-02                      | 5.65E-02                      | 3.48E-02                      | 4.45E-02                      | 2.57E-02                      | 1.21E-04                      | 1.67E-05                       | 2.93E-04                      | 4.04E-05                       |
| 7  | 8   | 3.36E-02                      | 4.92E-02                      | 4.70E-02                      | 2.90E-02                      | 3.66E-02                      | 2.05E-02                      | 7.67E-05                      | 1.06E-05                       | 1.96E-04                      | 2.70E-05                       |
| 8  | 9   | 2.75E-02                      | 4.17E-02                      | 3.90E-02                      | 2.40E-02                      | 2.97E-02                      | 1.73E-02                      | 1.07E-04                      | 0.                             | 6.81E-05                      | 1.40E-05                       |
| 9  | 10  | 2.23E-02                      | 3.41E-02                      | 3.24E-02                      | 1.96E-02                      | 2.38E-02                      | 1.62E-02                      | 7.99E-05                      | 0.                             | 4.37E-05                      | 1.02E-05                       |
| 10 | 11  | 1.78E-02                      | 2.80E-02                      | 2.64E-02                      | 1.75E-02                      | 2.13E-02                      | 1.62E-02                      | 6.81E-05                      | 0.                             | 5.37E-05                      | 1.10E-05                       |
| 11 | 12  | 1.59E-02                      | 2.32E-02                      | 2.15E-02                      | 1.72E-02                      | 2.12E-02                      | 1.63E-02                      | 6.25E-05                      | 0.                             | 6.19E-05                      | 1.27E-05                       |
| 12 | 13  | 1.58E-02                      | 1.85E-02                      | 1.72E-02                      | 1.69E-02                      | 2.12E-02                      | 1.62E-02                      | 5.83E-05                      | 0.                             | 7.12E-05                      | 1.46E-05                       |
| 13 | 14  | 1.58E-02                      | 1.76E-02                      | 1.64E-02                      | 1.65E-02                      | 2.13E-02                      | 1.62E-02                      | 5.75E-05                      | 0.                             | 7.33E-05                      | 1.59E-05                       |
| 14 | 15  | 1.58E-02                      | 1.66E-02                      | 1.54E-02                      | 1.63E-02                      | 2.13E-02                      | 1.63E-02                      | 5.83E-05                      | 0.                             | 7.30E-05                      | 1.62E-05                       |
| 15 | 16  | 1.58E-02                      | 1.57E-02                      | 1.55E-02                      | 1.60E-02                      | 2.05E-02                      | 1.60E-02                      | 5.83E-05                      | 0.                             | 7.69E-05                      | 1.58E-05                       |
| 16 | 17  | 1.57E-02                      | 1.48E-02                      | 1.52E-02                      | 1.56E-02                      | 2.13E-02                      | 1.57E-02                      | 5.64E-05                      | 0.                             | 7.06E-05                      | 1.45E-05                       |
| 17 | 18  | 1.58E-02                      | 1.39E-02                      | 1.54E-02                      | 1.55E-02                      | 2.11E-02                      | 1.53E-02                      | 5.28E-05                      | 0.                             | 6.18E-05                      | 1.27E-05                       |
| 18 | 19  | 1.57E-02                      | 1.30E-02                      | 1.56E-02                      | 1.51E-02                      | 2.12E-02                      | 1.50E-02                      | 4.78E-05                      | 0.                             | 5.16E-05                      | 1.06E-05                       |
| 19 | 20  | 1.57E-02                      | 1.22E-02                      | 1.62E-02                      | 1.48E-02                      | 2.13E-02                      | 1.46E-02                      | 4.15E-05                      | 0.                             | 4.14E-05                      | 0.49E-06                       |
| 20 | 21  | 1.60E-02                      | 1.18E-02                      | 1.67E-02                      | 1.51E-02                      | 2.10E-02                      | 1.42E-02                      | 3.51E-05                      | 0.                             | 3.30E-05                      | 6.78E-06                       |
| 21 | 22  | 1.66E-02                      | 1.38E-02                      | 1.74E-02                      | 1.50E-02                      | 2.11E-02                      | 1.39E-02                      | 2.93E-05                      | 0.                             | 2.84E-05                      | 5.41E-06                       |
| 22 | 23  | 1.72E-02                      | 1.62E-02                      | 1.83E-02                      | 1.49E-02                      | 2.11E-02                      | 1.36E-02                      | 2.43E-05                      | 0.                             | 2.05E-05                      | 4.21E-06                       |
| 23 | 24  | 1.78E-02                      | 1.84E-02                      | 1.97E-02                      | 1.47E-02                      | 2.14E-02                      | 1.33E-02                      | 1.95E-05                      | 0.                             | 1.59E-05                      | 3.26E-06                       |
| 24 | 25  | 1.85E-02                      | 1.78E-02                      | 1.99E-02                      | 1.54E-02                      | 2.25E-02                      | 1.30E-02                      | 1.54E-05                      | 0.                             | 1.25E-05                      | 2.57E-06                       |
| 25 | 30  | 1.95E-02                      | 2.31E-02                      | 2.31E-02                      | 1.43E-02                      | 2.49E-02                      | 1.34E-02                      | 1.10E-05                      | 2.33E-06                       | 2.82E-05                      | 5.96E-06                       |
| 30 | 35  | 1.60E-02                      | 2.11E-02                      | 2.11E-02                      | 1.16E-02                      | 3.35E-02                      | 9.86E-03                      | 3.40E-06                      | 0.                             | 6.89E-06                      | 1.37E-06                       |
| 35 | 40  | 1.49E-02                      | 1.67E-02                      | 1.91E-02                      | 1.06E-02                      | 2.09E-02                      | 8.07E-03                      | 1.67E-06                      | 0.                             | 2.10E-06                      | 0.                             |
| 40 | 45  | 1.20E-02                      | 1.24E-02                      | 1.52E-02                      | 8.97E-03                      | 1.69E-02                      | 6.27E-03                      | 0.                            | 0.                             | 0.                            | 0.                             |
| 45 | 50  | 8.01E-03                      | 1.05E-02                      | 1.05E-02                      | 1.12E-02                      | 4.50E-03                      | 0.                            | 0.                            | 0.                             | 0.                            | 0.                             |
| 50 | 70  | 1.28E-03                      | 1.60E-03                      | 1.60E-03                      | 1.63E-03                      | 1.13E-03                      | 0.                            | 0.                            | 0.                             | 0.                            | 0.                             |
| 70 | 100 | 2.47E-05                      | 2.91E-05                      | 2.91E-05                      | 2.95E-05                      | 2.95E-05                      | 2.82E-05                      | 0.                            | 0.                             | 0.                            | 0.                             |

URBAN

\*\*\*\*\* 5.95E-02 3.10E-02

HARITIME

4.85E-03 1.21E-02 5.29E-02 1.31E-01

TROPOSPHERIC 2.93E-03 4.04E-04 \*\*\*\*\*

WAVELENGTH = 9.271355 MICROMETERS  
FREQUENCY = 1070.591 HAVENUMBER

| ht(km) | U.S. STANDARD                 |                                | TROPICAL                      |                                | MIDLAT SUMMER                 |                                | MIDLAT WINTER                 |                                | SUBARCTIC SUMMER              |                                | SUBARCTIC WINTER              |                                | CLEAR                         |                                | AEROSOL                       |                                | HAZY                          |                                |
|--------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|        | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0      | 1.39E-01                      | 0.                             | 9.00E-01                      | 2.51E-01                       | 9.16E-02                      | 1.83E-01                       | 9.16E-02                      | 1.83E-01                       | 1.83E-01                      | 1.83E-01                       | 5.46E-02                      | 5.46E-02                       | 5.66E-03                      | 3.71E-03                       | 5.66E-03                      | 3.71E-03                       | 6.16E-02                      | 4.04E-02                       |
| 1      | 1.28E-01                      | 0.                             | 3.20E-01                      | 2.28E-01                       | 8.41E-02                      | 1.59E-01                       | 8.41E-02                      | 1.59E-01                       | 1.59E-01                      | 1.59E-01                       | 5.55E-02                      | 5.55E-02                       | 3.75E-03                      | 2.45E-03                       | 3.75E-03                      | 2.45E-03                       | 6.16E-02                      | 4.04E-02                       |
| 2      | 9.97E-02                      | 0.                             | 2.17E-01                      | 1.56E-01                       | 7.25E-02                      | 1.19E-01                       | 7.25E-02                      | 1.19E-01                       | 1.19E-01                      | 1.19E-01                       | 5.41E-02                      | 5.41E-02                       | 7.50E-04                      | 1.02E-04                       | 1.19E-02                      | 1.63E-03                       | 1.19E-02                      | 1.63E-03                       |
| 3      | 8.06E-02                      | 0.                             | 1.44E-01                      | 1.14E-01                       | 6.36E-02                      | 9.09E-02                       | 6.36E-02                      | 9.09E-02                       | 9.09E-02                      | 9.09E-02                       | 4.89E-02                      | 4.89E-02                       | 3.83E-04                      | 5.24E-05                       | 2.02E-03                      | 2.76E-04                       | 2.02E-03                      | 2.76E-04                       |
| 4      | 6.69E-02                      | 0.                             | 1.05E-01                      | 8.77E-02                       | 5.46E-02                      | 7.47E-02                       | 5.46E-02                      | 7.47E-02                       | 7.47E-02                      | 7.47E-02                       | 4.39E-02                      | 4.39E-02                       | 3.13E-04                      | 4.27E-05                       | 1.11E-03                      | 1.51E-04                       | 1.11E-03                      | 1.51E-04                       |
| 5      | 5.46E-02                      | 0.                             | 7.97E-02                      | 7.21E-02                       | 4.59E-02                      | 6.23E-02                       | 4.59E-02                      | 6.23E-02                       | 6.23E-02                      | 6.23E-02                       | 3.61E-02                      | 3.61E-02                       | 2.41E-04                      | 3.29E-05                       | 5.75E-04                      | 7.85E-05                       | 5.75E-04                      | 7.85E-05                       |
| 6      | 4.54E-02                      | 0.                             | 6.58E-02                      | 6.13E-02                       | 3.86E-02                      | 5.16E-02                       | 3.86E-02                      | 5.16E-02                       | 5.16E-02                      | 5.16E-02                       | 2.93E-02                      | 2.93E-02                       | 1.79E-04                      | 2.44E-05                       | 3.64E-04                      | 4.98E-05                       | 3.64E-04                      | 4.98E-05                       |
| 7      | 3.77E-02                      | 0.                             | 5.56E-02                      | 5.39E-02                       | 3.23E-02                      | 4.16E-02                       | 3.23E-02                      | 4.16E-02                       | 4.16E-02                      | 4.16E-02                       | 2.36E-02                      | 2.36E-02                       | 1.24E-04                      | 1.69E-05                       | 2.99E-04                      | 4.07E-05                       | 2.99E-04                      | 4.07E-05                       |
| 8      | 3.11E-02                      | 0.                             | 4.60E-02                      | 4.39E-02                       | 2.69E-02                      | 3.40E-02                       | 2.69E-02                      | 3.40E-02                       | 3.40E-02                      | 3.40E-02                       | 1.89E-02                      | 1.89E-02                       | 7.82E-05                      | 1.07E-05                       | 2.00E-04                      | 2.73E-05                       | 7.82E-05                      | 1.07E-05                       |
| 9      | 2.54E-02                      | 0.                             | 3.80E-02                      | 3.64E-02                       | 2.23E-02                      | 2.79E-02                       | 2.23E-02                      | 2.79E-02                       | 2.79E-02                      | 2.79E-02                       | 1.61E-02                      | 1.61E-02                       | 1.07E-04                      | 0.                             | 6.79E-05                      | 1.40E-05                       | 6.79E-05                      | 1.40E-05                       |
| 10     | 2.08E-02                      | 0.                             | 3.15E-02                      | 3.02E-02                       | 1.84E-02                      | 2.23E-02                       | 1.84E-02                      | 2.23E-02                       | 2.23E-02                      | 2.23E-02                       | 1.55E-02                      | 1.55E-02                       | 7.95E-05                      | 0.                             | 4.96E-05                      | 1.02E-05                       | 4.96E-05                      | 1.02E-05                       |
| 11     | 1.67E-02                      | 0.                             | 2.59E-02                      | 2.46E-02                       | 1.57E-02                      | 2.01E-02                       | 1.57E-02                      | 2.01E-02                       | 2.01E-02                      | 2.01E-02                       | 1.60E-02                      | 1.60E-02                       | 6.77E-05                      | 0.                             | 5.36E-05                      | 1.11E-05                       | 5.36E-05                      | 1.11E-05                       |
| 12     | 1.51E-02                      | 0.                             | 2.06E-02                      | 2.02E-02                       | 1.68E-02                      | 2.06E-02                       | 1.68E-02                      | 2.06E-02                       | 2.06E-02                      | 2.06E-02                       | 1.59E-02                      | 1.59E-02                       | 6.21E-05                      | 0.                             | 6.17E-05                      | 1.27E-05                       | 6.17E-05                      | 1.27E-05                       |
| 13     | 1.52E-02                      | 0.                             | 1.70E-02                      | 1.63E-02                       | 1.70E-02                      | 2.06E-02                       | 1.70E-02                      | 2.06E-02                       | 2.06E-02                      | 2.06E-02                       | 1.59E-02                      | 1.59E-02                       | 5.80E-05                      | 0.                             | 7.10E-05                      | 1.47E-05                       | 7.10E-05                      | 1.47E-05                       |
| 14     | 1.54E-02                      | 0.                             | 1.25E-02                      | 1.49E-02                       | 1.71E-02                      | 2.12E-02                       | 1.71E-02                      | 2.12E-02                       | 2.12E-02                      | 2.12E-02                       | 1.81E-02                      | 1.81E-02                       | 5.72E-05                      | 0.                             | 7.71E-05                      | 1.59E-05                       | 7.71E-05                      | 1.59E-05                       |
| 15     | 1.57E-02                      | 0.                             | 1.62E-02                      | 1.57E-02                       | 1.73E-02                      | 2.21E-02                       | 1.73E-02                      | 2.21E-02                       | 2.21E-02                      | 2.21E-02                       | 1.95E-02                      | 1.95E-02                       | 5.82E-05                      | 0.                             | 7.47E-05                      | 1.53E-05                       | 7.47E-05                      | 1.53E-05                       |
| 16     | 1.61E-02                      | 0.                             | 7.88E-03                      | 1.56E-02                       | 1.74E-02                      | 2.14E-02                       | 1.74E-02                      | 2.14E-02                       | 2.14E-02                      | 2.14E-02                       | 1.95E-02                      | 1.95E-02                       | 5.80E-05                      | 0.                             | 7.67E-05                      | 1.58E-05                       | 7.67E-05                      | 1.58E-05                       |
| 17     | 1.66E-02                      | 0.                             | 6.39E-03                      | 1.57E-02                       | 1.76E-02                      | 2.27E-02                       | 1.76E-02                      | 2.27E-02                       | 2.27E-02                      | 2.27E-02                       | 2.00E-02                      | 2.00E-02                       | 5.51E-05                      | 0.                             | 7.04E-05                      | 1.45E-05                       | 7.04E-05                      | 1.45E-05                       |
| 18     | 1.71E-02                      | 0.                             | 6.97E-03                      | 1.63E-02                       | 1.79E-02                      | 2.32E-02                       | 1.79E-02                      | 2.32E-02                       | 2.32E-02                      | 2.32E-02                       | 2.00E-02                      | 2.00E-02                       | 5.25E-05                      | 0.                             | 6.17E-05                      | 1.27E-05                       | 6.17E-05                      | 1.27E-05                       |
| 19     | 1.77E-02                      | 0.                             | 8.64E-03                      | 1.71E-02                       | 1.79E-02                      | 2.35E-02                       | 1.79E-02                      | 2.35E-02                       | 2.35E-02                      | 2.35E-02                       | 1.98E-02                      | 1.98E-02                       | 4.76E-05                      | 0.                             | 5.14E-05                      | 1.06E-05                       | 5.14E-05                      | 1.06E-05                       |
| 20     | 1.80E-02                      | 0.                             | 1.05E-02                      | 1.81E-02                       | 1.80E-02                      | 2.37E-02                       | 1.80E-02                      | 2.37E-02                       | 2.37E-02                      | 2.37E-02                       | 1.92E-02                      | 1.92E-02                       | 4.12E-05                      | 0.                             | 4.13E-05                      | 8.52E-06                       | 4.13E-05                      | 8.52E-06                       |
| 21     | 1.89E-02                      | 0.                             | 1.28E-02                      | 1.86E-02                       | 1.82E-02                      | 2.31E-02                       | 1.82E-02                      | 2.31E-02                       | 2.31E-02                      | 2.31E-02                       | 1.84E-02                      | 1.84E-02                       | 3.40E-05                      | 0.                             | 3.29E-05                      | 6.80E-06                       | 3.29E-05                      | 6.80E-06                       |
| 22     | 1.94E-02                      | 0.                             | 1.51E-02                      | 1.96E-02                       | 1.79E-02                      | 2.28E-02                       | 1.79E-02                      | 2.28E-02                       | 2.28E-02                      | 2.28E-02                       | 1.74E-02                      | 1.74E-02                       | 2.92E-05                      | 0.                             | 2.63E-05                      | 5.83E-06                       | 2.63E-05                      | 5.83E-06                       |
| 23     | 1.93E-02                      | 0.                             | 1.67E-02                      | 1.99E-02                       | 1.74E-02                      | 2.23E-02                       | 1.74E-02                      | 2.23E-02                       | 2.23E-02                      | 2.23E-02                       | 1.64E-02                      | 1.64E-02                       | 2.42E-05                      | 0.                             | 2.05E-05                      | 4.23E-06                       | 2.05E-05                      | 4.23E-06                       |
| 24     | 1.95E-02                      | 0.                             | 1.79E-02                      | 2.11E-02                       | 1.66E-02                      | 2.23E-02                       | 1.66E-02                      | 2.23E-02                       | 2.23E-02                      | 2.23E-02                       | 1.63E-02                      | 1.63E-02                       | 1.94E-05                      | 0.                             | 1.58E-05                      | 3.27E-06                       | 1.58E-05                      | 3.27E-06                       |
| 25     | 1.97E-02                      | 0.                             | 2.11E-02                      | 2.06E-02                       | 1.68E-02                      | 2.23E-02                       | 1.68E-02                      | 2.23E-02                       | 2.23E-02                      | 2.23E-02                       | 1.63E-02                      | 1.63E-02                       | 1.53E-05                      | 0.                             | 1.25E-05                      | 2.58E-06                       | 1.25E-05                      | 2.58E-06                       |
| 30     | 1.94E-02                      | 0.                             | 1.81E-02                      | 2.28E-02                       | 1.49E-02                      | 2.41E-02                       | 1.49E-02                      | 2.41E-02                       | 2.41E-02                      | 2.41E-02                       | 1.38E-02                      | 1.38E-02                       | 1.09E-05                      | 2.33E-06                       | 2.83E-05                      | 5.95E-06                       | 2.83E-05                      | 5.95E-06                       |
| 35     | 1.51E-02                      | 0.                             | 1.61E-02                      | 1.99E-02                       | 1.10E-02                      | 3.14E-02                       | 1.10E-02                      | 3.14E-02                       | 3.14E-02                      | 3.14E-02                       | 9.27E-03                      | 9.27E-03                       | 3.33E-06                      | 0.                             | 6.41E-06                      | 1.37E-06                       | 3.33E-06                      | 1.37E-06                       |
| 40     | 1.33E-02                      | 0.                             | 1.20E-02                      | 1.49E-02                       | 8.34E-03                      | 1.59E-02                       | 8.34E-03                      | 1.59E-02                       | 1.59E-02                      | 1.59E-02                       | 5.79E-03                      | 5.79E-03                       | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 45     | 7.53E-03                      | 0.                             | 7.96E-03                      | 2.46E-03                       | 5.87E-03                      | 1.86E-02                       | 5.87E-03                      | 1.86E-02                       | 1.86E-02                      | 1.86E-02                       | 4.19E-03                      | 4.19E-03                       | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 50     | 1.13E-03                      | 0.                             | 1.25E-03                      | 1.48E-03                       | 1.11E-03                      | 1.51E-03                       | 1.11E-03                      | 1.51E-03                       | 1.51E-03                      | 1.51E-03                       | 1.05E-03                      | 1.05E-03                       | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 60     | 2.22E-05                      | 0.                             | 2.30E-05                      | 2.62E-05                       | 2.31E-05                      | 2.64E-05                       | 2.31E-05                      | 2.64E-05                       | 2.64E-05                      | 2.64E-05                       | 2.57E-05                      | 2.57E-05                       | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|              | CLEAR                         |                                | HAZY                          |                                |
|--------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|              | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN        | *****                         | *****                          | 5.89E-02                      | 3.18E-02                       |
| MARITIME     | 4.88E-03                      | 1.25E-02                       | 5.31E-02                      | 1.32E-01                       |
| TROPOSPHERIC | 2.99E-03                      | 4.03E-04                       | *****                         | *****                          |

[illegible]

|        | U.S.<br>STANDARD             | TROPICAL                     | MIDLAT<br>SUMMER             | MIDLAT<br>WINTER             | SUBARCTIC<br>SUMMER          | SUBARCTIC<br>WINTER          | AEROSOL                      | HAZY                           |
|--------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------------------------|
| ht(km) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0      | 2.44E-01                     | 4.65E-01                     | 3.63E-01                     | 2.80E-01                     | 2.79E-01                     | 1.70E-01                     | 1.46E-03                     | 1.59E-02                       |
| 1      | 2.66E-01                     | 3.81E-01                     | 3.13E-01                     | 1.92E-01                     | 2.50E-01                     | 1.70E-01                     | 1.68E-04                     | 1.59E-02                       |
| 2      | 1.99E-01                     | 2.91E-01                     | 2.45E-01                     | 1.80E-01                     | 2.12E-01                     | 1.67E-01                     | 1.14E-04                     | 1.82E-03                       |
| 3      | 1.72E-01                     | 2.07E-01                     | 2.24E-01                     | 1.71E-01                     | 1.90E-01                     | 1.63E-01                     | 5.83E-05                     | 3.07E-04                       |
| 4      | 1.81E-01                     | 1.45E-01                     | 1.64E-01                     | 1.67E-01                     | 1.77E-01                     | 1.58E-01                     | 4.75E-05                     | 1.68E-04                       |
| 5      | 1.63E-01                     | 1.75E-01                     | 1.71E-01                     | 1.58E-01                     | 1.67E-01                     | 1.53E-01                     | 3.66E-05                     | 8.74E-05                       |
| 6      | 1.57E-01                     | 1.67E-01                     | 1.64E-01                     | 1.54E-01                     | 1.62E-01                     | 1.48E-01                     | 2.72E-05                     | 5.54E-05                       |
| 7      | 1.52E-01                     | 1.60E-01                     | 1.62E-01                     | 1.49E-01                     | 1.54E-01                     | 1.43E-01                     | 1.88E-05                     | 4.53E-05                       |
| 8      | 1.48E-01                     | 1.55E-01                     | 1.59E-01                     | 1.45E-01                     | 1.50E-01                     | 1.38E-01                     | 1.19E-05                     | 3.80E-05                       |
| 9      | 1.46E-01                     | 1.50E-01                     | 1.48E-01                     | 1.41E-01                     | 1.44E-01                     | 1.35E-01                     | 5.06E-05                     | 8.24E-05                       |
| 10     | 1.39E-01                     | 1.46E-01                     | 1.43E-01                     | 1.37E-01                     | 1.41E-01                     | 1.34E-01                     | 3.27E-05                     | 6.02E-05                       |
| 11     | 1.35E-01                     | 1.44E-01                     | 1.41E-01                     | 1.35E-01                     | 1.39E-01                     | 1.34E-01                     | 3.21E-05                     | 6.50E-05                       |
| 12     | 1.32E-01                     | 1.37E-01                     | 1.34E-01                     | 1.35E-01                     | 1.38E-01                     | 1.34E-01                     | 2.99E-05                     | 7.49E-05                       |
| 13     | 1.32E-01                     | 1.37E-01                     | 1.34E-01                     | 1.34E-01                     | 1.38E-01                     | 1.34E-01                     | 2.79E-05                     | 8.62E-05                       |
| 14     | 1.32E-01                     | 1.28E-01                     | 1.31E-01                     | 1.33E-01                     | 1.39E-01                     | 1.34E-01                     | 2.71E-05                     | 9.35E-06                       |
| 15     | 1.32E-01                     | 1.28E-01                     | 1.31E-01                     | 1.33E-01                     | 1.42E-01                     | 1.34E-01                     | 2.76E-05                     | 9.55E-06                       |
| 16     | 1.32E-01                     | 1.21E-01                     | 1.32E-01                     | 1.32E-01                     | 1.33E-01                     | 1.34E-01                     | 2.79E-05                     | 9.30E-06                       |
| 17     | 1.31E-01                     | 1.13E-01                     | 1.30E-01                     | 1.31E-01                     | 1.38E-01                     | 1.32E-01                     | 2.66E-05                     | 8.54E-06                       |
| 18     | 1.31E-01                     | 1.12E-01                     | 1.31E-01                     | 1.32E-01                     | 1.37E-01                     | 1.32E-01                     | 2.66E-05                     | 7.49E-06                       |
| 19     | 1.31E-01                     | 1.12E-01                     | 1.30E-01                     | 1.30E-01                     | 1.37E-01                     | 1.31E-01                     | 2.26E-05                     | 6.24E-06                       |
| 20     | 1.31E-01                     | 1.21E-01                     | 1.31E-01                     | 1.69E-01                     | 1.37E-01                     | 1.30E-01                     | 1.98E-05                     | 5.04E-06                       |
| 21     | 1.31E-01                     | 1.26E-01                     | 1.31E-01                     | 1.26E-01                     | 1.36E-01                     | 1.29E-01                     | 1.66E-05                     | 4.30E-06                       |
| 22     | 1.32E-01                     | 1.32E-01                     | 1.31E-01                     | 1.30E-01                     | 1.37E-01                     | 1.29E-01                     | 1.36E-05                     | 3.19E-06                       |
| 23     | 1.32E-01                     | 1.29E-01                     | 1.31E-01                     | 1.30E-01                     | 1.36E-01                     | 1.24E-01                     | 1.15E-05                     | 2.44E-06                       |
| 24     | 1.33E-01                     | 1.30E-01                     | 1.37E-01                     | 1.28E-01                     | 1.36E-01                     | 1.28E-01                     | 9.21E-06                     | 1.92E-06                       |
| 25     | 1.34E-01                     | 1.33E-01                     | 1.34E-01                     | 1.33E-01                     | 1.37E-01                     | 1.27E-01                     | 7.29E-06                     | 1.51E-06                       |
| 30     | 1.29E-01                     | 1.31E-01                     | 1.33E-01                     | 1.24E-01                     | 1.34E-01                     | 1.22E-01                     | 1.09E-05                     | 2.79E-05                       |
| 35     | 1.34E-02                     | 4.43E-02                     | 4.73E-02                     | 4.80E-02                     | 1.44E-01                     | 1.37E-02                     | 3.36E-06                     | 6.44E-06                       |
| 40     | 2.40E-02                     | 2.48E-02                     | 2.68E-02                     | 2.15E-02                     | 2.72E-02                     | 1.95E-02                     | 1.65E-06                     | 2.00E-06                       |
| 45     | 1.24E-02                     | 1.46E-02                     | 1.66E-02                     | 1.42E-02                     | 1.69E-02                     | 9.90E-03                     | 0.                           | 0.                             |
| 50     | 6.74E-03                     | 7.14E-03                     | 7.93E-03                     | 5.05E-03                     | 8.11E-03                     | 5.09E-03                     | 0.                           | 0.                             |
| 60     | 1.72E-03                     | 2.05E-03                     | 2.25E-03                     | 2.12E-03                     | 2.12E-03                     | 1.27E-03                     | 0.                           | 0.                             |
| 70     | 7.44E-05                     | 7.84E-05                     | 9.03E-05                     | 6.51E-05                     | 9.43E-05                     | 5.30E-05                     | 0.                           | 0.                             |
| 100    | 7.44E-05                     |                              |                              |                              |                              |                              |                              |                                |

## ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|             | CLEAR                         | HAZY                          |
|-------------|-------------------------------|-------------------------------|
|             | $\mathcal{L}(\text{km}^{-1})$ | $\mathcal{L}(\text{km}^{-1})$ |
|             | $\sigma_2(\text{km}^{-1})$    | $\sigma_2(\text{km}^{-1})$    |
| URBAN       | *****                         | 5.36E-02                      |
| WINTER      | 2.70E-03                      | 2.94E-02                      |
| ATMOSPHERIC | 4.54E-04                      | 6.74E-04                      |
| TOTAL       | *****                         | *****                         |

| WAVELENGTH =<br>FREQUENCY = |  | 4.863704 MICROMETERS<br>2056.046 WAVENUMBER |  |                                 |  |                                 |  |                                 |  |                                 |  |
|-----------------------------|--|---------------------------------------------|--|---------------------------------|--|---------------------------------|--|---------------------------------|--|---------------------------------|--|
|                             |  | MIDLAT<br>SUMMER                            |  | MIDLAT<br>WINTER                |  | SUBARCTIC<br>SUMMER             |  | SUBARCTIC<br>WINTER             |  | AEROSOL                         |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
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|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_m$ (km <sup>-1</sup> ) |  | $\lambda_a$ (km <sup>-1</sup> ) |  |
|                             |  | $\lambda_m$ (km <sup>-1</sup> )             |  | $\lambda_m$ (km <sup>-1</sup> ) |  |                                 |  |                                 |  |                                 |  |

| 4.925727 MICROMETERS<br>2030.157 WAVENUMBER |                               |                                |                               |                                |                               |                                |                               |                                |          |
|---------------------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|----------|
| WAVELENGTH =<br>FREQUENCY =                 |                               |                                |                               |                                |                               |                                |                               |                                |          |
| ht(km)                                      | U.S. STANDARD                 |                                | TROPICAL                      |                                | MIDLAT                        |                                | MIDLAT SUBARCTIC              |                                | HAZY     |
|                                             | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | WINTER                        | SUMMER                         |          |
|                                             | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) |          |
| 0                                           | 1.11E-01                      | 0.                             | 4.49E-01                      | 2.93E-01                       | 5.74E-02                      | 1.70E-01                       | 1.44E-02                      | 1.36E-03                       | 1.56E-02 |
| 0 - 1                                       | 8.62E-02                      | 0.                             | 3.36E-01                      | 2.24E-01                       | 4.16E-02                      | 1.28E-01                       | 1.40E-02                      | 3.55E-03                       | 1.56E-02 |
| 1 - 2                                       | 5.06E-02                      | 0.                             | 1.90E-01                      | 1.25E-01                       | 2.59E-02                      | 7.37E-02                       | 1.12E-02                      | 1.15E-04                       | 1.79E-03 |
| 2 - 3                                       | 2.76E-02                      | 0.                             | 1.02E-01                      | 6.31E-02                       | 1.59E-02                      | 4.17E-02                       | 7.26E-03                      | 5.65E-05                       | 2.98E-04 |
| 3 - 4                                       | 1.40E-02                      | 0.                             | 4.16E-02                      | 2.97E-02                       | 7.97E-03                      | 2.23E-02                       | 4.09E-03                      | 4.61E-05                       | 1.63E-04 |
| 4 - 5                                       | 6.83E-03                      | 0.                             | 1.88E-02                      | 1.36E-02                       | 3.68E-03                      | 1.13E-02                       | 1.84E-03                      | 3.59E-05                       | 8.48E-05 |
| 5 - 6                                       | 3.26E-03                      | 0.                             | 9.59E-03                      | 6.27E-03                       | 1.70E-03                      | 5.18E-03                       | 7.34E-04                      | 2.64E-05                       | 5.37E-05 |
| 6 - 7                                       | 1.51E-03                      | 0.                             | 4.37E-03                      | 3.12E-03                       | 8.79E-04                      | 2.33E-03                       | 3.11E-04                      | 1.82E-05                       | 4.40E-05 |
| 7 - 8                                       | 6.63E-04                      | 0.                             | 1.90E-03                      | 1.44E-03                       | 2.33E-04                      | 8.88E-04                       | 1.02E-04                      | 1.15E-05                       | 2.94E-05 |
| 8 - 9                                       | 2.67E-04                      | 0.                             | 7.82E-04                      | 6.00E-04                       | 8.91E-05                      | 2.83E-04                       | 3.88E-05                      | 4.99E-05                       | 8.34E-05 |
| 9 - 10                                      | 8.69E-05                      | 0.                             | 2.88E-04                      | 3.04E-04                       | 3.89E-05                      | 8.33E-05                       | 2.52E-05                      | 7.61E-05                       | 6.09E-06 |
| 10 - 11                                     | 3.45E-05                      | 0.                             | 9.35E-05                      | 1.12E-04                       | 2.31E-05                      | 3.94E-05                       | 1.63E-05                      | 3.14E-05                       | 6.58E-06 |
| 11 - 12                                     | 1.64E-05                      | 0.                             | 3.08E-05                      | 3.31E-05                       | 1.74E-05                      | 2.20E-05                       | 1.09E-05                      | 2.89E-05                       | 7.57E-06 |
| 12 - 13                                     | 9.08E-06                      | 0.                             | 1.24E-05                      | 1.17E-05                       | 9.95E-06                      | 1.15E-05                       | 7.30E-06                      | 2.69E-05                       | 8.75E-06 |
| 13 - 14                                     | 5.50E-06                      | 0.                             | 6.33E-06                      | 6.37E-06                       | 5.39E-06                      | 6.28E-06                       | 4.31E-06                      | 2.65E-05                       | 9.47E-06 |
| 14 - 15                                     | 3.73E-06                      | 0.                             | 4.36E-06                      | 4.47E-06                       | 3.67E-06                      | 4.35E-06                       | 3.27E-06                      | 2.70E-05                       | 9.67E-06 |
| 15 - 16                                     | 2.72E-06                      | 0.                             | 3.02E-06                      | 3.12E-06                       | 2.68E-06                      | 3.82E-06                       | 2.33E-06                      | 2.69E-05                       | 9.42E-06 |
| 16 - 17                                     | 1.98E-06                      | 0.                             | 2.05E-06                      | 2.26E-06                       | 1.91E-06                      | 2.30E-06                       | 1.70E-06                      | 2.60E-05                       | 8.69E-06 |
| 17 - 18                                     | 1.45E-06                      | 0.                             | 1.49E-06                      | 1.67E-06                       | 1.41E-06                      | 1.71E-06                       | 1.25E-06                      | 2.43E-05                       | 7.57E-06 |
| 18 - 19                                     | 1.06E-06                      | 0.                             | 1.10E-06                      | 1.25E-06                       | 1.04E-06                      | 1.29E-06                       | 0.                            | 2.20E-05                       | 6.32E-06 |
| 19 - 20                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 1.91E-05                       | 5.07E-06 |
| 20 - 21                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 1.62E-05                       | 4.05E-06 |
| 21 - 22                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 1.39E-05                       | 3.23E-06 |
| 22 - 23                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 1.12E-05                       | 2.51E-06 |
| 23 - 24                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 9.09E-06                       | 1.99E-06 |
| 24 - 25                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 7.08E-06                       | 1.53E-06 |
| 25 - 30                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 1.07E-05                       | 2.74E-06 |
| 30 - 35                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 3.31E-06                       | 6.38E-06 |
| 35 - 40                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 1.63E-06                       | 2.84E-06 |
| 40 - 45                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.       |
| 45 - 50                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.       |
| 50 - 70                                     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.       |
| 70 - 100                                    | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.       |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|              | CLEAR                         |                                | HAZY                          |                                |
|--------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|              | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN        | *****                         | *****                          | 5.23E-02                      | 4.50E-02                       |
| MARITIME     | 2.69E-03                      | 2.07E-02                       | 2.83E-02                      | 3.15E-01                       |
| TROPOSPHERIC | 4.10E-04                      | 6.19E-04                       | *****                         | *****                          |

| WAVELENGTH = 4.989181 MICROMETERS<br>FREQUENCY = 2004.337 WAVENUMBERS |                                     |                                |                                               |                                               |                                               |                                               |                                               |                                               |                   |
|-----------------------------------------------------------------------|-------------------------------------|--------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-------------------|
| ht(km)                                                                | U. S.                               |                                | MIDLAT                                        |                                               | TROPICAL                                      |                                               | SUBARCTIC                                     |                                               | HAZY              |
|                                                                       | $\mathcal{L}_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | SUMMER<br>$\mathcal{L}_m$ (km <sup>-1</sup> ) | WINTER<br>$\mathcal{L}_m$ (km <sup>-1</sup> ) | SUMMER<br>$\mathcal{L}_m$ (km <sup>-1</sup> ) | WINTER<br>$\mathcal{L}_m$ (km <sup>-1</sup> ) | SUMMER<br>$\mathcal{L}_m$ (km <sup>-1</sup> ) | WINTER<br>$\mathcal{L}_m$ (km <sup>-1</sup> ) |                   |
| 0                                                                     | 9.15E-02 0.                         | 0.                             | 2.43E-01                                      | 4.46E-02                                      | 3.62E-01                                      | 4.46E-02                                      | 1.44E-01                                      | 1.26E-02                                      | 1.54E-02 5.01E-02 |
| 1                                                                     | 7.04E-02 0.                         | 0.                             | 1.83E-01                                      | 3.49E-02                                      | 2.73E-01                                      | 3.49E-02                                      | 1.05E-01                                      | 1.20E-02                                      | 1.54E-02 5.81E-02 |
| 2                                                                     | 4.05E-02 0.                         | 0.                             | 9.91E-02                                      | 2.12E-02                                      | 1.56E-01                                      | 2.12E-02                                      | 5.90E-02                                      | 9.38E-03                                      | 1.78E-02 2.38E-03 |
| 3                                                                     | 2.18E-02 0.                         | 0.                             | 4.49E-02                                      | 1.25E-02                                      | 7.88E-02                                      | 1.25E-02                                      | 3.28E-02                                      | 5.96E-03                                      | 2.94E-04 4.02E-04 |
| 4                                                                     | 1.09E-02 0.                         | 0.                             | 2.27E-02                                      | 6.33E-03                                      | 3.15E-02                                      | 6.33E-03                                      | 1.73E-02                                      | 3.32E-03                                      | 1.61E-04 2.20E-04 |
| 5                                                                     | 5.32E-03 0.                         | 0.                             | 1.41E-02                                      | 2.92E-03                                      | 1.41E-02                                      | 2.92E-03                                      | 8.67E-03                                      | 1.50E-03                                      | 8.35E-05 1.14E-04 |
| 6                                                                     | 2.56E-03 0.                         | 0.                             | 4.74E-03                                      | 1.36E-03                                      | 7.20E-03                                      | 1.36E-03                                      | 3.98E-03                                      | 6.00E-04                                      | 5.30E-05 7.25E-05 |
| 7                                                                     | 1.19E-03 0.                         | 0.                             | 2.37E-03                                      | 5.49E-04                                      | 3.20E-03                                      | 5.49E-04                                      | 1.73E-03                                      | 2.66E-04                                      | 4.33E-05 5.93E-05 |
| 8                                                                     | 5.49E-04 0.                         | 0.                             | 1.14E-03                                      | 1.93E-04                                      | 1.55E-03                                      | 1.93E-04                                      | 7.03E-04                                      | 9.37E-05                                      | 2.90E-05 3.97E-05 |
| 9                                                                     | 2.22E-04 0.                         | 0.                             | 5.32E-04                                      | 8.14E-05                                      | 6.08E-04                                      | 8.14E-05                                      | 2.34E-04                                      | 3.92E-05                                      | 8.39E-06 3.04E-05 |
| 10                                                                    | 7.93E-05 0.                         | 0.                             | 2.45E-04                                      | 3.86E-05                                      | 2.32E-04                                      | 3.86E-05                                      | 7.44E-05                                      | 2.62E-05                                      | 6.12E-06 2.22E-05 |
| 11                                                                    | 3.35E-05 0.                         | 0.                             | 9.50E-05                                      | 2.39E-05                                      | 8.12E-05                                      | 2.39E-05                                      | 3.55E-05                                      | 1.77E-05                                      | 6.62E-06 2.40E-05 |
| 12                                                                    | 1.73E-05 0.                         | 0.                             | 3.18E-05                                      | 1.80E-05                                      | 3.02E-05                                      | 1.80E-05                                      | 2.24E-05                                      | 1.28E-05                                      | 7.62E-06 2.77E-05 |
| 13                                                                    | 1.03E-05 0.                         | 0.                             | 1.31E-05                                      | 1.10E-05                                      | 1.39E-05                                      | 1.10E-05                                      | 1.23E-05                                      | 8.42E-06                                      | 8.77E-06 3.19E-05 |
| 14                                                                    | 6.59E-06 0.                         | 0.                             | 7.68E-06                                      | 6.54E-06                                      | 7.49E-06                                      | 6.54E-06                                      | 7.90E-06                                      | 5.80E-06                                      | 9.52E-06 3.46E-05 |
| 15                                                                    | 4.69E-06 0.                         | 0.                             | 5.55E-06                                      | 4.58E-06                                      | 5.33E-06                                      | 4.58E-06                                      | 5.69E-06                                      | 4.07E-06                                      | 9.72E-06 3.53E-05 |
| 16                                                                    | 2.52E-06 0.                         | 0.                             | 3.44E-06                                      | 3.31E-06                                      | 3.26E-06                                      | 3.31E-06                                      | 3.97E-06                                      | 2.93E-06                                      | 9.47E-06 3.44E-05 |
| 17                                                                    | 1.52E-06 0.                         | 0.                             | 2.11E-06                                      | 2.41E-06                                      | 2.11E-06                                      | 2.41E-06                                      | 3.06E-06                                      | 2.14E-06                                      | 8.69E-06 3.16E-05 |
| 18                                                                    | 1.45E-06 0.                         | 0.                             | 2.12E-06                                      | 1.77E-06                                      | 1.57E-06                                      | 1.77E-06                                      | 2.27E-06                                      | 1.56E-06                                      | 7.62E-06 2.76E-05 |
| 19                                                                    | 1.37E-06 0.                         | 0.                             | 1.57E-06                                      | 1.30E-06                                      | 1.21E-06                                      | 1.30E-06                                      | 1.70E-06                                      | 1.15E-06                                      | 6.35E-06 2.31E-05 |
| 20                                                                    | 1.02E-06 0.                         | 0.                             | 1.19E-06                                      | 0.                                            | 0.                                            | 0.                                            | 1.29E-06                                      | 0.                                            | 5.18E-06 1.85E-05 |
| 21                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 4.07E-06 1.48E-05 |
| 22                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 3.29E-06 1.18E-05 |
| 23                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 2.53E-06 9.18E-06 |
| 24                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 1.96E-06 7.10E-06 |
| 25                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 1.54E-06 5.60E-06 |
| 26                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 2.72E-05 2.74E-05 |
| 27                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 5.29E-06 6.21E-06 |
| 28                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 2.03E-06 2.03E-06 |
| 29                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 30                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 31                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 32                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 33                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 34                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 35                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 36                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 37                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 38                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 39                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 40                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 41                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 42                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 43                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 44                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 45                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 46                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 47                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 48                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 49                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 50                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 51                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 52                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 53                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 54                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 55                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 56                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 57                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 58                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 59                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 60                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 61                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 62                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 63                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 64                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 65                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 66                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 67                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 68                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 69                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |
| 70                                                                    | 0.                                  | 0.                             | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                                            | 0.                |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|             | CLEAR                               |                                | HAZY                                |                                |
|-------------|-------------------------------------|--------------------------------|-------------------------------------|--------------------------------|
|             | $\mathcal{L}_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\mathcal{L}_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN       | *****                               | *****                          | 5.12E-02                            | 4.47E-02                       |
| MARITIME    | 2.55E-03                            | 2.84E-02                       | 2.78E-02                            | 3.09E-01                       |
| TOPOGRAPHIC | 4.34E-04                            | 5.94E-04                       | *****                               | *****                          |

WAVELENGTH = 4.972449 MICROMETERS  
FREQUENCY = 2011.082 WAVENUMBER

| ht(km) | U.S.            |                 |                 |                 | SUBARCTIC       |                 |                 |                 | AEROSOL         |                 |                      |                      |
|--------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------|----------------------|
|        | STANDARD        | TROPICAL        | MIDLAT          | MIDLAT          | WINTER          | SUMMER          | WINTER          | CLEAR           | AEROSOL         | HAZY            |                      |                      |
|        | $L_m (km^{-1})$ | $L_m (km^{-1})$ | $L_m (km^{-1})$ | $L_m (km^{-1})$ | $L_m (km^{-1})$ | $L_m (km^{-1})$ | $L_m (km^{-1})$ | $L_a (km^{-1})$ | $L_a (km^{-1})$ | $L_a (km^{-1})$ | $\sigma_a (km^{-1})$ | $\sigma_a (km^{-1})$ |
| 0      | 1.54E-01        | 5.89E-01        | 4.02E-01        | 7.70E-02        | 2.36E-01        | 2.20E-02        | 1.42E-03        | 5.34E-03        | 1.55E-02        | 5.82E-02        |                      |                      |
| 1      | 1.19E-01        | 4.48E-01        | 3.04E-01        | 6.06E-02        | 1.79E-01        | 2.10E-02        | 4.39E-04        | 3.54E-03        | 1.55E-02        | 5.42E-02        |                      |                      |
| 2      | 6.99E-02        | 2.62E-01        | 1.69E-01        | 3.71E-02        | 1.02E-01        | 1.53E-02        | 1.09E-04        | 1.51E-04        | 1.74E-03        | 2.40E-03        |                      |                      |
| 3      | 3.80E-02        | 1.34E-01        | 8.39E-02        | 2.19E-02        | 5.72E-02        | 1.05E-02        | 5.59E-05        | 7.71E-05        | 2.95E-04        | 4.06E-04        |                      |                      |
| 4      | 1.93E-02        | 5.43E-02        | 3.94E-02        | 1.11E-02        | 3.04E-02        | 5.40E-03        | 4.56E-05        | 6.23E-05        | 1.61E-04        | 2.22E-04        |                      |                      |
| 5      | 9.39E-03        | 2.47E-02        | 1.80E-02        | 5.12E-03        | 1.53E-02        | 2.59E-03        | 3.51E-05        | 4.84E-05        | 8.39E-05        | 1.16E-04        |                      |                      |
| 6      | 4.48E-03        | 1.27E-02        | 8.36E-03        | 2.35E-03        | 7.86E-03        | 1.01E-03        | 1.80E-05        | 3.60E-05        | 5.32E-05        | 7.33E-05        |                      |                      |
| 7      | 2.07E-03        | 5.81E-03        | 4.17E-03        | 9.17E-04        | 3.05E-03        | 4.15E-04        | 1.40E-05        | 2.49E-05        | 4.35E-05        | 6.00E-05        |                      |                      |
| 8      | 9.32E-04        | 2.55E-03        | 1.99E-03        | 3.84E-04        | 1.21E-03        | 1.23E-04        | 1.14E-05        | 1.57E-05        | 2.91E-05        | 4.01E-05        |                      |                      |
| 9      | 3.57E-04        | 1.04E-03        | 9.10E-04        | 1.07E-04        | 3.76E-04        | 3.85E-05        | 4.91E-05        | 1.77E-05        | 8.37E-06        | 3.03E-05        |                      |                      |
| 10     | 1.11E-04        | 3.79E-04        | 4.04E-04        | 4.13E-05        | 1.02E-04        | 2.36E-05        | 3.65E-05        | 1.32E-06        | 6.12E-05        | 2.26E-05        |                      |                      |
| 11     | 3.82E-05        | 1.17E-04        | 1.43E-04        | 2.26E-05        | 4.01E-05        | 1.42E-05        | 3.11E-05        | 1.12E-06        | 6.61E-05        | 2.44E-05        |                      |                      |
| 12     | 1.54E-05        | 3.37E-05        | 3.73E-05        | 1.71E-05        | 2.26E-05        | 8.81E-06        | 2.86E-05        | 1.03E-06        | 7.61E-05        | 2.80E-05        |                      |                      |
| 13     | 7.06E-06        | 1.03E-05        | 9.83E-06        | 8.50E-06        | 9.92E-06        | 5.50E-06        | 2.67E-05        | 0.              | 6.76E-06        | 3.23E-05        |                      |                      |
| 14     | 3.53E-06        | 4.04E-06        | 4.09E-06        | 3.60E-06        | 4.19E-06        | 3.27E-06        | 2.63E-05        | 0.              | 9.51E-06        | 3.51E-05        |                      |                      |
| 15     | 2.16E-06        | 2.43E-06        | 2.59E-06        | 2.35E-06        | 2.83E-06        | 2.02E-06        | 2.67E-05        | 0.              | 9.71E-06        | 3.58E-05        |                      |                      |
| 16     | 1.58E-06        | 1.59E-06        | 1.79E-06        | 1.56E-06        | 1.81E-06        | 1.42E-06        | 2.67E-05        | 0.              | 9.45E-06        | 3.47E-05        |                      |                      |
| 17     | 1.15E-06        | 1.06E-06        | 1.30E-06        | 1.14E-06        | 1.37E-06        | 1.03E-06        | 2.58E-05        | 0.              | 8.68E-06        | 3.20E-05        |                      |                      |
| 18     | 0.              | 0.              | 0.              | 0.              | 1.02E-06        | 0.              | 2.42E-05        | 0.              | 7.60E-06        | 2.80E-05        |                      |                      |
| 19     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 2.19E-05        | 0.              | 6.34E-06        | 2.34E-05        |                      |                      |
| 20     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 1.90E-05        | 0.              | 5.09E-06        | 1.83E-05        |                      |                      |
| 21     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 1.60E-05        | 0.              | 4.86E-06        | 1.59E-05        |                      |                      |
| 22     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 1.34E-05        | 0.              | 3.24E-06        | 1.20E-05        |                      |                      |
| 23     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 1.11E-05        | 0.              | 2.53E-06        | 9.31E-06        |                      |                      |
| 24     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 8.92E-06        | 0.              | 1.95E-06        | 7.29E-06        |                      |                      |
| 25     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 7.02E-06        | 0.              | 1.54E-06        | 5.68E-06        |                      |                      |
| 30     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 1.07E-05        | 1.07E-05        | 2.73E-05        | 2.74E-05        |                      |                      |
| 35     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 3.29E-06        | 3.31E-06        | 6.27E-06        | 6.30E-06        |                      |                      |
| 40     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 1.62E-06        | 1.63E-06        | 2.03E-06        | 2.04E-06        |                      |                      |
| 45     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              |                      |                      |
| 50     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              |                      |                      |
| 70     | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              |                      |                      |
| 100    | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              | 0.              |                      |                      |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|              | CLEAR           | HAZY            |
|--------------|-----------------|-----------------|
|              | $L_a (km^{-1})$ | $L_a (km^{-1})$ |
| URBAN        | *****           | *****           |
| MARITIME     | 2.56E-03        | 2.79E-02        |
| TROPOSPHERIC | 4.36E-04        | 6.01E-04        |
|              | *****           | *****           |

WAVELENGTH =  
FREQUENCY =

| ht(km) | U.S.     |            | TROPICAL |            | MIDLAT   |            | MIDLAT   |            | SUBARCTIC |            | SUBARCTIC |            | CLEAR    |            | AEROSOL  |            | HAZY     |            |
|--------|----------|------------|----------|------------|----------|------------|----------|------------|-----------|------------|-----------|------------|----------|------------|----------|------------|----------|------------|
|        | $\rho_m$ | $\sigma_m$ | $\rho_m$ | $\sigma_m$ | $\rho_m$ | $\sigma_m$ | $\rho_m$ | $\sigma_m$ | $\rho_m$  | $\sigma_m$ | $\rho_m$  | $\sigma_m$ | $\rho_m$ | $\sigma_m$ | $\rho_m$ | $\sigma_m$ | $\rho_m$ | $\sigma_m$ |
| 0      | 2.13E-01 | 0.         | 7.84E-01 | 5.43E-01   | 1.84E-01 | 3.27E-01   | 3.11E-02 | 1.44E-03   | 5.28E-03  | 1.57E-02   | 5.75E-02  | 1.57E-02   | 5.75E-02 |            |          |            |          |            |
| 1      | 1.71E-01 | 0.         | 6.16E-01 | 4.25E-01   | 8.74E-02 | 2.54E-01   | 3.86E-02 | 9.53E-04   | 3.50E-03  | 1.57E-02   | 5.75E-02  | 1.57E-02   | 5.75E-02 |            |          |            |          |            |
| 2      | 1.07E-01 | 0.         | 3.90E-01 | 2.53E-01   | 5.74E-02 | 1.56E-01   | 2.55E-02 | 1.12E-04   | 1.44E-04  | 1.78E-03   | 2.30E-03  | 1.78E-03   | 2.30E-03 |            |          |            |          |            |
| 3      | 6.31E-02 | 0.         | 2.17E-01 | 1.30E-01   | 3.66E-02 | 9.47E-02   | 1.77E-02 | 5.47E-05   | 7.37E-05  | 3.01E-04   | 3.83E-04  | 3.01E-04   | 3.83E-04 |            |          |            |          |            |
| 4      | 3.47E-02 | 0.         | 9.63E-02 | 7.04E-02   | 2.02E-02 | 5.48E-02   | 1.06E-02 | 4.66E-05   | 6.01E-05  | 1.65E-04   | 2.13E-04  | 1.65E-04   | 2.13E-04 |            |          |            |          |            |
| 5      | 1.84E-02 | 0.         | 4.77E-02 | 3.50E-02   | 1.41E-02 | 3.40E-02   | 5.13E-03 | 3.59E-05   | 4.63E-05  | 8.56E-05   | 1.11E-04  | 8.56E-05   | 1.11E-04 |            |          |            |          |            |
| 6      | 9.51E-03 | 0.         | 2.66E-02 | 1.76E-02   | 5.02E-03 | 1.50E-02   | 2.16E-03 | 2.66E-05   | 3.44E-05  | 5.43E-05   | 7.01E-05  | 5.43E-05   | 7.01E-05 |            |          |            |          |            |
| 7      | 4.76E-03 | 0.         | 1.32E-02 | 9.51E-03   | 2.11E-03 | 7.03E-03   | 9.52E-04 | 1.86E-05   | 2.38E-05  | 4.44E-05   | 5.73E-05  | 4.44E-05   | 5.73E-05 |            |          |            |          |            |
| 8      | 2.30E-03 | 0.         | 6.23E-03 | 4.64E-03   | 7.82E-04 | 2.59E-03   | 2.63E-04 | 1.16E-05   | 1.50E-05  | 2.97E-05   | 3.86E-05  | 2.97E-05   | 3.86E-05 |            |          |            |          |            |
| 9      | 9.37E-04 | 0.         | 2.73E-03 | 2.39E-03   | 2.71E-04 | 9.88E-04   | 8.89E-05 | 5.06E-05   | 1.67E-05  | 8.54E-06   | 2.94E-05  | 8.54E-06   | 2.94E-05 |            |          |            |          |            |
| 10     | 3.02E-04 | 0.         | 1.05E-03 | 1.13E-03   | 1.05E-04 | 2.76E-04   | 5.62E-05 | 3.77E-05   | 1.24E-06  | 6.24E-06   | 2.15E-05  | 6.24E-06   | 2.15E-05 |            |          |            |          |            |
| 11     | 1.03E-04 | 0.         | 3.34E-04 | 4.15E-04   | 5.81E-05 | 1.09E-04   | 3.43E-05 | 3.21E-05   | 1.06E-06  | 6.74E-06   | 2.32E-05  | 6.74E-06   | 2.32E-05 |            |          |            |          |            |
| 12     | 4.00E-05 | 0.         | 1.07E-04 | 4.84E-05   | 4.84E-05 | 6.27E-05   | 2.12E-05 | 2.95E-05   | 0.        | 7.76E-06   | 2.67E-05  | 7.76E-06   | 2.67E-05 |            |          |            |          |            |
| 13     | 1.67E-05 | 0.         | 2.53E-05 | 2.43E-05   | 2.23E-05 | 2.68E-05   | 1.30E-05 | 2.75E-05   | 0.        | 8.93E-06   | 3.07E-05  | 8.93E-06   | 3.07E-05 |            |          |            |          |            |
| 14     | 7.04E-06 | 0.         | 7.77E-06 | 6.03E-06   | 7.65E-06 | 9.40E-06   | 7.16E-06 | 2.71E-05   | 0.        | 9.49E-06   | 3.41E-05  | 9.49E-06   | 3.41E-05 |            |          |            |          |            |
| 15     | 3.55E-06 | 0.         | 3.88E-06 | 4.55E-06   | 4.29E-06 | 5.15E-06   | 4.79E-06 | 2.75E-05   | 0.        | 8.85E-06   | 3.04E-05  | 8.85E-06   | 3.04E-05 |            |          |            |          |            |
| 16     | 1.75E-06 | 0.         | 2.35E-06 | 3.17E-06   | 2.96E-06 | 3.61E-06   | 2.79E-06 | 2.66E-05   | 0.        | 7.75E-06   | 2.62E-05  | 7.75E-06   | 2.62E-05 |            |          |            |          |            |
| 17     | 2.42E-06 | 0.         | 1.57E-06 | 2.37E-06   | 2.80E-06 | 2.71E-06   | 2.05E-06 | 2.66E-05   | 0.        | 6.47E-06   | 2.23E-05  | 6.47E-06   | 2.23E-05 |            |          |            |          |            |
| 18     | 1.55E-06 | 0.         | 1.29E-06 | 1.82E-06   | 1.65E-06 | 2.09E-06   | 1.55E-06 | 2.25E-05   | 0.        | 5.19E-06   | 1.79E-05  | 5.19E-06   | 1.79E-05 |            |          |            |          |            |
| 19     | 1.23E-06 | 0.         | 1.44E-06 | 1.44E-06   | 1.32E-06 | 1.69E-06   | 1.23E-06 | 1.95E-05   | 0.        | 4.14E-06   | 1.42E-05  | 4.14E-06   | 1.42E-05 |            |          |            |          |            |
| 20     | 1.05E-06 | 0.         | 1.21E-06 | 1.10E-06   | 1.07E-06 | 1.39E-06   | 0.       | 1.65E-05   | 0.        | 3.31E-06   | 1.15E-05  | 3.31E-06   | 1.15E-05 |            |          |            |          |            |
| 21     | 0.       | 0.         | 1.10E-06 | 1.03E-06   | 0.       | 1.22E-06   | 0.       | 1.38E-05   | 0.        | 2.57E-06   | 8.66E-06  | 2.57E-06   | 8.66E-06 |            |          |            |          |            |
| 22     |          |            |          |            |          |            |          |            |           |            |           |            |          |            |          |            |          |            |

ALTFHATE BOUNDRY LAYER AEROSOL MODELS

|             | CLEAR                       | HAZY                        |
|-------------|-----------------------------|-----------------------------|
|             | $\beta$ (km <sup>-1</sup> ) | $\beta$ (km <sup>-1</sup> ) |
| URBAN       | *****                       | 5.15E-02 4.43E-02           |
| NARITIME    | 2.51E-03 2.79E-02           | 2.74E-02 3.04E-01           |
| TOPOSPHERIC | 4.45E-04 5.24E-04           | *****                       |

|              |                      |
|--------------|----------------------|
| WAVELENGTH = | 5.054114 MICROMETERS |
| FREQUENCY =  | 1978.586 WAVENUMBER  |

| ht(km)   | U.S.                         |                                | TROPICAL                     |                              | MIDLAT                       |                              | MIDLAT                       |                              | SUBARCTIC                    |                              | SUBARCTIC                    |                              | CLEAR                        |                              | AEROSOL                      |                              | HAZY                         |                              |
|----------|------------------------------|--------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|
|          | $\rho_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) | $\rho_m$ (km <sup>-1</sup> ) |
| 0        | 8.36E-02                     | 0.                             | 3.09E-01                     | 2.11E-01                     | 4.44E-02                     | 1.30E-01                     | 1.36E-02                     | 1.45E-03                     | 5.27E-03                     | 1.58E-02                     | 5.74E-02                     |                              |                              |                              |                              |                              |                              |                              |
| 0 - 1    | 5.51E-02                     | 0.                             | 2.36E-01                     | 1.63E-01                     | 3.50E-02                     | 3.78E-02                     | 1.26E-02                     | 9.58E-04                     | 3.49E-04                     | 1.58E-02                     | 5.74E-02                     |                              |                              |                              |                              |                              |                              |                              |
| 1 - 2    | 3.64E-02                     | 0.                             | 1.39E-01                     | 8.93E-02                     | 2.15E-02                     | 1.28E-02                     | 9.94E-03                     | 1.12E-04                     | 1.43E-04                     | 1.79E-02                     | 2.28E-02                     |                              |                              |                              |                              |                              |                              |                              |
| 2 - 3    | 2.15E-02                     | 0.                             | 7.17E-02                     | 4.55E-02                     | 1.28E-02                     | 1.28E-02                     | 6.42E-03                     | 5.75E-05                     | 7.33E-05                     | 3.03E-04                     | 3.06E-04                     |                              |                              |                              |                              |                              |                              |                              |
| 3 - 4    | 1.11E-02                     | 0.                             | 2.95E-02                     | 2.18E-02                     | 6.66E-03                     | 1.73E-02                     | 3.63E-03                     | 4.69E-05                     | 5.37E-05                     | 1.66E-04                     | 2.11E-04                     |                              |                              |                              |                              |                              |                              |                              |
| 4 - 5    | 5.58E-03                     | 0.                             | 1.37E-02                     | 1.02E-02                     | 3.15E-03                     | 8.90E-03                     | 1.68E-04                     | 3.61E-05                     | 4.62E-05                     | 8.62E-05                     | 1.10E-04                     |                              |                              |                              |                              |                              |                              |                              |
| 5 - 6    | 2.74E-03                     | 0.                             | 4.68E-03                     | 4.68E-03                     | 1.50E-03                     | 4.22E-03                     | 6.95E-04                     | 2.68E-05                     | 3.62E-05                     | 5.46E-05                     | 6.46E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 6 - 7    | 1.32E-03                     | 0.                             | 2.45E-03                     | 2.45E-03                     | 6.20E-04                     | 1.89E-03                     | 3.06E-04                     | 1.85E-05                     | 2.36E-05                     | 4.47E-05                     | 5.70E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 7 - 8    | 6.21E-04                     | 0.                             | 1.56E-03                     | 1.23E-03                     | 2.25E-04                     | 7.07E-04                     | 1.04E-04                     | 5.10E-05                     | 1.49E-05                     | 2.99E-05                     | 3.31E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 8 - 9    | 2.54E-04                     | 0.                             | 6.69E-04                     | 5.93E-04                     | 9.43E-05                     | 2.66E-04                     | 3.99E-05                     | 1.17E-05                     | 1.66E-05                     | 6.57E-06                     | 2.92E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 9 - 10   | 8.89E-05                     | 0.                             | 2.60E-04                     | 2.77E-04                     | 4.04E-05                     | 8.31E-05                     | 2.56E-05                     | 7.80E-05                     | 1.23E-06                     | 6.26E-06                     | 2.13E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 10 - 11  | 3.53E-05                     | 0.                             | 9.07E-05                     | 1.91E-04                     | 2.39E-05                     | 3.76E-05                     | 1.67E-05                     | 3.24E-05                     | 1.05E-06                     | 7.79E-06                     | 2.30E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 11 - 12  | 1.67E-05                     | 0.                             | 3.19E-05                     | 3.39E-05                     | 1.78E-05                     | 2.30E-05                     | 1.11E-05                     | 2.19E-05                     | 0.                           | 6.77E-06                     | 2.65E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 12 - 13  | 9.23E-06                     | 0.                             | 1.30E-05                     | 1.23E-05                     | 1.03E-05                     | 1.25E-05                     | 6.45E-06                     | 2.77E-05                     | 0.                           | 9.73E-06                     | 3.31E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 13 - 14  | 5.62E-06                     | 0.                             | 6.15E-06                     | 6.44E-06                     | 5.60E-06                     | 7.16E-06                     | 4.95E-06                     | 2.73E-05                     | 0.                           | 9.94E-06                     | 3.36E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 14 - 15  | 3.82E-06                     | 0.                             | 3.72E-06                     | 4.52E-06                     | 3.80E-06                     | 5.95E-06                     | 3.78E-06                     | 2.78E-05                     | 0.                           | 9.68E-06                     | 3.29E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 15 - 16  | 2.04E-06                     | 0.                             | 2.13E-06                     | 3.11E-06                     | 2.71E-06                     | 3.91E-06                     | 2.40E-06                     | 2.77E-05                     | 0.                           | 9.68E-06                     | 3.29E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 16 - 17  | 2.04E-06                     | 0.                             | 1.37E-06                     | 2.24E-06                     | 1.96E-06                     | 2.69E-06                     | 1.74E-06                     | 2.68E-05                     | 0.                           | 8.39E-06                     | 3.02E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 17 - 18  | 1.49E-06                     | 0.                             | 1.70E-06                     | 1.43E-06                     | 1.43E-06                     | 1.39E-06                     | 1.26E-06                     | 2.57E-05                     | 0.                           | 7.79E-06                     | 2.55E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 18 - 19  | 1.11E-06                     | 0.                             | 1.24E-06                     | 1.05E-06                     | 1.05E-06                     | 1.50E-06                     | 1.26E-06                     | 2.57E-05                     | 0.                           | 6.50E-06                     | 2.21E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 19 - 20  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 1.14E-06                     | 0.                           | 1.97E-05                     | 0.                           | 5.21E-06                     | 1.77E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 20 - 21  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 1.67E-05                     | 0.                           | 4.15E-06                     | 1.42E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 21 - 22  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 1.43E-05                     | 0.                           | 3.32E-06                     | 1.13E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 22 - 23  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 1.16E-05                     | 0.                           | 2.59E-06                     | 8.80E-06                     |                              |                              |                              |                              |                              |                              |                              |
| 23 - 24  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 9.24E-06                     | 0.                           | 2.00E-06                     | 6.41E-06                     |                              |                              |                              |                              |                              |                              |                              |
| 24 - 25  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 7.31E-06                     | 0.                           | 1.58E-06                     | 5.36E-06                     |                              |                              |                              |                              |                              |                              |                              |
| 25 - 30  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 1.05E-05                     | 1.06E-05                     | 2.69E-05                     | 2.70E-05                     |                              |                              |                              |                              |                              |                              |                              |
| 30 - 35  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 7.24E-06                     | 3.26E-06                     | 6.10E-06                     | 6.21E-06                     |                              |                              |                              |                              |                              |                              |                              |
| 35 - 40  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 1.59E-06                     | 1.80E-06                     | 2.00E-06                     | 2.01E-06                     |                              |                              |                              |                              |                              |                              |                              |
| 40 - 45  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           |                              |                              |                              |                              |                              |                              |                              |
| 45 - 50  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           |                              |                              |                              |                              |                              |                              |                              |
| 50 - 70  | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           |                              |                              |                              |                              |                              |                              |                              |
| 70 - 100 | 0.                           | 0.                             | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           | 0.                           |                              |                              |                              |                              |                              |                              |                              |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|             | CLEAR                                    | HAZY                                     |
|-------------|------------------------------------------|------------------------------------------|
|             | $\mathcal{L}_{\text{a}}(\text{km}^{-1})$ | $\mathcal{L}_{\text{a}}(\text{km}^{-1})$ |
| UPPER       | *****                                    | *****                                    |
| MIDDLE      | 2.51E-03                                 | 2.72E-02                                 |
| ATMOSPHERIC | 4.46E-04                                 | 5.71E-04                                 |
| TOTAL       | *****                                    | *****                                    |

WAVELENGTH = 5.064891 MICROMETERS  
FREQUENCY = 1974.376 WAVENUMBER

| ht(km)   | U.S.                            |                                 |                                 |                                 | MIDLAT SUBARCTIC SUBARCTIC      |                                 |                                 |                                 | AEROSOL                        |                                 |                                |                                |
|----------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|--------------------------------|
|          | STANDARD                        | TROPICAL                        | MIDLAT                          | MIDLAT                          | WINTER                          | SUMMER                          | WINTER                          | HAZY                            | CLEAR                          | AEROSOL                         | HAZY                           | HAZY                           |
|          | $\lambda_m$ (km <sup>-1</sup> ) | $\lambda_m$ (km <sup>-1</sup> ) | $\lambda_m$ (km <sup>-1</sup> ) | $\lambda_m$ (km <sup>-1</sup> ) | $\lambda_m$ (km <sup>-1</sup> ) | $\lambda_m$ (km <sup>-1</sup> ) | $\lambda_m$ (km <sup>-1</sup> ) | $\lambda_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\lambda_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0        | 1.25E-01                        | 4.51E-01                        | 3.20E-01                        | 6.62E-02                        | 1.94E-01                        | 2.01E-02                        | 1.44E-03                        | 5.26E-03                        | 1.45E-03                       | 5.26E-03                        | 1.58E-02                       | 5.73E-02                       |
| 0 - 1    | 9.79E-02                        | 3.53E-01                        | 2.43E-01                        | 5.23E-02                        | 1.47E-01                        | 1.90E-02                        | 1.40E-02                        | 9.62E-04                        | 9.62E-04                       | 3.44E-03                        | 1.54E-02                       | 5.73E-02                       |
| 1 - 2    | 5.46E-02                        | 2.11E-01                        | 1.36E-01                        | 3.24E-02                        | 9.51E-02                        | 1.40E-02                        | 1.40E-02                        | 1.13E-04                        | 1.13E-04                       | 1.42E-04                        | 1.80E-03                       | 2.27E-03                       |
| 2 - 3    | 3.27E-02                        | 1.10E-01                        | 6.97E-02                        | 1.94E-02                        | 4.99E-02                        | 9.62E-03                        | 9.62E-03                        | 5.79E-05                        | 5.79E-05                       | 7.29E-05                        | 3.05E-04                       | 3.83E-04                       |
| 3 - 4    | 1.70E-02                        | 4.55E-02                        | 3.36E-02                        | 1.81E-02                        | 2.66E-02                        | 5.44E-03                        | 5.44E-03                        | 5.79E-05                        | 5.79E-05                       | 5.93E-05                        | 1.67E-04                       | 2.10E-04                       |
| 4 - 5    | 8.94E-03                        | 2.14E-02                        | 1.52E-02                        | 4.76E-03                        | 1.38E-02                        | 2.49E-03                        | 2.49E-03                        | 3.63E-05                        | 3.63E-05                       | 4.57E-05                        | 8.68E-05                       | 1.09E-04                       |
| 5 - 6    | 4.19E-03                        | 1.13E-02                        | 7.51E-03                        | 2.25E-03                        | 6.51E-03                        | 1.00E-03                        | 1.00E-03                        | 2.70E-05                        | 2.70E-05                       | 3.39E-05                        | 5.50E-05                       | 6.92E-05                       |
| 6 - 7    | 2.00E-03                        | 5.32E-03                        | 3.95E-03                        | 9.81E-04                        | 2.91E-03                        | 4.24E-04                        | 4.24E-04                        | 1.87E-05                        | 1.87E-05                       | 2.34E-05                        | 4.53E-05                       | 5.66E-05                       |
| 7 - 8    | 9.26E-04                        | 2.40E-03                        | 1.89E-03                        | 3.05E-04                        | 1.19E-03                        | 1.27E-04                        | 1.27E-04                        | 1.13E-05                        | 1.13E-05                       | 1.43E-05                        | 3.01E-05                       | 3.79E-05                       |
| 8 - 9    | 3.64E-04                        | 1.01E-03                        | 8.89E-04                        | 1.09E-04                        | 3.80E-04                        | 3.81E-05                        | 3.81E-05                        | 5.15E-05                        | 5.15E-05                       | 1.64E-06                        | 8.61E-05                       | 2.90E-05                       |
| 9 - 10   | 1.15E-04                        | 3.77E-04                        | 4.06E-04                        | 4.14E-05                        | 1.05E-04                        | 2.30E-05                        | 2.30E-05                        | 3.83E-05                        | 3.83E-05                       | 1.22E-06                        | 6.29E-05                       | 2.12E-05                       |
| 10 - 11  | 3.94E-05                        | 1.18E-04                        | 1.87E-04                        | 2.24E-05                        | 4.05E-05                        | 1.34E-05                        | 1.34E-05                        | 3.26E-05                        | 3.26E-05                       | 1.04E-06                        | 6.79E-06                       | 2.53E-05                       |
| 11 - 12  | 1.52E-05                        | 3.39E-05                        | 3.79E-05                        | 1.71E-05                        | 2.23E-05                        | 8.05E-06                        | 8.05E-06                        | 3.00E-05                        | 3.00E-05                       | 0.                              | 7.82E-06                       | 2.63E-05                       |
| 12 - 13  | 6.33E-06                        | 9.46E-06                        | 9.11E-06                        | 8.10E-06                        | 9.21E-06                        | 4.84E-06                        | 4.84E-06                        | 2.80E-05                        | 2.80E-05                       | 0.                              | 9.01E-06                       | 3.03E-05                       |
| 13 - 14  | 2.78E-06                        | 3.12E-06                        | 3.22E-06                        | 2.92E-06                        | 3.40E-06                        | 2.69E-06                        | 2.69E-06                        | 2.75E-05                        | 2.75E-05                       | 0.                              | 9.77E-06                       | 3.29E-05                       |
| 14 - 15  | 1.56E-06                        | 1.69E-06                        | 1.87E-06                        | 1.68E-06                        | 1.99E-06                        | 1.55E-06                        | 1.55E-06                        | 2.80E-05                        | 2.80E-05                       | 0.                              | 9.98E-06                       | 3.36E-05                       |
| 15 - 16  | 1.14E-06                        | 1.05E-06                        | 1.20E-06                        | 1.15E-06                        | 1.37E-06                        | 1.07E-06                        | 1.07E-06                        | 2.79E-05                        | 2.79E-05                       | 0.                              | 9.72E-06                       | 3.27E-05                       |
| 16 - 17  | 0.                              | 0.                              | 0.                              | 0.                              | 1.02E-06                        | 0.                              | 0.                              | 2.71E-05                        | 2.71E-05                       | 0.                              | 8.92E-06                       | 3.00E-05                       |
| 17 - 18  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 2.53E-05                        | 2.53E-05                       | 0.                              | 7.82E-06                       | 2.63E-05                       |
| 18 - 19  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 2.29E-05                        | 2.29E-05                       | 0.                              | 6.52E-06                       | 2.20E-05                       |
| 19 - 20  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 1.99E-05                        | 1.99E-05                       | 0.                              | 5.23E-06                       | 1.76E-05                       |
| 20 - 21  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 1.68E-05                        | 1.68E-05                       | 0.                              | 4.18E-06                       | 1.41E-05                       |
| 21 - 22  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 1.41E-05                        | 1.41E-05                       | 0.                              | 3.33E-06                       | 1.12E-05                       |
| 22 - 23  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 1.17E-05                        | 1.17E-05                       | 0.                              | 2.60E-06                       | 8.74E-06                       |
| 23 - 24  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 9.36E-06                        | 9.36E-06                       | 0.                              | 2.01E-06                       | 6.76E-06                       |
| 24 - 25  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 7.37E-06                        | 7.37E-06                       | 0.                              | 1.58E-06                       | 5.33E-06                       |
| 25 - 30  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 1.09E-05                        | 1.09E-05                       | 1.05E-05                        | 2.69E-05                       | 2.70E-05                       |
| 30 - 35  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 3.24E-06                        | 3.24E-06                       | 3.25E-06                        | 6.16E-06                       | 6.19E-06                       |
| 35 - 40  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 1.59E-06                        | 1.59E-06                       | 1.60E-06                        | 2.00E-06                       | 2.01E-06                       |
| 40 - 45  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                             | 0.                              | 0.                             | 0.                             |
| 45 - 50  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                             | 0.                              | 0.                             | 0.                             |
| 50 - 70  | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                             | 0.                              | 0.                             | 0.                             |
| 70 - 100 | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                              | 0.                             | 0.                              | 0.                             | 0.                             |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|              | CLEAR                           |                                | HAZY                            |                                |
|--------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|
|              | $\lambda_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\lambda_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN        | *****                           | *****                          | 5.14E-02                        | 4.41E-02                       |
| MARITIME     | 2.50E-03                        | 2.77E-02                       | 2.72E-02                        | 3.01E-01                       |
| TROPOSPHERIC | 4.51E-04                        | 5.67E-04                       | *****                           | *****                          |

WAVELENGTH = 5.120587 MICROMETERS  
FREQUENCY = 1952.901 WAVENUMBER

| Alt(km) | U.S. STANDARD                 |                                |          |          | MIDLAT SUBARCTIC SUBARCTIC |          |          |          | AEROSOL  |          |          |          |
|---------|-------------------------------|--------------------------------|----------|----------|----------------------------|----------|----------|----------|----------|----------|----------|----------|
|         | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | TROPICAL | MIDLAT   | SUBARCTIC                  | WINTER   | SUMMER   | WINTER   | CLEAR    | HAZY     | HAZY     | HAZY     |
| 0       | 2.90E-01                      | 0.                             | 1.06E+00 | 7.40E-01 | 1.56E-01                   | 4.57E-01 | 4.82E-02 | 9.85E-02 | 9.85E-03 | 1.62E-02 | 5.66E-02 | 1.62E-02 |
| 1       | 2.27E-01                      | 0.                             | 8.12E-01 | 5.62E-01 | 1.23E-01                   | 3.41E-01 | 4.55E-02 | 9.85E-02 | 9.85E-03 | 1.62E-02 | 5.66E-02 | 1.62E-02 |
| 2       | 1.56E-01                      | 0.                             | 4.82E-01 | 3.12E-01 | 7.61E-02                   | 1.97E-01 | 3.52E-02 | 1.17E-04 | 1.37E-04 | 1.86E-03 | 2.19E-03 | 1.86E-03 |
| 3       | 7.55E-02                      | 0.                             | 2.43E-01 | 1.55E-01 | 4.54E-02                   | 1.13E-01 | 2.27E-02 | 5.38E-05 | 7.03E-05 | 3.15E-04 | 3.70E-04 | 3.15E-04 |
| 4       | 3.93E-02                      | 0.                             | 1.03E-01 | 7.63E-02 | 2.35E-02                   | 6.10E-02 | 1.29E-02 | 4.88E-05 | 5.73E-05 | 1.72E-04 | 2.02E-04 | 1.72E-04 |
| 5       | 1.97E-02                      | 0.                             | 4.91E-02 | 3.57E-02 | 1.11E-02                   | 3.15E-02 | 5.89E-03 | 3.75E-05 | 4.41E-05 | 8.96E-05 | 1.05E-04 | 8.96E-05 |
| 6       | 9.70E-03                      | 0.                             | 2.55E-02 | 1.70E-02 | 5.26E-03                   | 1.49E-02 | 2.39E-03 | 2.79E-05 | 3.20E-05 | 5.68E-05 | 6.64E-05 | 5.68E-05 |
| 7       | 4.65E-03                      | 0.                             | 1.20E-02 | 8.73E-03 | 2.12E-03                   | 6.70E-03 | 1.02E-03 | 1.93E-05 | 2.26E-05 | 4.65E-05 | 5.46E-05 | 4.65E-05 |
| 8       | 2.17E-03                      | 0.                             | 5.68E-03 | 4.30E-03 | 7.30E-04                   | 2.76E-03 | 3.20E-04 | 1.22E-05 | 1.43E-05 | 3.11E-05 | 3.66E-05 | 3.11E-05 |
| 9       | 8.64E-04                      | 0.                             | 2.32E-03 | 2.05E-03 | 2.69E-04                   | 8.97E-04 | 1.09E-04 | 5.37E-05 | 1.59E-05 | 8.79E-06 | 2.80E-05 | 8.79E-06 |
| 10      | 2.82E-04                      | 0.                             | 8.76E-04 | 9.49E-04 | 1.09E-04                   | 2.56E-04 | 6.54E-05 | 2.99E-05 | 1.18E-06 | 6.42E-06 | 2.04E-05 | 6.42E-06 |
| 11      | 1.02E-04                      | 0.                             | 2.83E-04 | 3.49E-04 | 6.16E-05                   | 1.04E-05 | 3.97E-05 | 3.40E-05 | 1.01E-06 | 6.94E-06 | 2.21E-05 | 6.94E-06 |
| 12      | 4.29E-05                      | 0.                             | 8.62E-05 | 9.59E-05 | 4.66E-05                   | 5.88E-05 | 2.49E-05 | 3.12E-05 | 0.       | 7.98E-06 | 2.54E-05 | 7.98E-06 |
| 13      | 2.01E-05                      | 0.                             | 2.83E-05 | 2.72E-05 | 2.38E-05                   | 2.64E-05 | 1.57E-05 | 2.92E-05 | 0.       | 9.19E-06 | 2.93E-05 | 9.19E-06 |
| 14      | 1.03E-05                      | 0.                             | 1.21E-05 | 1.04E-05 | 1.04E-05                   | 1.04E-05 | 9.48E-06 | 2.80E-05 | 0.       | 9.98E-06 | 3.18E-05 | 9.98E-06 |
| 15      | 6.44E-06                      | 0.                             | 7.71E-06 | 7.44E-06 | 6.54E-06                   | 7.39E-06 | 5.93E-06 | 2.92E-05 | 0.       | 1.32E-05 | 3.25E-05 | 1.32E-05 |
| 16      | 4.70E-06                      | 0.                             | 5.30E-06 | 5.37E-06 | 4.62E-06                   | 5.11E-06 | 4.17E-06 | 2.91E-05 | 0.       | 9.92E-06 | 3.16E-05 | 9.92E-06 |
| 17      | 3.42E-06                      | 0.                             | 3.64E-06 | 3.37E-06 | 3.37E-06                   | 3.88E-06 | 3.03E-06 | 2.82E-05 | 0.       | 9.11E-06 | 2.90E-05 | 9.11E-06 |
| 18      | 2.49E-06                      | 0.                             | 2.68E-06 | 2.91E-06 | 2.51E-06                   | 2.88E-06 | 2.26E-06 | 2.64E-05 | 0.       | 7.96E-06 | 2.54E-05 | 7.96E-06 |
| 19      | 1.88E-06                      | 0.                             | 2.01E-06 | 2.21E-06 | 1.90E-06                   | 2.22E-06 | 1.72E-06 | 2.59E-05 | 0.       | 6.66E-06 | 2.12E-05 | 6.66E-06 |
| 20      | 1.49E-06                      | 0.                             | 1.53E-06 | 1.71E-06 | 1.46E-06                   | 1.74E-06 | 1.32E-06 | 2.07E-05 | 0.       | 5.34E-06 | 1.70E-05 | 5.34E-06 |
| 21      | 1.21E-06                      | 0.                             | 1.23E-06 | 1.38E-06 | 1.18E-06                   | 1.40E-06 | 1.08E-06 | 1.75E-05 | 0.       | 4.26E-06 | 1.36E-05 | 4.26E-06 |
| 22      | 1.02E-06                      | 0.                             | 1.03E-06 | 1.14E-06 | 0.                         | 1.18E-06 | 0.       | 1.47E-05 | 0.       | 3.40E-06 | 1.08E-05 | 3.40E-06 |
| 23      | 0.                            | 0.                             | 0.       | 0.       | 0.                         | 0.       | 0.       | 1.22E-05 | 0.       | 2.65E-06 | 8.44E-06 | 2.65E-06 |
| 24      | 0.                            | 0.                             | 0.       | 0.       | 0.                         | 0.       | 0.       | 9.76E-06 | 0.       | 2.09E-06 | 6.53E-06 | 2.09E-06 |
| 25      | 0.                            | 0.                             | 0.       | 0.       | 0.                         | 0.       | 0.       | 7.68E-06 | 0.       | 1.62E-06 | 5.14E-06 | 1.62E-06 |
| 30      | 0.                            | 0.                             | 0.       | 0.       | 0.                         | 0.       | 0.       | 1.04E-05 | 1.04E-05 | 2.66E-05 | 2.67E-05 | 2.66E-05 |
| 35      | 0.                            | 0.                             | 0.       | 0.       | 0.                         | 0.       | 0.       | 3.20E-06 | 3.22E-06 | 6.10E-06 | 6.13E-06 | 6.10E-06 |
| 40      | 0.                            | 0.                             | 0.       | 0.       | 0.                         | 0.       | 0.       | 1.57E-06 | 1.54E-06 | 1.98E-06 | 1.99E-06 | 1.98E-06 |
| 45      | 0.                            | 0.                             | 0.       | 0.       | 0.                         | 0.       | 0.       | 0.       | 0.       | 0.       | 0.       | 0.       |
| 50      | 0.                            | 0.                             | 0.       | 0.       | 0.                         | 0.       | 0.       | 0.       | 0.       | 0.       | 0.       | 0.       |
| 70      | 0.                            | 0.                             | 0.       | 0.       | 0.                         | 0.       | 0.       | 0.       | 0.       | 0.       | 0.       | 0.       |

ALTERNATE 900NDY LAYER AEROSOL MODELS

|             | CLEAR                         | HAZY                           |
|-------------|-------------------------------|--------------------------------|
|             | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN       | *****                         | *****                          |
| MARITIME    | 2.46E-03                      | 2.71E-02                       |
| TOPOSPHERIC | 4.66E-04                      | 5.47E-04                       |

WAVELENGTH = 3.679804 MICROMETERS  
FREQUENCY = 2717.936 WAVENUMBER

| ht(km) | U.S. STANDARD                 |                                | TROPICAL                      |                                | MIDLAT SUMMER                 |                                | MIDLAT WINTER                 |                                | SUBARCTIC SUMMER              |                                | SUBARCTIC WINTER              |                                | CLEAR                         |                                | HAZY                          |                                |
|--------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|        | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0      | 5.02E-02                      | 0.                             | 2.27E-01                      | 1.65E-01                       | 4.19E-02                      | 1.06E-01                       | 3.42E-02                      | 1.62E-02                       | 9.85E-04                      | 6.57E-03                       | 1.07E-02                      | 7.15E-02                       | 1.07E-02                      | 7.15E-02                       | 1.07E-02                      | 7.15E-02                       |
| 1      | 5.57E-02                      | 0.                             | 1.80E-01                      | 1.29E-01                       | 3.42E-02                      | 8.29E-02                       | 3.42E-02                      | 1.51E-02                       | 6.52E-04                      | 4.33E-03                       | 1.07E-02                      | 7.15E-02                       | 1.07E-02                      | 7.15E-02                       | 1.07E-02                      | 7.15E-02                       |
| 2      | 3.62E-02                      | 0.                             | 1.15E-01                      | 7.66E-02                       | 2.27E-02                      | 5.17E-02                       | 2.27E-02                      | 1.22E-02                       | 7.39E-05                      | 3.16E-04                       | 1.22E-02                      | 7.15E-02                       | 1.22E-02                      | 7.15E-02                       | 1.22E-02                      | 7.15E-02                       |
| 3      | 2.21E-02                      | 0.                             | 6.36E-02                      | 4.20E-02                       | 1.47E-02                      | 3.21E-02                       | 1.47E-02                      | 8.56E-03                       | 3.78E-05                      | 1.72E-04                       | 1.47E-02                      | 7.15E-02                       | 1.47E-02                      | 7.15E-02                       | 1.47E-02                      | 7.15E-02                       |
| 4      | 1.27E-02                      | 0.                             | 2.84E-02                      | 2.20E-02                       | 8.45E-03                      | 1.89E-02                       | 8.45E-03                      | 5.41E-03                       | 2.08E-05                      | 1.40E-04                       | 1.89E-02                      | 7.15E-02                       | 1.89E-02                      | 7.15E-02                       | 1.89E-02                      | 7.15E-02                       |
| 5      | 7.19E-03                      | 0.                             | 1.46E-02                      | 1.13E-02                       | 4.61E-03                      | 1.07E-02                       | 4.61E-03                      | 3.08E-03                       | 1.37E-05                      | 8.02E-05                       | 1.07E-02                      | 7.15E-02                       | 1.37E-05                      | 8.02E-05                       | 1.37E-05                      | 8.02E-05                       |
| 6      | 4.06E-03                      | 0.                             | 8.51E-03                      | 6.01E-03                       | 2.59E-03                      | 5.73E-03                       | 2.59E-03                      | 1.63E-03                       | 8.08E-04                      | 5.54E-05                       | 5.73E-03                      | 7.15E-02                       | 8.08E-04                      | 5.54E-05                       | 8.08E-04                      | 5.54E-05                       |
| 7      | 2.29E-03                      | 0.                             | 4.51E-03                      | 3.44E-03                       | 1.35E-03                      | 2.99E-03                       | 1.35E-03                      | 9.55E-04                       | 5.57E-04                      | 3.51E-05                       | 2.99E-03                      | 7.15E-02                       | 5.57E-04                      | 3.51E-05                       | 5.57E-04                      | 3.51E-05                       |
| 8      | 1.31E-03                      | 0.                             | 2.37E-03                      | 1.98E-03                       | 6.96E-04                      | 1.52E-03                       | 6.96E-04                      | 5.37E-04                       | 3.43E-04                      | 3.43E-04                       | 1.52E-03                      | 7.15E-02                       | 5.37E-04                      | 3.43E-04                       | 5.37E-04                      | 3.43E-04                       |
| 9      | 7.07E-04                      | 0.                             | 1.22E-03                      | 1.13E-03                       | 4.19E-04                      | 7.04E-04                       | 4.19E-04                      | 2.49E-04                       | 2.49E-04                      | 2.49E-04                       | 7.04E-04                      | 7.15E-02                       | 2.49E-04                      | 2.49E-04                       | 2.49E-04                      | 2.49E-04                       |
| 10     | 3.79E-04                      | 0.                             | 6.14E-04                      | 6.55E-04                       | 2.05E-04                      | 3.60E-04                       | 2.05E-04                      | 1.77E-04                       | 1.77E-04                      | 1.77E-04                       | 3.60E-04                      | 7.15E-02                       | 1.77E-04                      | 1.77E-04                       | 1.77E-04                      | 1.77E-04                       |
| 11     | 2.40E-04                      | 0.                             | 3.22E-04                      | 3.54E-04                       | 1.53E-04                      | 2.81E-04                       | 1.53E-04                      | 1.27E-04                       | 1.27E-04                      | 1.27E-04                       | 2.81E-04                      | 7.15E-02                       | 1.27E-04                      | 1.27E-04                       | 1.27E-04                      | 1.27E-04                       |
| 12     | 1.62E-04                      | 0.                             | 1.89E-04                      | 1.95E-04                       | 1.03E-04                      | 1.65E-04                       | 1.03E-04                      | 9.05E-05                       | 9.05E-05                      | 9.05E-05                       | 1.65E-04                      | 7.15E-02                       | 9.05E-05                      | 9.05E-05                       | 9.05E-05                      | 9.05E-05                       |
| 13     | 1.11E-04                      | 0.                             | 1.33E-04                      | 1.28E-04                       | 7.31E-05                      | 1.03E-04                       | 7.31E-05                      | 6.52E-05                       | 6.52E-05                      | 6.52E-05                       | 1.28E-04                      | 7.15E-02                       | 6.52E-05                      | 6.52E-05                       | 6.52E-05                      | 6.52E-05                       |
| 14     | 7.84E-05                      | 0.                             | 9.46E-05                      | 9.16E-05                       | 5.34E-05                      | 7.63E-05                       | 5.34E-05                      | 4.72E-05                       | 4.72E-05                      | 4.72E-05                       | 9.16E-05                      | 7.15E-02                       | 4.72E-05                      | 4.72E-05                       | 4.72E-05                      | 4.72E-05                       |
| 15     | 5.65E-05                      | 0.                             | 7.70E-05                      | 6.82E-05                       | 3.91E-05                      | 5.65E-05                       | 3.91E-05                      | 3.43E-05                       | 3.43E-05                      | 3.43E-05                       | 6.82E-05                      | 7.15E-02                       | 3.43E-05                      | 3.43E-05                       | 3.43E-05                      | 3.43E-05                       |
| 16     | 4.13E-05                      | 0.                             | 5.96E-05                      | 4.81E-05                       | 2.86E-05                      | 3.93E-05                       | 2.86E-05                      | 2.53E-05                       | 2.53E-05                      | 2.53E-05                       | 4.81E-05                      | 7.15E-02                       | 2.53E-05                      | 2.53E-05                       | 2.53E-05                      | 2.53E-05                       |
| 17     | 3.61E-05                      | 0.                             | 4.30E-05                      | 3.46E-05                       | 2.05E-05                      | 2.23E-05                       | 2.05E-05                      | 1.86E-05                       | 1.86E-05                      | 1.86E-05                       | 3.46E-05                      | 7.15E-02                       | 1.86E-05                      | 1.86E-05                       | 1.86E-05                      | 1.86E-05                       |
| 18     | 2.21E-05                      | 0.                             | 3.06E-05                      | 2.55E-05                       | 1.66E-05                      | 1.66E-05                       | 1.66E-05                      | 1.37E-05                       | 1.37E-05                      | 1.37E-05                       | 2.55E-05                      | 7.15E-02                       | 1.37E-05                      | 1.37E-05                       | 1.37E-05                      | 1.37E-05                       |
| 19     | 1.62E-05                      | 0.                             | 2.10E-05                      | 1.89E-05                       | 1.13E-05                      | 1.24E-05                       | 1.13E-05                      | 1.01E-05                       | 1.01E-05                      | 1.01E-05                       | 1.89E-05                      | 7.15E-02                       | 1.01E-05                      | 1.01E-05                       | 1.01E-05                      | 1.01E-05                       |
| 20     | 1.19E-05                      | 0.                             | 1.43E-05                      | 1.35E-05                       | 8.49E-06                      | 9.09E-06                       | 8.49E-06                      | 7.43E-06                       | 7.43E-06                      | 7.43E-06                       | 1.35E-05                      | 7.15E-02                       | 7.43E-06                      | 7.43E-06                       | 7.43E-06                      | 7.43E-06                       |
| 21     | 8.72E-06                      | 0.                             | 9.98E-06                      | 9.68E-06                       | 6.23E-06                      | 6.85E-06                       | 6.23E-06                      | 5.52E-06                       | 5.52E-06                      | 5.52E-06                       | 1.35E-05                      | 7.15E-02                       | 5.52E-06                      | 5.52E-06                       | 5.52E-06                      | 5.52E-06                       |
| 22     | 6.41E-06                      | 0.                             | 6.99E-06                      | 7.31E-06                       | 4.59E-06                      | 5.13E-06                       | 4.59E-06                      | 4.13E-06                       | 4.13E-06                      | 4.13E-06                       | 1.35E-05                      | 7.15E-02                       | 4.13E-06                      | 4.13E-06                       | 4.13E-06                      | 4.13E-06                       |
| 23     | 4.73E-06                      | 0.                             | 5.27E-06                      | 5.27E-06                       | 3.39E-06                      | 3.89E-06                       | 3.39E-06                      | 3.10E-06                       | 3.10E-06                      | 3.10E-06                       | 1.35E-05                      | 7.15E-02                       | 3.10E-06                      | 3.10E-06                       | 3.10E-06                      | 3.10E-06                       |
| 24     | 3.51E-06                      | 0.                             | 4.04E-06                      | 4.04E-06                       | 2.66E-06                      | 2.89E-06                       | 2.66E-06                      | 2.34E-06                       | 2.34E-06                      | 2.34E-06                       | 1.35E-05                      | 7.15E-02                       | 2.34E-06                      | 2.34E-06                       | 2.34E-06                      | 2.34E-06                       |
| 25     | 2.62E-06                      | 0.                             | 2.71E-06                      | 2.96E-06                       | 1.12E-06                      | 1.27E-06                       | 1.12E-06                      | 1.00E-06                       | 1.00E-06                      | 1.00E-06                       | 1.35E-05                      | 7.15E-02                       | 1.00E-06                      | 1.00E-06                       | 1.00E-06                      | 1.00E-06                       |
| 30     | 1.15E-06                      | 0.                             | 1.14E-06                      | 1.29E-06                       | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 1.35E-05                      | 7.15E-02                       | 0.                            | 0.                             | 0.                            | 0.                             |
| 35     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 1.35E-05                      | 7.15E-02                       | 0.                            | 0.                             | 0.                            | 0.                             |
| 40     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 1.35E-05                      | 7.15E-02                       | 0.                            | 0.                             | 0.                            | 0.                             |
| 45     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 1.35E-05                      | 7.15E-02                       | 0.                            | 0.                             | 0.                            | 0.                             |
| 50     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 1.35E-05                      | 7.15E-02                       | 0.                            | 0.                             | 0.                            | 0.                             |
| 70     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 1.35E-05                      | 7.15E-02                       | 0.                            | 0.                             | 0.                            | 0.                             |
| 100    | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 1.35E-05                      | 7.15E-02                       | 0.                            | 0.                             | 0.                            | 0.                             |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|              | CLEAR                         |                                | HAZY                          |                                |
|--------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|              | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN        | *****                         | *****                          | 6.21E-02                      | 5.54E-02                       |
| MARITIME     | 1.05E-03                      | 3.96E-02                       | 1.80E-02                      | 4.31E-01                       |
| TROPOSPHERIC | 2.94E-04                      | 1.34E-03                       | *****                         | *****                          |

| WAVELENGTH =<br>FREQUENCY = |    | 3.752064 MICROMETERS<br>2665.200 WAVENUMBER |    |                           |          |                           |          |                           |          |                           |          |                                      |          |                                      |          |
|-----------------------------|----|---------------------------------------------|----|---------------------------|----------|---------------------------|----------|---------------------------|----------|---------------------------|----------|--------------------------------------|----------|--------------------------------------|----------|
|                             |    | U.S. STANDARD                               |    | TROPICAL                  |          | MIDLAT                    |          | MIDLAT SUBARCTIC          |          | SUBARCTIC                 |          | AEROSOL                              |          | HAZY                                 |          |
|                             |    | $L_m$ (km <sup>-1</sup> ) $\sigma_m$        |    | $L_m$ (km <sup>-1</sup> ) |          | $L_m$ (km <sup>-1</sup> ) |          | $L_m$ (km <sup>-1</sup> ) |          | $L_m$ (km <sup>-1</sup> ) |          | $L_a$ (km <sup>-1</sup> ) $\sigma_a$ |          | $L_a$ (km <sup>-1</sup> ) $\sigma_a$ |          |
| ht(km)                      |    |                                             |    |                           |          |                           |          |                           |          |                           |          |                                      |          |                                      |          |
| 0                           | 0  | 2.49E-02                                    | 0. | 6.11E-02                  | 4.89E-02 | 2.03E-02                  | 3.43E-02 | 1.43E-02                  | 0.44E-04 | 6.53E-03                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 1                           | 1  | 2.11E-02                                    | 0. | 4.96E-02                  | 3.85E-02 | 1.76E-02                  | 2.85E-02 | 1.31E-02                  | 6.25E-04 | 4.32E-03                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 2                           | 2  | 1.57E-02                                    | 0. | 3.36E-02                  | 2.48E-02 | 1.34E-02                  | 1.98E-02 | 1.10E-02                  | 7.03E-05 | 3.20E-04                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 3                           | 3  | 1.16E-02                                    | 0. | 2.07E-02                  | 1.58E-02 | 1.02E-02                  | 1.41E-02 | 8.96E-03                  | 3.59E-05 | 1.64E-04                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 4                           | 4  | 8.57E-03                                    | 0. | 1.16E-02                  | 1.03E-02 | 7.72E-03                  | 1.01E-02 | 7.19E-03                  | 2.93E-05 | 1.34E-04                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 5                           | 5  | 6.53E-03                                    | 0. | 7.75E-03                  | 7.09E-03 | 6.01E-03                  | 7.29E-03 | 5.79E-03                  | 2.23E-05 | 1.03E-04                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 6                           | 6  | 5.12E-03                                    | 0. | 5.55E-03                  | 5.26E-03 | 4.83E-03                  | 5.47E-03 | 4.75E-03                  | 1.67E-05 | 7.64E-05                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 7                           | 7  | 4.11E-03                                    | 0. | 4.37E-03                  | 4.19E-03 | 3.89E-03                  | 4.17E-03 | 3.97E-03                  | 1.16E-05 | 5.24E-05                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 8                           | 8  | 3.34E-03                                    | 0. | 3.40E-03                  | 3.11E-03 | 3.17E-03                  | 3.32E-03 | 3.29E-03                  | 7.32E-06 | 3.34E-05                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 9                           | 9  | 2.70E-03                                    | 0. | 2.73E-03                  | 2.66E-03 | 2.61E-03                  | 2.65E-03 | 2.62E-03                  | 5.29E-05 | 6.02E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 10                          | 10 | 2.19E-03                                    | 0. | 2.15E-03                  | 2.14E-03 | 2.14E-03                  | 2.16E-03 | 2.07E-03                  | 7.11E-05 | 4.44E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 11                          | 11 | 1.79E-03                                    | 0. | 1.76E-03                  | 1.75E-03 | 1.69E-03                  | 1.72E-03 | 1.56E-03                  | 4.51E-05 | 3.82E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 12                          | 12 | 1.40E-03                                    | 0. | 1.43E-03                  | 1.43E-03 | 1.28E-03                  | 1.29E-03 | 1.17E-03                  | 3.14E-05 | 3.50E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 13                          | 13 | 1.04E-03                                    | 0. | 1.20E-03                  | 1.18E-03 | 9.62E-04                  | 9.79E-04 | 8.62E-04                  | 3.86E-05 | 3.27E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 14                          | 14 | 7.59E-04                                    | 0. | 8.24E-04                  | 8.24E-04 | 7.13E-04                  | 7.32E-04 | 6.39E-04                  | 3.81E-05 | 3.22E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 15                          | 15 | 5.68E-04                                    | 0. | 6.84E-04                  | 6.84E-04 | 5.34E-04                  | 5.55E-04 | 4.73E-04                  | 3.87E-05 | 3.27E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 16                          | 16 | 4.19E-04                                    | 0. | 5.23E-04                  | 5.23E-04 | 3.95E-04                  | 3.90E-04 | 3.47E-04                  | 3.85E-05 | 3.27E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 17                          | 17 | 3.37E-04                                    | 0. | 4.56E-04                  | 4.56E-04 | 2.92E-04                  | 3.02E-04 | 2.58E-04                  | 3.73E-05 | 3.16E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 18                          | 18 | 2.66E-04                                    | 0. | 3.28E-04                  | 3.28E-04 | 2.17E-04                  | 2.23E-04 | 1.90E-04                  | 3.50E-05 | 2.96E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 19                          | 19 | 1.66E-04                                    | 0. | 1.99E-04                  | 1.99E-04 | 1.59E-04                  | 1.66E-04 | 1.40E-04                  | 4.17E-05 | 2.65E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 20                          | 20 | 1.21E-04                                    | 0. | 1.49E-04                  | 1.49E-04 | 1.16E-04                  | 1.24E-04 | 1.03E-04                  | 2.77E-05 | 2.32E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 21                          | 21 | 8.83E-05                                    | 0. | 1.03E-04                  | 9.93E-05 | 8.61E-05                  | 9.03E-05 | 7.59E-05                  | 2.32E-05 | 1.97E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 22                          | 22 | 6.40E-05                                    | 0. | 7.06E-05                  | 7.25E-05 | 6.24E-05                  | 6.74E-05 | 5.57E-05                  | 1.94E-05 | 1.65E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 23                          | 23 | 4.63E-05                                    | 0. | 4.88E-05                  | 5.17E-05 | 4.54E-05                  | 4.99E-05 | 4.09E-05                  | 1.61E-05 | 1.36E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 24                          | 24 | 3.36E-05                                    | 0. | 3.49E-05                  | 3.80E-05 | 3.24E-05                  | 3.67E-05 | 3.00E-05                  | 1.29E-05 | 1.09E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 25                          | 25 | 2.44E-05                                    | 0. | 2.53E-05                  | 2.76E-05 | 2.51E-05                  | 2.67E-05 | 2.20E-05                  | 1.02E-05 | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 26                          | 26 | 1.74E-05                                    | 0. | 1.87E-05                  | 1.97E-05 | 1.82E-05                  | 1.94E-05 | 1.65E-05                  | 1.15E-05 | 1.43E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 27                          | 27 | 1.25E-05                                    | 0. | 1.35E-05                  | 1.44E-05 | 1.29E-05                  | 1.41E-05 | 1.27E-05                  | 3.43E-06 | 4.40E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 28                          | 28 | 8.91E-06                                    | 0. | 9.62E-06                  | 1.03E-05 | 8.83E-06                  | 9.49E-06 | 8.09E-06                  | 1.69E-06 | 2.17E-06                  | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 29                          | 29 | 6.40E-06                                    | 0. | 6.84E-06                  | 7.25E-06 | 6.24E-06                  | 6.74E-06 | 5.57E-06                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 30                          | 30 | 4.63E-06                                    | 0. | 4.88E-06                  | 5.17E-06 | 4.54E-06                  | 4.99E-06 | 4.09E-06                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 31                          | 31 | 3.36E-06                                    | 0. | 3.49E-06                  | 3.80E-06 | 3.24E-06                  | 3.67E-06 | 3.00E-06                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 32                          | 32 | 2.44E-06                                    | 0. | 2.53E-06                  | 2.76E-06 | 2.51E-06                  | 2.67E-06 | 2.20E-06                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 33                          | 33 | 1.74E-06                                    | 0. | 1.87E-06                  | 1.97E-06 | 1.82E-06                  | 1.94E-06 | 1.65E-06                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 34                          | 34 | 1.25E-06                                    | 0. | 1.35E-06                  | 1.44E-06 | 1.29E-06                  | 1.41E-06 | 1.27E-06                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 35                          | 35 | 8.91E-07                                    | 0. | 9.62E-07                  | 1.03E-06 | 8.83E-07                  | 9.49E-07 | 8.09E-07                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 36                          | 36 | 6.40E-07                                    | 0. | 6.84E-07                  | 7.25E-07 | 6.24E-07                  | 6.74E-07 | 5.57E-07                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 37                          | 37 | 4.63E-07                                    | 0. | 4.88E-07                  | 5.17E-07 | 4.54E-07                  | 4.99E-07 | 4.09E-07                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 38                          | 38 | 3.36E-07                                    | 0. | 3.49E-07                  | 3.80E-07 | 3.24E-07                  | 3.67E-07 | 3.00E-07                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 39                          | 39 | 2.44E-07                                    | 0. | 2.53E-07                  | 2.76E-07 | 2.51E-07                  | 2.67E-07 | 2.20E-07                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 40                          | 40 | 1.74E-07                                    | 0. | 1.87E-07                  | 1.97E-07 | 1.82E-07                  | 1.94E-07 | 1.65E-07                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 41                          | 41 | 1.25E-07                                    | 0. | 1.35E-07                  | 1.44E-07 | 1.29E-07                  | 1.41E-07 | 1.27E-07                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 42                          | 42 | 8.91E-08                                    | 0. | 9.62E-08                  | 1.03E-07 | 8.83E-08                  | 9.49E-08 | 8.09E-08                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 43                          | 43 | 6.40E-08                                    | 0. | 6.84E-08                  | 7.25E-08 | 6.24E-08                  | 6.74E-08 | 5.57E-08                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 44                          | 44 | 4.63E-08                                    | 0. | 4.88E-08                  | 5.17E-08 | 4.54E-08                  | 4.99E-08 | 4.09E-08                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 45                          | 45 | 3.36E-08                                    | 0. | 3.49E-08                  | 3.80E-08 | 3.24E-08                  | 3.67E-08 | 3.00E-08                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 46                          | 46 | 2.44E-08                                    | 0. | 2.53E-08                  | 2.76E-08 | 2.51E-08                  | 2.67E-08 | 2.20E-08                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 47                          | 47 | 1.74E-08                                    | 0. | 1.87E-08                  | 1.97E-08 | 1.82E-08                  | 1.94E-08 | 1.65E-08                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 48                          | 48 | 1.25E-08                                    | 0. | 1.35E-08                  | 1.44E-08 | 1.29E-08                  | 1.41E-08 | 1.27E-08                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 49                          | 49 | 8.91E-09                                    | 0. | 9.62E-09                  | 1.03E-08 | 8.83E-09                  | 9.49E-09 | 8.09E-09                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 50                          | 50 | 6.40E-09                                    | 0. | 6.84E-09                  | 7.25E-09 | 6.24E-09                  | 6.74E-09 | 5.57E-09                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 51                          | 51 | 4.63E-09                                    | 0. | 4.88E-09                  | 5.17E-09 | 4.54E-09                  | 4.99E-09 | 4.09E-09                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 52                          | 52 | 3.36E-09                                    | 0. | 3.49E-09                  | 3.80E-09 | 3.24E-09                  | 3.67E-09 | 3.00E-09                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 53                          | 53 | 2.44E-09                                    | 0. | 2.53E-09                  | 2.76E-09 | 2.51E-09                  | 2.67E-09 | 2.20E-09                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 54                          | 54 | 1.74E-09                                    | 0. | 1.87E-09                  | 1.97E-09 | 1.82E-09                  | 1.94E-09 | 1.65E-09                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 55                          | 55 | 1.25E-09                                    | 0. | 1.35E-09                  | 1.44E-09 | 1.29E-09                  | 1.41E-09 | 1.27E-09                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 56                          | 56 | 8.91E-10                                    | 0. | 9.62E-10                  | 1.03E-09 | 8.83E-10                  | 9.49E-10 | 8.09E-10                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 57                          | 57 | 6.40E-10                                    | 0. | 6.84E-10                  | 7.25E-10 | 6.24E-10                  | 6.74E-10 | 5.57E-10                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 58                          | 58 | 4.63E-10                                    | 0. | 4.88E-10                  | 5.17E-10 | 4.54E-10                  | 4.99E-10 | 4.09E-10                  | 0.       | 0.                        | 1.03E-02 | 1.03E-02                             | 7.11E-02 | 1.03E-02                             | 7.11E-02 |
| 59                          | 59 | 3.36E-10                                    | 0. | 3.49E-10                  | 3.80E-10 | 3.24E-10                  |          |                           |          |                           |          |                                      |          |                                      |          |

WAVELENGTH = 3.730353 MICROMETERS  
FREQUENCY = 260.0207 HAVENUMBERS

| H(km)    | U.S.<br>STANDARD<br>$L_m(km^{-1})$ | MIDLAT SUBARCTIC SUBARCTIC |                          |                          |                          | AEROSOL                 |                        |
|----------|------------------------------------|----------------------------|--------------------------|--------------------------|--------------------------|-------------------------|------------------------|
|          |                                    | TROPICAL<br>$L_m(km^{-1})$ | SUMMER<br>$L_m(km^{-1})$ | WINTER<br>$L_m(km^{-1})$ | WINTER<br>$L_m(km^{-1})$ | CLEAR<br>$L_a(km^{-1})$ | HAZY<br>$L_a(km^{-1})$ |
| 0 - 1    | 3.31E-02 0.                        | 1.10E-01                   | 8.63E-02                 | 2.95E-02                 | 5.94E-02                 | 0.54E-04                | 1.04E-02               |
| 1 - 2    | 3.25E-02 0.                        | 0.14E-02                   | 6.42E-02                 | 2.36E-02                 | 4.70E-02                 | 6.32E-04                | 1.04E-02               |
| 2 - 3    | 2.29E-02 1.                        | 5.04E-02                   | 4.13E-02                 | 1.52E-02                 | 3.03E-02                 | 7.11E-05                | 1.13E-03               |
| 3 - 4    | 1.44E-02 0.                        | 3.78E-02                   | 2.37E-02                 | 1.00E-02                 | 1.96E-02                 | 3.64E-05                | 1.92E-04               |
| 4 - 5    | 9.12E-03 0.                        | 1.61E-02                   | 1.33E-02                 | 7.05E-03                 | 1.22E-02                 | 7.97E-05                | 1.05E-04               |
| 5 - 6    | 5.41E-03 0.                        | 9.11E-03                   | 7.54E-03                 | 4.52E-03                 | 7.56E-03                 | 7.24E-05                | 5.45E-05               |
| 6 - 7    | 3.80E-03 0.                        | 5.83E-03                   | 4.59E-03                 | 3.04E-03                 | 4.64E-03                 | 1.70E-05                | 3.46E-05               |
| 7 - 8    | 2.56E-03 0.                        | 3.56E-03                   | 3.06E-03                 | 2.04E-03                 | 2.99E-03                 | 1.17E-05                | 2.23E-05               |
| 8 - 9    | 1.70E-03 0.                        | 2.27E-03                   | 2.06E-03                 | 1.83E-03                 | 1.67E-03                 | 7.42E-06                | 1.89E-05               |
| 9 - 10   | 1.25E-03 0.                        | 1.49E-03                   | 1.42E-03                 | 1.07E-03                 | 1.23E-03                 | 7.27E-06                | 1.25E-05               |
| 10 - 11  | 8.92E-04 0.                        | 9.96E-04                   | 1.02E-03                 | 9.22E-04                 | 9.73E-04                 | 5.42E-06                | 9.15E-06               |
| 11 - 12  | 6.77E-04 0.                        | 7.29E-04                   | 7.27E-04                 | 6.26E-04                 | 6.51E-04                 | 4.62E-06                | 9.88E-06               |
| 12 - 13  | 5.06E-04 0.                        | 5.35E-04                   | 5.37E-04                 | 4.75E-04                 | 4.75E-04                 | 4.24E-06                | 1.14E-05               |
| 13 - 14  | 3.66E-04 0.                        | 4.13E-04                   | 3.40E-04                 | 3.45E-04                 | 3.01E-04                 | 3.95E-06                | 1.31E-05               |
| 14 - 15  | 2.66E-04 0.                        | 3.11E-04                   | 2.34E-04                 | 2.55E-04                 | 2.20E-04                 | 3.69E-06                | 1.42E-05               |
| 15 - 16  | 1.94E-04 0.                        | 2.58E-04                   | 2.34E-04                 | 1.82E-04                 | 1.91E-04                 | 3.99E-06                | 1.45E-05               |
| 16 - 17  | 1.40E-04 0.                        | 1.65E-04                   | 1.56E-04                 | 1.34E-04                 | 1.33E-04                 | 3.95E-06                | 1.41E-05               |
| 17 - 18  | 1.05E-04 0.                        | 1.15E-04                   | 1.15E-04                 | 9.38E-05                 | 1.03E-04                 | 3.82E-06                | 1.30E-05               |
| 18 - 19  | 7.59E-05 0.                        | 8.78E-05                   | 7.95E-05                 | 7.55E-05                 | 6.34E-05                 | 3.55E-06                | 1.14E-05               |
| 19 - 20  | 5.55E-05 0.                        | 7.37E-05                   | 6.36E-05                 | 5.31E-05                 | 5.60E-05                 | 3.24E-06                | 9.49E-06               |
| 20 - 21  | 4.06E-05 0.                        | 4.65E-05                   | 4.63E-05                 | 4.17E-05                 | 3.45E-05                 | 2.81E-06                | 7.51E-06               |
| 21 - 22  | 2.96E-05 0.                        | 3.42E-05                   | 3.34E-05                 | 2.89E-05                 | 2.74E-05                 | 2.38E-06                | 6.04E-06               |
| 22 - 23  | 2.16E-05 0.                        | 2.45E-05                   | 2.45E-05                 | 2.27E-05                 | 1.86E-05                 | 1.99E-06                | 4.85E-06               |
| 23 - 24  | 1.56E-05 0.                        | 1.64E-05                   | 1.52E-05                 | 1.54E-05                 | 1.37E-05                 | 1.65E-06                | 3.74E-06               |
| 24 - 25  | 1.13E-05 0.                        | 1.17E-05                   | 1.31E-05                 | 1.10E-05                 | 1.24E-05                 | 1.32E-06                | 2.92E-06               |
| 25 - 26  | 8.24E-06 0.                        | 9.35E-06                   | 8.47E-06                 | 9.37E-06                 | 7.43E-06                 | 1.04E-06                | 2.30E-06               |
| 26 - 27  | 5.93E-06 0.                        | 5.93E-06                   | 5.93E-06                 | 3.39E-06                 | 3.03E-06                 | 1.11E-06                | 2.30E-06               |
| 27 - 28  | 4.06E-06 0.                        | 3.92E-06                   | 3.92E-06                 | 3.47E-06                 | 3.03E-06                 | 1.11E-06                | 2.30E-06               |
| 28 - 29  | 2.84E-06 0.                        | 2.84E-06                   | 2.84E-06                 | 2.84E-06                 | 2.84E-06                 | 1.11E-06                | 2.30E-06               |
| 29 - 30  | 2.06E-06 0.                        | 2.06E-06                   | 2.06E-06                 | 2.06E-06                 | 2.06E-06                 | 1.11E-06                | 2.30E-06               |
| 30 - 31  | 1.49E-06 0.                        | 1.49E-06                   | 1.49E-06                 | 1.49E-06                 | 1.49E-06                 | 1.11E-06                | 2.30E-06               |
| 31 - 32  | 1.06E-06 0.                        | 1.06E-06                   | 1.06E-06                 | 1.06E-06                 | 1.06E-06                 | 1.11E-06                | 2.30E-06               |
| 32 - 33  | 7.59E-07 0.                        | 7.59E-07                   | 7.59E-07                 | 7.59E-07                 | 7.59E-07                 | 1.11E-06                | 2.30E-06               |
| 33 - 34  | 5.41E-07 0.                        | 5.41E-07                   | 5.41E-07                 | 5.41E-07                 | 5.41E-07                 | 1.11E-06                | 2.30E-06               |
| 34 - 35  | 3.80E-07 0.                        | 3.80E-07                   | 3.80E-07                 | 3.80E-07                 | 3.80E-07                 | 1.11E-06                | 2.30E-06               |
| 35 - 36  | 2.56E-07 0.                        | 2.56E-07                   | 2.56E-07                 | 2.56E-07                 | 2.56E-07                 | 1.11E-06                | 2.30E-06               |
| 36 - 37  | 1.70E-07 0.                        | 1.70E-07                   | 1.70E-07                 | 1.70E-07                 | 1.70E-07                 | 1.11E-06                | 2.30E-06               |
| 37 - 38  | 1.25E-07 0.                        | 1.25E-07                   | 1.25E-07                 | 1.25E-07                 | 1.25E-07                 | 1.11E-06                | 2.30E-06               |
| 38 - 39  | 8.92E-08 0.                        | 8.92E-08                   | 8.92E-08                 | 8.92E-08                 | 8.92E-08                 | 1.11E-06                | 2.30E-06               |
| 39 - 40  | 6.77E-08 0.                        | 6.77E-08                   | 6.77E-08                 | 6.77E-08                 | 6.77E-08                 | 1.11E-06                | 2.30E-06               |
| 40 - 41  | 5.06E-08 0.                        | 5.06E-08                   | 5.06E-08                 | 5.06E-08                 | 5.06E-08                 | 1.11E-06                | 2.30E-06               |
| 41 - 42  | 3.66E-08 0.                        | 3.66E-08                   | 3.66E-08                 | 3.66E-08                 | 3.66E-08                 | 1.11E-06                | 2.30E-06               |
| 42 - 43  | 2.66E-08 0.                        | 2.66E-08                   | 2.66E-08                 | 2.66E-08                 | 2.66E-08                 | 1.11E-06                | 2.30E-06               |
| 43 - 44  | 1.94E-08 0.                        | 1.94E-08                   | 1.94E-08                 | 1.94E-08                 | 1.94E-08                 | 1.11E-06                | 2.30E-06               |
| 44 - 45  | 1.40E-08 0.                        | 1.40E-08                   | 1.40E-08                 | 1.40E-08                 | 1.40E-08                 | 1.11E-06                | 2.30E-06               |
| 45 - 46  | 1.05E-08 0.                        | 1.05E-08                   | 1.05E-08                 | 1.05E-08                 | 1.05E-08                 | 1.11E-06                | 2.30E-06               |
| 46 - 47  | 7.59E-09 0.                        | 7.59E-09                   | 7.59E-09                 | 7.59E-09                 | 7.59E-09                 | 1.11E-06                | 2.30E-06               |
| 47 - 48  | 5.55E-09 0.                        | 5.55E-09                   | 5.55E-09                 | 5.55E-09                 | 5.55E-09                 | 1.11E-06                | 2.30E-06               |
| 48 - 49  | 4.06E-09 0.                        | 4.06E-09                   | 4.06E-09                 | 4.06E-09                 | 4.06E-09                 | 1.11E-06                | 2.30E-06               |
| 49 - 50  | 2.96E-09 0.                        | 2.96E-09                   | 2.96E-09                 | 2.96E-09                 | 2.96E-09                 | 1.11E-06                | 2.30E-06               |
| 50 - 51  | 2.16E-09 0.                        | 2.16E-09                   | 2.16E-09                 | 2.16E-09                 | 2.16E-09                 | 1.11E-06                | 2.30E-06               |
| 51 - 52  | 1.56E-09 0.                        | 1.56E-09                   | 1.56E-09                 | 1.56E-09                 | 1.56E-09                 | 1.11E-06                | 2.30E-06               |
| 52 - 53  | 1.13E-09 0.                        | 1.13E-09                   | 1.13E-09                 | 1.13E-09                 | 1.13E-09                 | 1.11E-06                | 2.30E-06               |
| 53 - 54  | 8.24E-10 0.                        | 8.24E-10                   | 8.24E-10                 | 8.24E-10                 | 8.24E-10                 | 1.11E-06                | 2.30E-06               |
| 54 - 55  | 5.93E-10 0.                        | 5.93E-10                   | 5.93E-10                 | 5.93E-10                 | 5.93E-10                 | 1.11E-06                | 2.30E-06               |
| 55 - 56  | 4.06E-10 0.                        | 4.06E-10                   | 4.06E-10                 | 4.06E-10                 | 4.06E-10                 | 1.11E-06                | 2.30E-06               |
| 56 - 57  | 2.84E-10 0.                        | 2.84E-10                   | 2.84E-10                 | 2.84E-10                 | 2.84E-10                 | 1.11E-06                | 2.30E-06               |
| 57 - 58  | 2.06E-10 0.                        | 2.06E-10                   | 2.06E-10                 | 2.06E-10                 | 2.06E-10                 | 1.11E-06                | 2.30E-06               |
| 58 - 59  | 1.49E-10 0.                        | 1.49E-10                   | 1.49E-10                 | 1.49E-10                 | 1.49E-10                 | 1.11E-06                | 2.30E-06               |
| 59 - 60  | 1.06E-10 0.                        | 1.06E-10                   | 1.06E-10                 | 1.06E-10                 | 1.06E-10                 | 1.11E-06                | 2.30E-06               |
| 60 - 61  | 7.59E-11 0.                        | 7.59E-11                   | 7.59E-11                 | 7.59E-11                 | 7.59E-11                 | 1.11E-06                | 2.30E-06               |
| 61 - 62  | 5.41E-11 0.                        | 5.41E-11                   | 5.41E-11                 | 5.41E-11                 | 5.41E-11                 | 1.11E-06                | 2.30E-06               |
| 62 - 63  | 3.80E-11 0.                        | 3.80E-11                   | 3.80E-11                 | 3.80E-11                 | 3.80E-11                 | 1.11E-06                | 2.30E-06               |
| 63 - 64  | 2.56E-11 0.                        | 2.56E-11                   | 2.56E-11                 | 2.56E-11                 | 2.56E-11                 | 1.11E-06                | 2.30E-06               |
| 64 - 65  | 1.70E-11 0.                        | 1.70E-11                   | 1.70E-11                 | 1.70E-11                 | 1.70E-11                 | 1.11E-06                | 2.30E-06               |
| 65 - 66  | 1.25E-11 0.                        | 1.25E-11                   | 1.25E-11                 | 1.25E-11                 | 1.25E-11                 | 1.11E-06                | 2.30E-06               |
| 66 - 67  | 8.92E-12 0.                        | 8.92E-12                   | 8.92E-12                 | 8.92E-12                 | 8.92E-12                 | 1.11E-06                | 2.30E-06               |
| 67 - 68  | 6.77E-12 0.                        | 6.77E-12                   | 6.77E-12                 | 6.77E-12                 | 6.77E-12                 | 1.11E-06                | 2.30E-06               |
| 68 - 69  | 5.06E-12 0.                        | 5.06E-12                   | 5.06E-12                 | 5.06E-12                 | 5.06E-12                 | 1.11E-06                | 2.30E-06               |
| 69 - 70  | 3.66E-12 0.                        | 3.66E-12                   | 3.66E-12                 | 3.66E-12                 | 3.66E-12                 | 1.11E-06                | 2.30E-06               |
| 70 - 71  | 2.66E-12 0.                        | 2.66E-12                   | 2.66E-12                 | 2.66E-12                 | 2.66E-12                 | 1.11E-06                | 2.30E-06               |
| 71 - 72  | 1.94E-12 0.                        | 1.94E-12                   | 1.94E-12                 | 1.94E-12                 | 1.94E-12                 | 1.11E-06                | 2.30E-06               |
| 72 - 73  | 1.40E-12 0.                        | 1.40E-12                   | 1.40E-12                 | 1.40E-12                 | 1.40E-12                 | 1.11E-06                | 2.30E-06               |
| 73 - 74  | 1.05E-12 0.                        | 1.05E-12                   | 1.05E-12                 | 1.05E-12                 | 1.05E-12                 | 1.11E-06                | 2.30E-06               |
| 74 - 75  | 7.59E-13 0.                        | 7.59E-13                   | 7.59E-13                 | 7.59E-13                 | 7.59E-13                 | 1.11E-06                | 2.30E-06               |
| 75 - 76  | 5.55E-13 0.                        | 5.55E-13                   | 5.55E-13                 | 5.55E-13                 | 5.55E-13                 | 1.11E-06                | 2.30E-06               |
| 76 - 77  | 4.06E-13 0.                        | 4.06E-13                   | 4.06E-13                 | 4.06E-13                 | 4.06E-13                 | 1.11E-06                | 2.30E-06               |
| 77 - 78  | 2.96E-13 0.                        | 2.96E-13                   | 2.96E-13                 | 2.96E-13                 | 2.96E-13                 | 1.11E-06                | 2.30E-06               |
| 78 - 79  | 2.16E-13 0.                        | 2.16E-13                   | 2.16E-13                 | 2.16E-13                 | 2.16E-13                 | 1.11E-06                | 2.30E-06               |
| 79 - 80  | 1.56E-13 0.                        | 1.56E-13                   | 1.56E-13                 | 1.56E-13                 | 1.56E-13                 | 1.11E-06                | 2.30E-06               |
| 80 - 81  | 1.13E-13 0.                        | 1.13E-13                   | 1.13E-13                 | 1.13E-13                 | 1.13E-13                 | 1.11E-06                | 2.30E-06               |
| 81 - 82  | 8.24E-14 0.                        | 8.24E-14                   | 8.24E-14                 | 8.24E-14                 | 8.24E-14                 | 1.11E-06                | 2.30E-06               |
| 82 - 83  | 5.93E-14 0.                        | 5.93E-14                   | 5.93E-14                 | 5.93E-14                 | 5.93E-14                 | 1.11E-06                | 2.30E-06               |
| 83 - 84  | 4.06E-14 0.                        | 4.06E-14                   | 4.06E-14                 | 4.06E-14                 | 4.06E-14                 | 1.11E-06                | 2.30E-06               |
| 84 - 85  | 2.84E-14 0.                        | 2.84E-14                   | 2.84E-14                 | 2.84E-14                 | 2.84E-14                 | 1.11E-06                | 2.30E-06               |
| 85 - 86  | 2.06E-14 0.                        | 2.06E-14                   | 2.06E-14                 | 2.06E-14                 | 2.06E-14                 | 1.11E-06                | 2.30E-06               |
| 86 - 87  | 1.49E-14 0.                        | 1.49E-14                   | 1.49E-14                 | 1.49E-14                 | 1.49E-14                 | 1.11E-06                | 2.30E-06               |
| 87 - 88  | 1.06E-14 0.                        | 1.06E-14                   | 1.06E-14                 | 1.06E-14                 | 1.06E-14                 | 1.11E-06                | 2.30E-06               |
| 88 - 89  | 7.59E-15 0.                        | 7.59E-15                   | 7.59E-15                 | 7.59E-15                 | 7.59E-15                 | 1.11E-06                | 2.30E-06               |
| 89 - 90  | 5.41E-15 0.                        | 5.41E-15                   | 5.41E-15                 | 5.41E-15                 | 5.41E-15                 | 1.11E-06                | 2.30E-06               |
| 90 - 91  | 3.80E-15 0.                        | 3.80E-15                   | 3.80E-15                 | 3.80E-15                 | 3.80E-15                 | 1.11E-06                | 2.30E-06               |
| 91 - 92  | 2.56E-15 0.                        | 2.56E-15                   | 2.56E-15                 | 2.56E-15                 | 2.56E-15                 | 1.11E-06                | 2.30E-06               |
| 92 - 93  | 1.70E-15 0.                        | 1.70E-15                   | 1.70E-15                 | 1.70E-15                 | 1.70E-15                 | 1.11E-06                | 2.30E-06               |
| 93 - 94  | 1.25E-15 0.                        | 1.25E-15                   | 1.25E-15                 | 1.25E-15                 | 1.25E-15                 | 1.11E-06                | 2.30E-06               |
| 94 - 95  | 8.92E-16 0.                        | 8.92E-16                   | 8.92E-16                 | 8.92E-16                 | 8.92E-16                 | 1.11E-06                | 2.30E-06               |
| 95 - 96  | 6.77E-16 0.                        | 6.77E-16                   | 6.77E-16                 | 6.77E-16                 | 6.77E-16                 | 1.11E-06                | 2.30E-06               |
| 96 - 97  | 5.06E-16 0.                        | 5.06E-16                   | 5.06E-16                 | 5.06E-16                 | 5.06E-16                 | 1.11E-06                | 2.30E-06               |
| 97 - 98  | 3.66E-16 0.                        | 3.66E-16                   | 3.66E-16                 | 3.66E-16                 | 3.66E-16                 | 1.11E-06                | 2.30E-06               |
| 98 - 99  | 2.66E-16 0.                        | 2.66E-16                   | 2.66E-16                 | 2.66E-16                 | 2.66E-16                 | 1.11E-06                | 2.30E-06               |
| 99 - 100 | 1.94E-16 0.                        | 1.94E-16                   | 1.94E-16                 | 1.94E-16                 | 1.94E-16                 | 1.11E-06                | 2.30E-06               |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

| U.S.<br>STANDARD<br>$L_m(km^{-1})$ | MIDLAT SUBARCTIC SUBARCTIC |                          |                          |                          | AEROSOL                 |                        |
|------------------------------------|----------------------------|--------------------------|--------------------------|--------------------------|-------------------------|------------------------|
|                                    | TROPICAL<br>$L_m(km^{-1})$ | SUMMER<br>$L_m(km^{-1})$ | WINTER<br>$L_m(km^{-1})$ | WINTER<br>$L_m(km^{-1})$ | CLEAR<br>$L_a(km^{-1})$ | HAZY<br>$L_a(km^{-1})$ |
| 0 - 1                              | 3.31E-02 0.                | 1.10E-01                 | 8.63E-02                 | 2.95E-02                 | 5.94E-02                | 0.54E-04               |
| 1 - 2                              | 3.25E-02 0.                | 0.14E-02                 | 6.42E-02                 | 2.36E-02                 | 4.70E-02                | 6.32E-04               |
| 2 - 3                              | 2.29E-02 1.                | 5.04E-02                 | 4.13E-02                 | 1.52E-02                 | 3.03E-02                | 7.11E-05               |
| 3 - 4                              | 1.44E-02 0.                | 3.78E-02                 | 2.37E-02                 | 1.00E-02                 | 1.96E-02                | 3.64E-05               |
| 4 - 5                              | 9.12E-03 0.                | 1.61E-02                 | 1.33E-02                 | 7.05E-03                 | 1.22E-02                | 7.97E-05               |
| 5 - 6                              | 5.41E-03 0.                | 9.11E-03                 | 7.54E-03                 | 4.52E-03                 | 7.56E-03                | 1.70E-05               |
| 6 - 7                              | 3.80E-03 0.                | 5.83E-03                 | 4.59E-03                 | 3.04E-03                 | 4.64E-03                | 1.17E-05               |
| 7 - 8                              | 2.56E-03 0.                | 3.56E-03                 | 3.06E-03                 | 2.04E-03                 | 2.99E-03                | 7.42E-06               |
| 8 - 9                              | 1.70E-03 0.                | 2.27E-03                 | 2.00E-03                 | 1.32E-03                 | 1.96E-03                | 4.64E-06               |
| 9 - 10                             | 1.00E-03 0.                | 1.32E-03                 | 1.32E-03                 | 8.63E-04                 | 1.32E-03                | 3.03E-06               |

WAVELENGTH = 3.90705 MICROMETERS  
FREQUENCY = 2531.090 WAVENUMBERS

| ht(km) | U.S. STANDARD                 |                                | TROPICAL                      |                                | MIDLAT                        |                                | MIDLAT SUBARCTIC              |                                | SUBARCTIC                     |                                | WINTER                        |                                | WINTER                        |                                | HAZY                          |                                |
|--------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|        | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0      | 1.56E-02                      | 0.                             | 3.22E-02                      | 3.00E-02                       | 1.32E-02                      | 2.12E-02                       | 9.47E-03                      | 9.47E-03                       | 9.59E-04                      | 6.47E-03                       | 1.04E-02                      | 7.05E-02                       | 1.04E-02                      | 7.05E-02                       | 1.04E-02                      | 7.05E-02                       |
| 1      | 1.36E-02                      | 0.                             | 3.12E-02                      | 2.44E-02                       | 1.14E-02                      | 1.91E-02                       | 8.62E-03                      | 8.62E-03                       | 6.35E-04                      | 4.28E-03                       | 1.04E-02                      | 7.05E-02                       | 1.04E-02                      | 7.05E-02                       | 1.04E-02                      | 7.05E-02                       |
| 2      | 1.04E-02                      | 0.                             | 2.15E-02                      | 1.60E-02                       | 6.94E-03                      | 1.23E-02                       | 7.44E-03                      | 7.44E-03                       | 7.13E-05                      | 3.10E-04                       | 1.14E-03                      | 4.95E-03                       | 1.14E-03                      | 4.95E-03                       | 1.14E-03                      | 4.95E-03                       |
| 3      | 7.30E-03                      | 0.                             | 1.36E-02                      | 1.05E-02                       | 7.15E-03                      | 9.54E-03                       | 6.40E-03                      | 6.40E-03                       | 3.65E-05                      | 1.59E-04                       | 1.92E-04                      | 2.77E-04                       | 1.92E-04                      | 2.77E-04                       | 1.92E-04                      | 2.77E-04                       |
| 4      | 5.27E-03                      | 0.                             | 9.11E-03                      | 7.31E-03                       | 5.82E-03                      | 7.25E-03                       | 5.53E-03                      | 5.53E-03                       | 2.97E-05                      | 1.29E-04                       | 1.05E-04                      | 2.34E-04                       | 1.05E-04                      | 2.34E-04                       | 1.05E-04                      | 2.34E-04                       |
| 5      | 4.57E-03                      | 0.                             | 4.95E-03                      | 5.53E-03                       | 4.92E-03                      | 5.44E-03                       | 4.92E-03                      | 4.92E-03                       | 2.29E-05                      | 9.47E-05                       | 5.47E-05                      | 2.34E-04                       | 5.47E-05                      | 2.34E-04                       | 5.47E-05                      | 2.34E-04                       |
| 6      | 4.24E-03                      | 0.                             | 4.22E-03                      | 4.14E-03                       | 4.14E-03                      | 4.24E-03                       | 4.14E-03                      | 4.14E-03                       | 1.70E-05                      | 7.40E-05                       | 3.47E-05                      | 1.51E-04                       | 3.47E-05                      | 1.51E-04                       | 3.47E-05                      | 1.51E-04                       |
| 7      | 4.00E-03                      | 0.                             | 3.42E-03                      | 3.42E-03                       | 3.42E-03                      | 3.42E-03                       | 3.42E-03                      | 3.42E-03                       | 1.10E-05                      | 5.12E-05                       | 2.64E-05                      | 1.23E-04                       | 2.64E-05                      | 1.23E-04                       | 2.64E-05                      | 1.23E-04                       |
| 8      | 3.60E-03                      | 0.                             | 3.42E-03                      | 3.42E-03                       | 3.42E-03                      | 3.42E-03                       | 3.42E-03                      | 3.42E-03                       | 7.44E-06                      | 3.24E-05                       | 1.90E-05                      | 8.26E-05                       | 1.90E-05                      | 8.26E-05                       | 1.90E-05                      | 8.26E-05                       |
| 9      | 3.50E-03                      | 0.                             | 3.42E-03                      | 3.42E-03                       | 3.42E-03                      | 3.42E-03                       | 3.42E-03                      | 3.42E-03                       | 6.96E-06                      | 5.76E-06                       | 1.15E-05                      | 7.02E-05                       | 1.15E-05                      | 7.02E-05                       | 1.15E-05                      | 7.02E-05                       |
| 10     | 3.51E-03                      | 0.                             | 3.28E-03                      | 3.25E-03                       | 3.45E-03                      | 3.37E-03                       | 3.34E-03                      | 3.34E-03                       | 5.18E-06                      | 3.13E-06                       | 8.39E-06                      | 5.13E-05                       | 8.39E-06                      | 5.13E-05                       | 8.39E-06                      | 5.13E-05                       |
| 11     | 3.23E-03                      | 0.                             | 3.08E-03                      | 3.08E-03                       | 3.08E-03                      | 3.08E-03                       | 3.08E-03                      | 3.08E-03                       | 4.05E-06                      | 3.35E-06                       | 1.04E-05                      | 6.34E-05                       | 1.04E-05                      | 6.34E-05                       | 1.04E-05                      | 6.34E-05                       |
| 12     | 2.83E-03                      | 0.                             | 3.00E-03                      | 2.94E-03                       | 2.70E-03                      | 2.63E-03                       | 2.57E-03                      | 2.57E-03                       | 3.78E-06                      | 3.13E-06                       | 1.20E-05                      | 7.34E-05                       | 1.20E-05                      | 7.34E-05                       | 1.20E-05                      | 7.34E-05                       |
| 13     | 2.42E-03                      | 0.                             | 2.57E-03                      | 2.53E-03                       | 2.30E-03                      | 2.23E-03                       | 2.17E-03                      | 2.17E-03                       | 3.73E-06                      | 3.09E-06                       | 1.30E-05                      | 7.97E-05                       | 1.30E-05                      | 7.97E-05                       | 1.30E-05                      | 7.97E-05                       |
| 14     | 2.03E-03                      | 0.                             | 2.57E-03                      | 2.53E-03                       | 1.94E-03                      | 1.86E-03                       | 1.80E-03                      | 1.80E-03                       | 3.70E-06                      | 3.13E-06                       | 1.30E-05                      | 7.97E-05                       | 1.30E-05                      | 7.97E-05                       | 1.30E-05                      | 7.97E-05                       |
| 15     | 1.66E-03                      | 0.                             | 2.29E-03                      | 1.84E-03                       | 1.59E-03                      | 1.52E-03                       | 1.45E-03                      | 1.45E-03                       | 3.65E-06                      | 3.02E-06                       | 1.19E-05                      | 7.29E-05                       | 1.19E-05                      | 7.29E-05                       | 1.19E-05                      | 7.29E-05                       |
| 16     | 1.32E-03                      | 0.                             | 1.66E-03                      | 1.17E-03                       | 1.27E-03                      | 1.28E-03                       | 1.16E-03                      | 1.16E-03                       | 3.42E-06                      | 2.83E-06                       | 1.04E-05                      | 6.34E-05                       | 1.04E-05                      | 6.34E-05                       | 1.04E-05                      | 6.34E-05                       |
| 17     | 1.04E-03                      | 0.                             | 1.46E-03                      | 1.01E-03                       | 1.01E-03                      | 1.02E-03                       | 9.09E-04                      | 9.09E-04                       | 3.10E-06                      | 2.57E-06                       | 8.70E-06                      | 5.32E-05                       | 8.70E-06                      | 5.32E-05                       | 8.70E-06                      | 5.32E-05                       |
| 18     | 8.08E-04                      | 0.                             | 1.04E-03                      | 9.09E-04                       | 7.80E-04                      | 7.99E-04                       | 7.02E-04                      | 7.02E-04                       | 2.69E-06                      | 2.22E-06                       | 6.34E-06                      | 4.27E-05                       | 6.34E-06                      | 4.27E-05                       | 6.34E-06                      | 4.27E-05                       |
| 19     | 6.17E-04                      | 0.                             | 7.50E-04                      | 5.93E-04                       | 5.93E-04                      | 6.23E-04                       | 5.36E-04                      | 5.36E-04                       | 2.27E-06                      | 1.88E-06                       | 5.57E-06                      | 3.41E-05                       | 5.57E-06                      | 3.41E-05                       | 5.57E-06                      | 3.41E-05                       |
| 20     | 4.64E-04                      | 0.                             | 5.37E-04                      | 5.17E-04                       | 4.54E-04                      | 4.59E-04                       | 4.05E-04                      | 4.05E-04                       | 1.90E-06                      | 1.57E-06                       | 4.45E-06                      | 2.72E-05                       | 4.45E-06                      | 2.72E-05                       | 4.45E-06                      | 2.72E-05                       |
| 21     | 3.44E-04                      | 0.                             | 3.73E-04                      | 3.68E-04                       | 3.37E-04                      | 3.59E-04                       | 3.03E-04                      | 3.03E-04                       | 1.50E-06                      | 1.31E-06                       | 3.46E-06                      | 2.12E-05                       | 3.46E-06                      | 2.12E-05                       | 3.46E-06                      | 2.12E-05                       |
| 22     | 2.53E-04                      | 0.                             | 2.67E-04                      | 2.61E-04                       | 2.44E-04                      | 2.71E-04                       | 2.26E-04                      | 2.26E-04                       | 1.26E-06                      | 1.05E-06                       | 2.66E-06                      | 1.64E-05                       | 2.66E-06                      | 1.64E-05                       | 2.66E-06                      | 1.64E-05                       |
| 23     | 1.86E-04                      | 0.                             | 1.93E-04                      | 2.14E-04                       | 1.82E-04                      | 2.02E-04                       | 1.67E-04                      | 1.67E-04                       | 9.96E-06                      | 0.                             | 2.11E-06                      | 1.29E-05                       | 2.11E-06                      | 1.29E-05                       | 2.11E-06                      | 1.29E-05                       |
| 24     | 1.37E-04                      | 0.                             | 1.41E-04                      | 1.54E-04                       | 1.43E-04                      | 1.45E-04                       | 1.24E-04                      | 1.24E-04                       | 1.12E-06                      | 1.41E-05                       | 2.06E-06                      | 3.60E-05                       | 1.12E-06                      | 3.60E-05                       | 1.12E-06                      | 3.60E-05                       |
| 25     | 5.86E-05                      | 0.                             | 5.79E-05                      | 6.56E-05                       | 5.80E-05                      | 6.42E-05                       | 5.16E-05                      | 5.16E-05                       | 3.45E-06                      | 4.33E-06                       | 6.56E-06                      | 8.25E-06                       | 3.45E-06                      | 8.25E-06                       | 3.45E-06                      | 8.25E-06                       |
| 30     | 2.18E-05                      | 0.                             | 2.18E-05                      | 2.48E-05                       | 1.99E-05                      | 1.37E-06                       | 1.75E-05                      | 1.75E-05                       | 1.69E-06                      | 2.13E-06                       | 2.13E-06                      | 2.67E-06                       | 1.69E-06                      | 2.67E-06                       | 1.69E-06                      | 2.67E-06                       |
| 35     | 5.95E-06                      | 0.                             | 5.31E-06                      | 7.13E-06                       | 5.10E-06                      | 7.31E-06                       | 4.91E-06                      | 4.91E-06                       | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 40     | 2.10E-06                      | 0.                             | 2.29E-06                      | 2.59E-06                       | 1.73E-06                      | 2.59E-06                       | 1.43E-06                      | 1.43E-06                       | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 45     | 0.                            | 0.                             | 0.                            | 1.14E-06                       | 0.                            | 1.18E-06                       | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 50     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 70     | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|              | CLEAR                         |                                | HAZY                          |                                |
|--------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|              | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| URBAN        | *****                         | *****                          | 6.05E-02                      | 5.44E-02                       |
| MARITIME     | 1.23E-03                      | 3.87E-02                       | 1.34E-02                      | 4.22E-01                       |
| TROPOSPHERIC | 2.84E-04                      | 1.24E-03                       | *****                         | *****                          |

| WAVELENGTH =<br>FREQUENCY = |    | 3.875729 MICROMETERS<br>2580.160 WAVENUMBERS |                                |                              |                                |                              |                                |                              |                                |                              |                                |                              |                                |
|-----------------------------|----|----------------------------------------------|--------------------------------|------------------------------|--------------------------------|------------------------------|--------------------------------|------------------------------|--------------------------------|------------------------------|--------------------------------|------------------------------|--------------------------------|
| h(km)                       | z  | U.S. STANDARD                                |                                | TROPICAL                     |                                | MIDLAT                       |                                | MIDLAT                       |                                | SUBARCTIC                    |                                | SUBARCTIC                    |                                |
|                             |    | $\rho_a$ (km <sup>-1</sup> )                 | $\sigma_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0                           | 1  | 1.73E-02                                     | 0.                             | 5.50E-02                     | 4.39E-02                       | 3.69E-02                     | 4.30E-02                       | 3.69E-02                     | 4.30E-02                       | 3.69E-02                     | 4.30E-02                       | 3.69E-02                     | 4.30E-02                       |
| 1                           | 2  | 3.31E-02                                     | 1.                             | 4.78E-02                     | 3.11E-02                       | 3.23E-02                     | 3.71E-02                       | 3.23E-02                     | 3.71E-02                       | 3.23E-02                     | 3.71E-02                       | 3.23E-02                     | 3.71E-02                       |
| 2                           | 3  | 2.54E-02                                     | 1.                             | 3.59E-02                     | 2.40E-02                       | 2.60E-02                     | 2.89E-02                       | 2.60E-02                     | 2.89E-02                       | 2.60E-02                     | 2.89E-02                       | 2.60E-02                     | 2.89E-02                       |
| 3                           | 4  | 2.14E-02                                     | 1.                             | 2.60E-02                     | 2.36E-02                       | 2.04E-02                     | 2.27E-02                       | 2.04E-02                     | 2.27E-02                       | 2.04E-02                     | 2.27E-02                       | 2.04E-02                     | 2.27E-02                       |
| 4                           | 5  | 1.70E-02                                     | 1.                             | 1.86E-02                     | 1.73E-02                       | 1.65E-02                     | 1.73E-02                       | 1.65E-02                     | 1.73E-02                       | 1.65E-02                     | 1.73E-02                       | 1.65E-02                     | 1.73E-02                       |
| 5                           | 6  | 1.35E-02                                     | 0.                             | 1.43E-02                     | 1.38E-02                       | 1.31E-02                     | 1.38E-02                       | 1.31E-02                     | 1.38E-02                       | 1.31E-02                     | 1.38E-02                       | 1.31E-02                     | 1.38E-02                       |
| 6                           | 7  | 1.07E-02                                     | 0.                             | 1.13E-02                     | 1.06E-02                       | 1.04E-02                     | 1.09E-02                       | 1.04E-02                     | 1.09E-02                       | 1.04E-02                     | 1.09E-02                       | 1.04E-02                     | 1.09E-02                       |
| 7                           | 8  | 8.47E-03                                     | 0.                             | 8.86E-03                     | 8.77E-03                       | 8.17E-03                     | 8.45E-03                       | 8.17E-03                     | 8.45E-03                       | 8.17E-03                     | 8.45E-03                       | 8.17E-03                     | 8.45E-03                       |
| 8                           | 9  | 6.56E-03                                     | 0.                             | 6.99E-03                     | 6.89E-03                       | 6.37E-03                     | 6.54E-03                       | 6.37E-03                     | 6.54E-03                       | 6.37E-03                     | 6.54E-03                       | 6.37E-03                     | 6.54E-03                       |
| 9                           | 10 | 5.17E-03                                     | 0.                             | 5.64E-03                     | 5.35E-03                       | 4.95E-03                     | 5.17E-03                       | 4.95E-03                     | 5.17E-03                       | 4.95E-03                     | 5.17E-03                       | 4.95E-03                     | 5.17E-03                       |
| 10                          | 11 | 3.98E-03                                     | 0.                             | 4.25E-03                     | 4.21E-03                       | 3.80E-03                     | 4.00E-03                       | 3.80E-03                     | 4.00E-03                       | 3.80E-03                     | 4.00E-03                       | 3.80E-03                     | 4.00E-03                       |
| 11                          | 12 | 3.05E-03                                     | 0.                             | 3.36E-03                     | 3.24E-03                       | 2.87E-03                     | 3.05E-03                       | 2.87E-03                     | 3.05E-03                       | 2.87E-03                     | 3.05E-03                       | 2.87E-03                     | 3.05E-03                       |
| 12                          | 13 | 2.29E-03                                     | 0.                             | 2.55E-03                     | 2.51E-03                       | 2.17E-03                     | 2.25E-03                       | 2.17E-03                     | 2.25E-03                       | 2.17E-03                     | 2.25E-03                       | 2.17E-03                     | 2.25E-03                       |
| 13                          | 14 | 1.68E-03                                     | 0.                             | 2.01E-03                     | 1.92E-03                       | 1.57E-03                     | 1.66E-03                       | 1.57E-03                     | 1.66E-03                       | 1.57E-03                     | 1.66E-03                       | 1.57E-03                     | 1.66E-03                       |
| 14                          | 15 | 1.23E-03                                     | 0.                             | 1.46E-03                     | 1.43E-03                       | 1.15E-03                     | 1.25E-03                       | 1.15E-03                     | 1.25E-03                       | 1.15E-03                     | 1.25E-03                       | 1.15E-03                     | 1.25E-03                       |
| 15                          | 16 | 9.02E-04                                     | 0.                             | 1.04E-03                     | 1.04E-03                       | 8.52E-04                     | 9.44E-04                       | 8.52E-04                     | 9.44E-04                       | 8.52E-04                     | 9.44E-04                       | 8.52E-04                     | 9.44E-04                       |
| 16                          | 17 | 6.60E-04                                     | 0.                             | 7.55E-04                     | 7.64E-04                       | 6.24E-04                     | 6.58E-04                       | 6.24E-04                     | 6.58E-04                       | 6.24E-04                     | 6.58E-04                       | 6.24E-04                     | 6.58E-04                       |
| 17                          | 18 | 4.93E-04                                     | 0.                             | 5.95E-04                     | 5.51E-04                       | 4.57E-04                     | 5.08E-04                       | 4.57E-04                     | 5.08E-04                       | 4.57E-04                     | 5.08E-04                       | 4.57E-04                     | 5.08E-04                       |
| 18                          | 19 | 3.54E-04                                     | 0.                             | 4.10E-04                     | 4.07E-04                       | 3.37E-04                     | 3.74E-04                       | 3.37E-04                     | 3.74E-04                       | 3.37E-04                     | 3.74E-04                       | 3.37E-04                     | 3.74E-04                       |
| 19                          | 20 | 2.50E-04                                     | 0.                             | 3.02E-04                     | 2.95E-04                       | 2.45E-04                     | 2.78E-04                       | 2.45E-04                     | 2.78E-04                       | 2.45E-04                     | 2.78E-04                       | 2.45E-04                     | 2.78E-04                       |
| 20                          | 21 | 1.89E-04                                     | 0.                             | 2.10E-04                     | 2.15E-04                       | 1.74E-04                     | 2.07E-04                       | 1.74E-04                     | 2.07E-04                       | 1.74E-04                     | 2.07E-04                       | 1.74E-04                     | 2.07E-04                       |
| 21                          | 22 | 1.34E-04                                     | 0.                             | 1.50E-04                     | 1.55E-04                       | 1.33E-04                     | 1.50E-04                       | 1.33E-04                     | 1.50E-04                       | 1.33E-04                     | 1.50E-04                       | 1.33E-04                     | 1.50E-04                       |
| 22                          | 23 | 1.01E-04                                     | 0.                             | 1.06E-04                     | 1.16E-04                       | 9.58E-05                     | 1.12E-04                       | 9.58E-05                     | 1.12E-04                       | 9.58E-05                     | 1.12E-04                       | 9.58E-05                     | 1.12E-04                       |
| 23                          | 24 | 7.33E-05                                     | 0.                             | 7.54E-05                     | 8.33E-05                       | 6.90E-05                     | 8.24E-05                       | 6.90E-05                     | 8.24E-05                       | 6.90E-05                     | 8.24E-05                       | 6.90E-05                     | 8.24E-05                       |
| 24                          | 25 | 5.35E-05                                     | 0.                             | 5.47E-05                     | 6.33E-05                       | 5.02E-05                     | 6.11E-05                       | 5.02E-05                     | 6.11E-05                       | 5.02E-05                     | 6.11E-05                       | 5.02E-05                     | 6.11E-05                       |
| 25                          | 26 | 3.93E-05                                     | 0.                             | 4.03E-05                     | 4.58E-05                       | 3.44E-05                     | 4.50E-05                       | 3.44E-05                     | 4.50E-05                       | 3.44E-05                     | 4.50E-05                       | 3.44E-05                     | 4.50E-05                       |
| 26                          | 27 | 1.70E-05                                     | 0.                             | 1.77E-05                     | 1.93E-05                       | 1.59E-05                     | 1.93E-05                       | 1.59E-05                     | 1.93E-05                       | 1.59E-05                     | 1.93E-05                       | 1.59E-05                     | 1.93E-05                       |
| 27                          | 28 | 3.69E-06                                     | 0.                             | 3.75E-06                     | 4.07E-06                       | 3.24E-06                     | 4.50E-06                       | 3.24E-06                     | 4.50E-06                       | 3.24E-06                     | 4.50E-06                       | 3.24E-06                     | 4.50E-06                       |
| 28                          | 29 | 0.                                           | 0.                             | 0.                           | 1.03E-06                       | 0.                           | 1.05E-06                       | 0.                           | 1.05E-06                       | 0.                           | 1.05E-06                       | 0.                           | 1.05E-06                       |
| 29                          | 30 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 30                          | 31 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 31                          | 32 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 32                          | 33 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 33                          | 34 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 34                          | 35 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 35                          | 36 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 36                          | 37 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 37                          | 38 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 38                          | 39 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 39                          | 40 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 40                          | 41 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 41                          | 42 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 42                          | 43 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 43                          | 44 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 44                          | 45 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 45                          | 46 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 46                          | 47 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 47                          | 48 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 48                          | 49 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 49                          | 50 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 50                          | 51 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 51                          | 52 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 52                          | 53 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 53                          | 54 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 54                          | 55 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 55                          | 56 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 56                          | 57 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 57                          | 58 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 58                          | 59 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 59                          | 60 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 60                          | 61 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 61                          | 62 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 62                          | 63 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 63                          | 64 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 64                          | 65 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 65                          | 66 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 66                          | 67 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 67                          | 68 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 68                          | 69 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 69                          | 70 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |
| 70                          | 71 | 0.                                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             | 0.                           | 0.                             |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

| UPDOWN | WGETIME  | TFCROSSPCTIC | CLEAR                        |                                | HAZY                         |                                |
|--------|----------|--------------|------------------------------|--------------------------------|------------------------------|--------------------------------|
|        |          |              | $\rho_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| *****  | 1.29E-03 | 3.79E-02     | *****                        | *****                          | 5.94E-02                     | 5.27E-02                       |
| *****  | 1.29E-03 | 3.79E-02     | *****                        | *****                          | 1.41E-02                     | 4.13E-01                       |
| *****  | 1.29E-03 | 3.79E-02     | *****                        | *****                          | *****                        | *****                          |

WAVELENGTH = 3.927159 MICROMETERS  
 FREQUENCY = 2546.379 WAVENUMBER

| ht(km) | U.S. STANDARD                 |                                | MIDLAT   |          | MIDLAT   |          | SUBARCTIC |          | AEROSOL  |          | HAZY     |      |
|--------|-------------------------------|--------------------------------|----------|----------|----------|----------|-----------|----------|----------|----------|----------|------|
|        | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | TROPICAL | SUMMER   | WINTER   | SUMMER   | WINTER    | CLEAR    | AEROSOL  | HAZY     | AEROSOL  | HAZY |
| 0      | 4.35E-02                      | 0.                             | 6.11E-02 | 4.35E-02 | 4.83E-02 | 4.25E-02 | 3.66E-02  | 5.97E-04 | 5.33E-03 | 1.09E-02 | 6.90E-02 | 0.   |
| 1      | 3.86E-02                      | 0.                             | 5.26E-02 | 3.93E-02 | 4.25E-02 | 3.66E-02 | 3.08E-02  | 6.50E-04 | 4.15E-03 | 1.03E-02 | 5.90E-02 | 0.   |
| 2      | 1.15E-02                      | 0.                             | 4.03E-02 | 3.12E-02 | 3.17E-02 | 3.08E-02 | 2.46E-02  | 7.42E-05 | 2.84E-04 | 1.14E-03 | 4.56E-03 | 0.   |
| 3      | 2.57E-02                      | 0.                             | 2.99E-02 | 2.52E-02 | 2.59E-02 | 2.46E-02 | 1.93E-02  | 7.79E-05 | 1.46E-04 | 2.00E-04 | 7.71E-04 | 0.   |
| 4      | 2.07E-02                      | 0.                             | 2.21E-02 | 2.03E-02 | 2.15E-02 | 2.03E-02 | 1.61E-02  | 3.09E-05 | 1.13E-04 | 1.05E-04 | 4.22E-04 | 0.   |
| 5      | 1.67E-02                      | 0.                             | 1.73E-02 | 1.64E-02 | 1.70E-02 | 1.61E-02 | 1.29E-02  | 2.38E-05 | 9.19E-05 | 5.69E-05 | 2.13E-04 | 0.   |
| 6      | 1.38E-02                      | 0.                             | 1.36E-02 | 1.32E-02 | 1.36E-02 | 1.29E-02 | 1.03E-02  | 1.77E-05 | 6.92E-05 | 3.60E-05 | 1.33E-04 | 0.   |
| 7      | 1.08E-02                      | 0.                             | 1.11E-02 | 1.05E-02 | 1.07E-02 | 1.03E-02 | 8.11E-03  | 7.73E-06 | 2.73E-05 | 1.97E-05 | 1.14E-04 | 0.   |
| 8      | 8.61E-03                      | 0.                             | 8.74E-03 | 8.31E-03 | 8.57E-03 | 8.11E-03 | 6.30E-03  | 6.58E-05 | 5.15E-06 | 7.03E-06 | 6.35E-05 | 0.   |
| 9      | 6.79E-03                      | 0.                             | 6.96E-03 | 6.55E-03 | 6.73E-03 | 6.30E-03 | 4.75E-03  | 4.90E-05 | 3.15E-06 | 7.03E-06 | 4.65E-05 | 0.   |
| 10     | 4.16E-03                      | 0.                             | 4.35E-03 | 3.93E-03 | 4.14E-03 | 3.66E-03 | 2.66E-03  | 3.33E-05 | 1.25E-06 | 7.88E-06 | 5.02E-05 | 0.   |
| 11     | 3.16E-03                      | 0.                             | 3.48E-03 | 3.05E-03 | 3.11E-03 | 2.66E-03 | 1.91E-03  | 3.57E-05 | 2.75E-06 | 1.02E-05 | 6.65E-05 | 0.   |
| 12     | 2.36E-03                      | 0.                             | 2.67E-03 | 2.22E-03 | 2.33E-03 | 1.91E-03 | 1.47E-03  | 3.53E-05 | 2.74E-06 | 1.03E-05 | 7.22E-05 | 0.   |
| 13     | 1.76E-03                      | 0.                             | 1.96E-03 | 1.64E-03 | 1.77E-03 | 1.47E-03 | 1.10E-03  | 3.56E-05 | 2.74E-06 | 1.03E-05 | 7.22E-05 | 0.   |
| 14     | 1.30E-03                      | 0.                             | 1.56E-03 | 1.23E-03 | 1.36E-03 | 1.10E-03 | 8.10E-04  | 3.57E-05 | 2.74E-06 | 1.03E-05 | 7.22E-05 | 0.   |
| 15     | 9.59E-04                      | 0.                             | 1.11E-03 | 9.18E-04 | 9.52E-04 | 8.10E-04 | 6.05E-04  | 3.56E-05 | 2.74E-06 | 1.03E-05 | 7.22E-05 | 0.   |
| 16     | 7.18E-04                      | 0.                             | 8.16E-04 | 6.82E-04 | 7.55E-04 | 6.05E-04 | 4.51E-04  | 3.54E-05 | 2.52E-06 | 8.92E-06 | 6.74E-05 | 0.   |
| 17     | 5.35E-04                      | 0.                             | 6.12E-04 | 5.12E-04 | 5.65E-04 | 4.51E-04 | 3.33E-04  | 2.93E-05 | 2.24E-06 | 7.36E-06 | 4.40E-05 | 0.   |
| 18     | 3.99E-04                      | 0.                             | 4.52E-04 | 3.78E-04 | 4.24E-04 | 3.33E-04 | 2.46E-04  | 2.54E-05 | 1.94E-06 | 5.93E-06 | 3.87E-05 | 0.   |
| 19     | 2.96E-04                      | 0.                             | 3.37E-04 | 2.80E-04 | 3.26E-04 | 2.46E-04 | 1.93E-04  | 2.15E-05 | 1.67E-06 | 4.71E-06 | 3.03E-05 | 0.   |
| 20     | 2.20E-04                      | 0.                             | 2.50E-04 | 2.11E-04 | 2.42E-04 | 1.85E-04 | 1.33E-04  | 1.80E-05 | 1.40E-06 | 3.75E-06 | 2.66E-05 | 0.   |
| 21     | 1.66E-04                      | 0.                             | 1.88E-04 | 1.56E-04 | 1.65E-04 | 1.33E-04 | 1.02E-04  | 1.49E-05 | 1.13E-06 | 2.91E-06 | 1.92E-05 | 0.   |
| 22     | 1.23E-04                      | 0.                             | 1.39E-04 | 1.16E-04 | 1.43E-04 | 1.02E-04 | 7.50E-05  | 1.20E-05 | 9.42E-07 | 1.79E-06 | 1.17E-05 | 0.   |
| 23     | 9.18E-05                      | 0.                             | 9.24E-05 | 8.48E-05 | 9.02E-05 | 7.50E-05 | 5.50E-05  | 1.13E-05 | 1.35E-06 | 2.90E-06 | 3.44E-05 | 0.   |
| 24     | 6.89E-05                      | 0.                             | 7.02E-05 | 6.50E-05 | 6.81E-05 | 5.50E-05 | 4.49E-05  | 1.49E-05 | 1.35E-06 | 2.90E-06 | 3.44E-05 | 0.   |
| 25     | 3.15E-05                      | 0.                             | 3.23E-05 | 2.82E-05 | 3.81E-05 | 2.49E-05 | 6.43E-05  | 1.72E-06 | 2.04E-06 | 2.16E-06 | 2.57E-05 | 0.   |
| 30     | 9.79E-06                      | 0.                             | 1.08E-05 | 7.80E-06 | 9.35E-06 | 6.43E-05 | 2.01E-05  | 0.       | 0.       | 0.       | 0.       | 0.   |
| 35     | 3.68E-06                      | 0.                             | 4.97E-06 | 2.65E-06 | 5.35E-06 | 5.35E-06 | 2.01E-05  | 0.       | 0.       | 0.       | 0.       | 0.   |
| 40     | 1.84E-06                      | 0.                             | 2.48E-06 | 1.31E-06 | 2.77E-06 | 2.77E-06 | 0.        | 0.       | 0.       | 0.       | 0.       | 0.   |
| 45     | 0.                            | 0.                             | 1.37E-06 | 0.       | 1.49E-06 | 1.49E-06 | 0.        | 0.       | 0.       | 0.       | 0.       | 0.   |
| 50     | 0.                            | 0.                             | 0.       | 0.       | 0.       | 0.       | 0.        | 0.       | 0.       | 0.       | 0.       | 0.   |
| 70     | 0.                            | 0.                             | 0.       | 0.       | 0.       | 0.       | 0.        | 0.       | 0.       | 0.       | 0.       | 0.   |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

| UPPER        | CLEAR                         |                                | HAZY                          |                                |
|--------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|              | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| MAINTIME     | 1.35E-03                      | 3.74E-02                       | 1.45E-02                      | 4.08E-01                       |
| TROPOSPHERIC | 2.95E-04                      | 1.14E-03                       | *****                         | *****                          |
| UPPER        | *****                         | *****                          | 5.93E-02                      | 5.32E-02                       |

WAVELENGTH = 6.005431 MICROMETERS  
FREQUENCY = 2496.619 WAVENUMBER

| h(km) | U.S. STANDARD                 |                                | TROPICAL                      |                                | MIDLAT SUMMER                 |                                | MIDLAT WINTER                 |                                | SUBARCTIC SUMMER              |                                | SUBARCTIC WINTER              |                                | AEROSOL CLEAR                 |                                | AEROSOL HAZY                  |                                |
|-------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|       | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0     | 3.91E-02                      | 0.                             | 6.31E-02                      | 5.45E-02                       | 3.76E-02                      | 4.61E-02                       | 3.76E-02                      | 4.61E-02                       | 4.61E-02                      | 3.76E-02                       | 4.61E-02                      | 3.76E-02                       | 1.02E-03                      | 6.25E-03                       | 1.12E-02                      | 6.20E-02                       |
| 1     | 3.76E-02                      | 0.                             | 5.72E-02                      | 4.55E-02                       | 3.05E-02                      | 3.93E-02                       | 3.05E-02                      | 3.93E-02                       | 3.93E-02                      | 3.05E-02                       | 3.93E-02                      | 3.05E-02                       | 6.71E-04                      | 4.13E-03                       | 1.12E-02                      | 6.40E-02                       |
| 2     | 2.52E-02                      | 0.                             | 3.82E-02                      | 3.14E-02                       | 2.30E-02                      | 2.93E-02                       | 2.30E-02                      | 2.93E-02                       | 2.93E-02                      | 2.30E-02                       | 2.93E-02                      | 2.30E-02                       | 7.63E-05                      | 2.72E-04                       | 1.22E-03                      | 4.31E-03                       |
| 3     | 1.87E-02                      | 0.                             | 2.69E-02                      | 2.23E-02                       | 1.72E-02                      | 2.05E-02                       | 1.72E-02                      | 2.05E-02                       | 2.05E-02                      | 1.72E-02                       | 2.05E-02                      | 1.72E-02                       | 3.90E-05                      | 1.39E-04                       | 2.05E-04                      | 7.31E-04                       |
| 4     | 1.38E-02                      | 0.                             | 1.65E-02                      | 1.55E-02                       | 1.27E-02                      | 1.38E-02                       | 1.27E-02                      | 1.38E-02                       | 1.38E-02                      | 1.27E-02                       | 1.38E-02                      | 1.27E-02                       | 7.18E-05                      | 1.13E-04                       | 1.12E-04                      | 4.01E-04                       |
| 5     | 1.01E-02                      | 0.                             | 1.14E-02                      | 1.11E-02                       | 9.35E-03                      | 1.08E-02                       | 9.35E-03                      | 1.08E-02                       | 1.08E-02                      | 9.35E-03                       | 1.08E-02                      | 9.35E-03                       | 2.45E-05                      | 8.74E-05                       | 5.85E-05                      | 2.03E-04                       |
| 6     | 7.48E-03                      | 0.                             | 8.75E-03                      | 8.11E-03                       | 5.91E-03                      | 7.30E-03                       | 5.91E-03                      | 7.30E-03                       | 7.30E-03                      | 5.91E-03                       | 7.30E-03                      | 5.91E-03                       | 1.82E-05                      | 6.43E-05                       | 3.71E-05                      | 1.32E-04                       |
| 7     | 5.52E-03                      | 0.                             | 6.33E-03                      | 6.13E-03                       | 5.05E-03                      | 5.67E-03                       | 5.05E-03                      | 5.67E-03                       | 5.67E-03                      | 5.05E-03                       | 5.67E-03                      | 5.05E-03                       | 1.26E-05                      | 4.88E-05                       | 3.03E-05                      | 1.03E-04                       |
| 8     | 4.08E-03                      | 0.                             | 4.68E-03                      | 4.50E-03                       | 3.72E-03                      | 4.35E-03                       | 3.72E-03                      | 4.35E-03                       | 4.35E-03                      | 3.72E-03                       | 4.35E-03                      | 3.72E-03                       | 7.95E-06                      | 2.84E-05                       | 2.03E-05                      | 7.28E-05                       |
| 9     | 2.98E-03                      | 0.                             | 3.48E-03                      | 3.33E-03                       | 2.74E-03                      | 3.02E-03                       | 2.74E-03                      | 3.02E-03                       | 3.02E-03                      | 2.74E-03                       | 3.02E-03                      | 2.74E-03                       | 4.35E-05                      | 3.53E-06                       | 8.74E-06                      | 5.91E-05                       |
| 10    | 1.58E-03                      | 0.                             | 1.88E-03                      | 1.81E-03                       | 1.44E-03                      | 1.52E-03                       | 1.44E-03                      | 1.52E-03                       | 1.52E-03                      | 1.44E-03                       | 1.52E-03                      | 1.44E-03                       | 4.73E-05                      | 3.53E-06                       | 6.89E-06                      | 4.73E-05                       |
| 11    | 1.15E-03                      | 0.                             | 1.36E-03                      | 1.31E-03                       | 1.05E-03                      | 1.12E-03                       | 1.05E-03                      | 1.12E-03                       | 1.12E-03                      | 1.05E-03                       | 1.12E-03                      | 1.05E-03                       | 3.70E-05                      | 2.75E-06                       | 7.93E-06                      | 5.43E-05                       |
| 12    | 8.35E-04                      | 0.                             | 1.03E-03                      | 9.74E-04                       | 7.91E-04                      | 8.55E-04                       | 7.91E-04                      | 8.55E-04                       | 8.55E-04                      | 7.91E-04                       | 8.55E-04                      | 7.91E-04                       | 3.45E-05                      | 2.88E-06                       | 9.14E-06                      | 6.25E-05                       |
| 13    | 6.12E-04                      | 0.                             | 7.15E-04                      | 7.11E-04                       | 5.76E-04                      | 5.93E-04                       | 5.76E-04                      | 5.93E-04                       | 5.93E-04                      | 5.76E-04                       | 5.93E-04                      | 5.76E-04                       | 3.41E-05                      | 2.54E-06                       | 9.92E-06                      | 5.93E-05                       |
| 14    | 4.47E-04                      | 0.                             | 5.46E-04                      | 5.38E-04                       | 4.24E-04                      | 4.37E-04                       | 4.24E-04                      | 4.37E-04                       | 4.37E-04                      | 4.24E-04                       | 4.37E-04                      | 4.24E-04                       | 3.45E-05                      | 2.57E-06                       | 9.66E-06                      | 6.75E-05                       |
| 15    | 3.25E-04                      | 0.                             | 3.91E-04                      | 3.77E-04                       | 3.09E-04                      | 3.39E-04                       | 3.09E-04                      | 3.39E-04                       | 3.39E-04                      | 3.09E-04                       | 3.39E-04                      | 3.09E-04                       | 2.76E-04                      | 2.03E-06                       | 7.34E-06                      | 5.43E-05                       |
| 16    | 2.38E-04                      | 0.                             | 2.65E-04                      | 2.71E-04                       | 2.25E-04                      | 2.31E-04                       | 2.25E-04                      | 2.31E-04                       | 2.31E-04                      | 2.25E-04                       | 2.31E-04                      | 2.25E-04                       | 2.13E-05                      | 2.33E-06                       | 9.06E-06                      | 6.23E-05                       |
| 17    | 1.74E-04                      | 0.                             | 1.92E-04                      | 2.00E-04                       | 1.68E-04                      | 1.82E-04                       | 1.68E-04                      | 1.82E-04                       | 1.82E-04                      | 1.68E-04                       | 1.82E-04                      | 1.68E-04                       | 2.83E-05                      | 2.11E-06                       | 6.62E-06                      | 4.53E-05                       |
| 18    | 1.27E-04                      | 0.                             | 1.37E-04                      | 1.45E-04                       | 1.20E-04                      | 1.28E-04                       | 1.20E-04                      | 1.28E-04                       | 1.28E-04                      | 1.20E-04                       | 1.28E-04                      | 1.20E-04                       | 2.46E-05                      | 1.83E-06                       | 5.31E-06                      | 3.63E-05                       |
| 19    | 9.29E-05                      | 0.                             | 9.73E-05                      | 1.07E-04                       | 8.70E-05                      | 1.05E-04                       | 8.70E-05                      | 1.05E-04                       | 1.05E-04                      | 8.70E-05                       | 1.05E-04                      | 8.70E-05                       | 2.04E-05                      | 1.55E-06                       | 4.24E-06                      | 2.90E-05                       |
| 20    | 6.79E-05                      | 0.                             | 7.09E-05                      | 7.92E-05                       | 6.43E-05                      | 7.73E-05                       | 6.43E-05                      | 7.73E-05                       | 7.73E-05                      | 6.43E-05                       | 7.73E-05                      | 6.43E-05                       | 1.74E-05                      | 1.30E-06                       | 3.33E-06                      | 2.32E-05                       |
| 21    | 4.98E-05                      | 0.                             | 5.17E-05                      | 5.75E-05                       | 4.67E-05                      | 5.24E-05                       | 4.67E-05                      | 5.24E-05                       | 5.24E-05                      | 4.67E-05                       | 5.24E-05                      | 4.67E-05                       | 1.44E-05                      | 1.08E-06                       | 2.63E-06                      | 1.83E-05                       |
| 22    | 3.65E-05                      | 0.                             | 3.70E-05                      | 4.18E-05                       | 3.40E-05                      | 4.05E-05                       | 3.40E-05                      | 4.05E-05                       | 4.05E-05                      | 3.40E-05                       | 4.05E-05                      | 3.40E-05                       | 1.16E-05                      | 0.                             | 2.04E-06                      | 1.33E-05                       |
| 23    | 2.68E-05                      | 0.                             | 2.71E-05                      | 3.20E-05                       | 2.45E-05                      | 3.14E-05                       | 2.45E-05                      | 3.14E-05                       | 3.14E-05                      | 2.45E-05                       | 3.14E-05                      | 2.45E-05                       | 9.10E-06                      | 0.                             | 1.61E-06                      | 1.13E-05                       |
| 24    | 1.98E-05                      | 0.                             | 2.02E-05                      | 2.30E-05                       | 1.84E-05                      | 2.33E-05                       | 1.84E-05                      | 2.33E-05                       | 2.33E-05                      | 1.84E-05                       | 2.33E-05                      | 1.84E-05                       | 7.52E-06                      | 4.06E-06                       | 2.92E-06                      | 3.36E-05                       |
| 25    | 8.65E-06                      | 0.                             | 8.47E-06                      | 1.04E-05                       | 7.76E-06                      | 1.05E-05                       | 7.76E-06                      | 1.05E-05                       | 1.05E-05                      | 7.76E-06                       | 1.05E-05                      | 7.76E-06                       | 7.52E-06                      | 4.06E-06                       | 6.70E-06                      | 7.72E-06                       |
| 30    | 1.95E-06                      | 0.                             | 2.05E-06                      | 2.44E-06                       | 1.64E-06                      | 2.50E-06                       | 1.64E-06                      | 2.50E-06                       | 2.50E-06                      | 1.64E-06                       | 2.50E-06                      | 1.64E-06                       | 1.73E-06                      | 1.99E-06                       | 2.17E-06                      | 2.51E-06                       |
| 35    | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 40    | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 45    | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 50    | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 55    | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 60    | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |
| 70    | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             | 0.                            | 0.                             |

ALTERNATE BOUNDARY LAYER AEROSOL MODELS

| UPPER | CLEAR                         |                                | HAZY                          |                                |
|-------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|       | $\beta_0$ (km <sup>-1</sup> ) | $\sigma_0$ (km <sup>-1</sup> ) | $\beta_0$ (km <sup>-1</sup> ) | $\sigma_0$ (km <sup>-1</sup> ) |
| ***** | *****                         | *****                          | 5.96E-02                      | 5.25E-02                       |
| ***** | *****                         | *****                          | 1.52E-02                      | 4.00E-01                       |
| ***** | *****                         | *****                          | *****                         | *****                          |

WAVELENGTH = 4.256677 MICRONS  
FREQUENCY = 2453.253 WAVELENGTH

| h(km) | U.S. STANDARD             |                                | TROPICAL                  |                                | MIDLAT. SUMMER            |                                | MIDLAT. WINTER            |                                | SEMIARCTIC SUMMER         |                                | SEMIARCTIC WINTER         |                                | CLEAR                     |                                | AEROSOL                   |                                | HAZY                      |                                |
|-------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|
|       | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $L_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| 0     | 6.05E-02                  | 0.                             | 1.04E-01                  | 9.17E-02                       | 5.70E-02                  | 7.93E-02                       | 6.24E-02                  | 1.09E-03                       | 6.15E-02                  | 1.09E-03                       | 6.15E-02                  | 1.09E-03                       | 6.15E-02                  | 1.09E-03                       | 6.15E-02                  | 1.09E-03                       | 6.15E-02                  | 1.09E-03                       |
| 1     | 5.95E-02                  | 0.                             | 9.12E-02                  | 7.45E-02                       | 5.47E-02                  | 6.67E-02                       | 4.95E-02                  | 8.23E-02                       | 5.47E-02                  | 6.67E-02                       | 4.95E-02                  | 8.23E-02                       | 5.47E-02                  | 6.67E-02                       | 4.95E-02                  | 8.23E-02                       | 5.47E-02                  | 6.67E-02                       |
| 2     | 4.51E-02                  | 0.                             | 6.58E-02                  | 5.57E-02                       | 4.15E-02                  | 6.21E-02                       | 3.77E-02                  | 6.21E-02                       | 4.15E-02                  | 6.21E-02                       | 3.77E-02                  | 6.21E-02                       | 4.15E-02                  | 6.21E-02                       | 3.77E-02                  | 6.21E-02                       | 4.15E-02                  | 6.21E-02                       |
| 3     | 3.10E-02                  | 0.                             | 4.54E-02                  | 3.98E-02                       | 3.14E-02                  | 3.65E-02                       | 2.71E-02                  | 2.71E-02                       | 2.71E-02                  | 2.71E-02                       | 2.71E-02                  | 2.71E-02                       | 2.71E-02                  | 2.71E-02                       | 2.71E-02                  | 2.71E-02                       | 2.71E-02                  | 2.71E-02                       |
| 4     | 2.55E-02                  | 0.                             | 3.07E-02                  | 2.82E-02                       | 2.35E-02                  | 2.71E-02                       | 1.93E-02                  | 1.93E-02                       | 1.93E-02                  | 1.93E-02                       | 1.93E-02                  | 1.93E-02                       | 1.93E-02                  | 1.93E-02                       | 1.93E-02                  | 1.93E-02                       | 1.93E-02                  | 1.93E-02                       |
| 5     | 1.95E-02                  | 0.                             | 2.18E-02                  | 2.05E-02                       | 1.75E-02                  | 1.93E-02                       | 1.49E-02                  | 1.49E-02                       | 1.49E-02                  | 1.49E-02                       | 1.49E-02                  | 1.49E-02                       | 1.49E-02                  | 1.49E-02                       | 1.49E-02                  | 1.49E-02                       | 1.49E-02                  | 1.49E-02                       |
| 6     | 1.42E-02                  | 0.                             | 1.64E-02                  | 1.54E-02                       | 1.33E-02                  | 1.49E-02                       | 1.17E-02                  | 1.17E-02                       | 1.17E-02                  | 1.17E-02                       | 1.17E-02                  | 1.17E-02                       | 1.17E-02                  | 1.17E-02                       | 1.17E-02                  | 1.17E-02                       | 1.17E-02                  | 1.17E-02                       |
| 7     | 1.07E-02                  | 0.                             | 1.22E-02                  | 1.18E-02                       | 9.92E-03                  | 1.07E-02                       | 9.09E-03                  | 9.09E-03                       | 9.09E-03                  | 9.09E-03                       | 9.09E-03                  | 9.09E-03                       | 9.09E-03                  | 9.09E-03                       | 9.09E-03                  | 9.09E-03                       | 9.09E-03                  | 9.09E-03                       |
| 8     | 8.09E-03                  | 0.                             | 9.14E-03                  | 8.44E-03                       | 7.44E-03                  | 8.16E-03                       | 6.78E-03                  | 6.78E-03                       | 6.78E-03                  | 6.78E-03                       | 6.78E-03                  | 6.78E-03                       | 6.78E-03                  | 6.78E-03                       | 6.78E-03                  | 6.78E-03                       | 6.78E-03                  | 6.78E-03                       |
| 9     | 5.99E-03                  | 0.                             | 6.46E-03                  | 6.05E-03                       | 5.57E-03                  | 6.05E-03                       | 5.07E-03                  | 5.07E-03                       | 5.07E-03                  | 5.07E-03                       | 5.07E-03                  | 5.07E-03                       | 5.07E-03                  | 5.07E-03                       | 5.07E-03                  | 5.07E-03                       | 5.07E-03                  | 5.07E-03                       |
| 10    | 4.44E-03                  | 0.                             | 5.16E-03                  | 5.05E-03                       | 4.16E-03                  | 4.95E-03                       | 4.09E-03                  | 4.09E-03                       | 4.09E-03                  | 4.09E-03                       | 4.09E-03                  | 4.09E-03                       | 4.09E-03                  | 4.09E-03                       | 4.09E-03                  | 4.09E-03                       | 4.09E-03                  | 4.09E-03                       |
| 11    | 3.82E-03                  | 0.                             | 4.34E-03                  | 3.78E-03                       | 3.12E-03                  | 3.49E-03                       | 2.79E-03                  | 2.79E-03                       | 2.79E-03                  | 2.79E-03                       | 2.79E-03                  | 2.79E-03                       | 2.79E-03                  | 2.79E-03                       | 2.79E-03                  | 2.79E-03                       | 2.79E-03                  | 2.79E-03                       |
| 12    | 2.67E-03                  | 0.                             | 2.91E-03                  | 2.55E-03                       | 2.35E-03                  | 2.57E-03                       | 2.09E-03                  | 2.09E-03                       | 2.09E-03                  | 2.09E-03                       | 2.09E-03                  | 2.09E-03                       | 2.09E-03                  | 2.09E-03                       | 2.09E-03                  | 2.09E-03                       | 2.09E-03                  | 2.09E-03                       |
| 13    | 1.85E-03                  | 0.                             | 2.05E-03                  | 1.85E-03                       | 1.75E-03                  | 1.94E-03                       | 1.54E-03                  | 1.54E-03                       | 1.54E-03                  | 1.54E-03                       | 1.54E-03                  | 1.54E-03                       | 1.54E-03                  | 1.54E-03                       | 1.54E-03                  | 1.54E-03                       | 1.54E-03                  | 1.54E-03                       |
| 14    | 1.39E-03                  | 0.                             | 1.59E-03                  | 1.49E-03                       | 1.31E-03                  | 1.49E-03                       | 1.17E-03                  | 1.17E-03                       | 1.17E-03                  | 1.17E-03                       | 1.17E-03                  | 1.17E-03                       | 1.17E-03                  | 1.17E-03                       | 1.17E-03                  | 1.17E-03                       | 1.17E-03                  | 1.17E-03                       |
| 15    | 1.04E-03                  | 0.                             | 1.23E-03                  | 1.13E-03                       | 9.91E-04                  | 1.15E-03                       | 9.21E-04                  | 9.21E-04                       | 9.21E-04                  | 9.21E-04                       | 9.21E-04                  | 9.21E-04                       | 9.21E-04                  | 9.21E-04                       | 9.21E-04                  | 9.21E-04                       | 9.21E-04                  | 9.21E-04                       |
| 16    | 7.78E-04                  | 0.                             | 9.15E-04                  | 8.48E-04                       | 7.49E-04                  | 8.18E-04                       | 6.54E-04                  | 6.54E-04                       | 6.54E-04                  | 6.54E-04                       | 6.54E-04                  | 6.54E-04                       | 6.54E-04                  | 6.54E-04                       | 6.54E-04                  | 6.54E-04                       | 6.54E-04                  | 6.54E-04                       |
| 17    | 5.80E-04                  | 0.                             | 6.13E-04                  | 5.55E-04                       | 5.51E-04                  | 5.45E-04                       | 4.45E-04                  | 4.45E-04                       | 4.45E-04                  | 4.45E-04                       | 4.45E-04                  | 4.45E-04                       | 4.45E-04                  | 4.45E-04                       | 4.45E-04                  | 4.45E-04                       | 4.45E-04                  | 4.45E-04                       |
| 18    | 4.13E-04                  | 0.                             | 4.93E-04                  | 4.55E-04                       | 4.13E-04                  | 4.93E-04                       | 3.63E-04                  | 3.63E-04                       | 3.63E-04                  | 3.63E-04                       | 3.63E-04                  | 3.63E-04                       | 3.63E-04                  | 3.63E-04                       | 3.63E-04                  | 3.63E-04                       | 3.63E-04                  | 3.63E-04                       |
| 19    | 3.22E-04                  | 0.                             | 3.74E-04                  | 3.45E-04                       | 3.03E-04                  | 3.65E-04                       | 2.65E-04                  | 2.65E-04                       | 2.65E-04                  | 2.65E-04                       | 2.65E-04                  | 2.65E-04                       | 2.65E-04                  | 2.65E-04                       | 2.65E-04                  | 2.65E-04                       | 2.65E-04                  | 2.65E-04                       |
| 20    | 2.42E-04                  | 0.                             | 2.73E-04                  | 2.73E-04                       | 2.23E-04                  | 2.73E-04                       | 2.03E-04                  | 2.03E-04                       | 2.03E-04                  | 2.03E-04                       | 2.03E-04                  | 2.03E-04                       | 2.03E-04                  | 2.03E-04                       | 2.03E-04                  | 2.03E-04                       | 2.03E-04                  | 2.03E-04                       |
| 21    | 1.76E-04                  | 0.                             | 1.90E-04                  | 2.03E-04                       | 1.67E-04                  | 2.03E-04                       | 1.45E-04                  | 1.45E-04                       | 1.45E-04                  | 1.45E-04                       | 1.45E-04                  | 1.45E-04                       | 1.45E-04                  | 1.45E-04                       | 1.45E-04                  | 1.45E-04                       | 1.45E-04                  | 1.45E-04                       |
| 22    | 1.31E-04                  | 0.                             | 1.52E-04                  | 1.52E-04                       | 1.22E-04                  | 1.52E-04                       | 1.03E-04                  | 1.03E-04                       | 1.03E-04                  | 1.03E-04                       | 1.03E-04                  | 1.03E-04                       | 1.03E-04                  | 1.03E-04                       | 1.03E-04                  | 1.03E-04                       | 1.03E-04                  | 1.03E-04                       |
| 23    | 9.54E-05                  | 0.                             | 9.65E-05                  | 1.11E-04                       | 8.91E-05                  | 1.11E-04                       | 7.78E-05                  | 7.78E-05                       | 7.78E-05                  | 7.78E-05                       | 7.78E-05                  | 7.78E-05                       | 7.78E-05                  | 7.78E-05                       | 7.78E-05                  | 7.78E-05                       | 7.78E-05                  | 7.78E-05                       |
| 24    | 7.17E-05                  | 0.                             | 7.17E-05                  | 8.54E-05                       | 6.45E-05                  | 8.54E-05                       | 5.64E-05                  | 5.64E-05                       | 5.64E-05                  | 5.64E-05                       | 5.64E-05                  | 5.64E-05                       | 5.64E-05                  | 5.64E-05                       | 5.64E-05                  | 5.64E-05                       | 5.64E-05                  | 5.64E-05                       |
| 25    | 5.29E-05                  | 0.                             | 5.29E-05                  | 6.18E-05                       | 4.36E-05                  | 6.18E-05                       | 3.36E-05                  | 3.36E-05                       | 3.36E-05                  | 3.36E-05                       | 3.36E-05                  | 3.36E-05                       | 3.36E-05                  | 3.36E-05                       | 3.36E-05                  | 3.36E-05                       | 3.36E-05                  | 3.36E-05                       |
| 26    | 2.61E-05                  | 0.                             | 2.61E-05                  | 2.84E-05                       | 2.07E-05                  | 2.84E-05                       | 1.75E-05                  | 1.75E-05                       | 1.75E-05                  | 1.75E-05                       | 1.75E-05                  | 1.75E-05                       | 1.75E-05                  | 1.75E-05                       | 1.75E-05                  | 1.75E-05                       | 1.75E-05                  | 1.75E-05                       |
| 27    | 1.35E-05                  | 0.                             | 1.35E-05                  | 1.75E-05                       | 1.04E-05                  | 1.75E-05                       | 7.04E-06                  | 7.04E-06                       | 7.04E-06                  | 7.04E-06                       | 7.04E-06                  | 7.04E-06                       | 7.04E-06                  | 7.04E-06                       | 7.04E-06                  | 7.04E-06                       | 7.04E-06                  | 7.04E-06                       |
| 28    | 5.50E-06                  | 0.                             | 5.50E-06                  | 1.07E-05                       | 4.05E-06                  | 1.07E-05                       | 2.85E-06                  | 2.85E-06                       | 2.85E-06                  | 2.85E-06                       | 2.85E-06                  | 2.85E-06                       | 2.85E-06                  | 2.85E-06                       | 2.85E-06                  | 2.85E-06                       | 2.85E-06                  | 2.85E-06                       |
| 29    | 1.35E-06                  | 0.                             | 1.35E-06                  | 1.07E-06                       | 1.05E-06                  | 1.07E-06                       | 7.04E-07                  | 7.04E-07                       | 7.04E-07                  | 7.04E-07                       | 7.04E-07                  | 7.04E-07                       | 7.04E-07                  | 7.04E-07                       | 7.04E-07                  | 7.04E-07                       | 7.04E-07                  | 7.04E-07                       |
| 30    | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             |
| 40    | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             |
| 45    | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             |
| 50    | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             |
| 70    | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             | 0.                        | 0.                             |

ELIMINATE JOURNAL LAYER AEROSOL MODELS

CLEAR HAZY  
 $L_a$  (km<sup>-1</sup>)  $\sigma_a$  (km<sup>-1</sup>)  $L_a$  (km<sup>-1</sup>)  $\sigma_a$  (km<sup>-1</sup>)  
 \*\*\*\*\*  
 1.59E-03 3.61E-02 1.73E-02 3.33E-01  
 3.95E-04 1.33E-01 \*\*\*\*\*

ADJACENCY =  
WAVELENGTH =

| h(km) | TROPICAL                     |                              | MIDLAT<br>SUMMER             |                              | MIDLAT<br>WINTER             |                              | SUBARCTIC<br>SUMMER          |                              | SUBARCTIC<br>WINTER          |                              | CLEAR                        |                              | AEROSOL                      |                              | DAYY                         |                              |
|-------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|
|       | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) | $\rho_a$ (km <sup>-1</sup> ) |
| 0     | 1.015-01.0                   | 1.208-01                     | 1.158-01                     | 1.045-01                     | 1.105-01                     | 1.025-01                     | 1.115-01                     | 1.155-01                     | 1.155-01                     | 1.155-01                     | 1.155-01                     | 1.155-01                     | 1.155-01                     | 1.285-02                     | 6.585-02                     | 1.285-02                     |
| 1     | 0.715-02.0                   | 0.815-02                     | 0.915-02                     | 0.815-02                     | 0.915-02                     | 0.815-02                     | 0.915-02                     | 0.915-02                     | 0.915-02                     | 0.915-02                     | 0.915-02                     | 0.915-02                     | 0.915-02                     | 1.045-03                     | 5.585-03                     | 1.045-03                     |
| 2     | 0.515-02.0                   | 0.615-02                     | 0.715-02                     | 0.615-02                     | 0.715-02                     | 0.615-02                     | 0.715-02                     | 0.715-02                     | 0.715-02                     | 0.715-02                     | 0.715-02                     | 0.715-02                     | 0.715-02                     | 1.145-04                     | 4.035-04                     | 1.145-04                     |
| 3     | 0.315-02.0                   | 0.415-02                     | 0.515-02                     | 0.415-02                     | 0.515-02                     | 0.415-02                     | 0.515-02                     | 0.515-02                     | 0.515-02                     | 0.515-02                     | 0.515-02                     | 0.515-02                     | 0.515-02                     | 1.245-05                     | 3.035-05                     | 1.245-05                     |
| 4     | 0.215-02.0                   | 0.315-02                     | 0.415-02                     | 0.315-02                     | 0.415-02                     | 0.315-02                     | 0.415-02                     | 0.415-02                     | 0.415-02                     | 0.415-02                     | 0.415-02                     | 0.415-02                     | 0.415-02                     | 1.345-06                     | 2.035-06                     | 1.345-06                     |
| 5     | 0.165-02.0                   | 0.265-02                     | 0.365-02                     | 0.265-02                     | 0.365-02                     | 0.265-02                     | 0.365-02                     | 0.365-02                     | 0.365-02                     | 0.365-02                     | 0.365-02                     | 0.365-02                     | 0.365-02                     | 1.445-07                     | 1.035-07                     | 1.445-07                     |
| 6     | 0.115-02.0                   | 0.215-02                     | 0.315-02                     | 0.215-02                     | 0.315-02                     | 0.215-02                     | 0.315-02                     | 0.315-02                     | 0.315-02                     | 0.315-02                     | 0.315-02                     | 0.315-02                     | 0.315-02                     | 1.545-08                     | 0.035-08                     | 1.545-08                     |
| 7     | 0.065-02.0                   | 0.165-02                     | 0.265-02                     | 0.165-02                     | 0.265-02                     | 0.165-02                     | 0.265-02                     | 0.265-02                     | 0.265-02                     | 0.265-02                     | 0.265-02                     | 0.265-02                     | 0.265-02                     | 1.645-09                     | 0.035-09                     | 1.645-09                     |
| 8     | 0.015-02.0                   | 0.115-02                     | 0.215-02                     | 0.115-02                     | 0.215-02                     | 0.115-02                     | 0.215-02                     | 0.215-02                     | 0.215-02                     | 0.215-02                     | 0.215-02                     | 0.215-02                     | 0.215-02                     | 1.745-10                     | 0.035-10                     | 1.745-10                     |
| 9     | 0.005-03.0                   | 0.055-03                     | 0.155-03                     | 0.055-03                     | 0.155-03                     | 0.055-03                     | 0.155-03                     | 0.155-03                     | 0.155-03                     | 0.155-03                     | 0.155-03                     | 0.155-03                     | 0.155-03                     | 1.845-11                     | 0.035-11                     | 1.845-11                     |
| 10    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 1.945-12                     | 0.035-12                     | 1.945-12                     |
| 11    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 2.045-13                     | 0.035-13                     | 2.045-13                     |
| 12    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 2.145-14                     | 0.035-14                     | 2.145-14                     |
| 13    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 2.245-15                     | 0.035-15                     | 2.245-15                     |
| 14    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 2.345-16                     | 0.035-16                     | 2.345-16                     |
| 15    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 2.445-17                     | 0.035-17                     | 2.445-17                     |
| 16    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 2.545-18                     | 0.035-18                     | 2.545-18                     |
| 17    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 2.645-19                     | 0.035-19                     | 2.645-19                     |
| 18    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 2.745-20                     | 0.035-20                     | 2.745-20                     |
| 19    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 2.845-21                     | 0.035-21                     | 2.845-21                     |
| 20    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 2.945-22                     | 0.035-22                     | 2.945-22                     |
| 21    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 3.045-23                     | 0.035-23                     | 3.045-23                     |
| 22    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 3.145-24                     | 0.035-24                     | 3.145-24                     |
| 23    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 3.245-25                     | 0.035-25                     | 3.245-25                     |
| 24    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 3.345-26                     | 0.035-26                     | 3.345-26                     |
| 25    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 3.445-27                     | 0.035-27                     | 3.445-27                     |
| 26    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 3.545-28                     | 0.035-28                     | 3.545-28                     |
| 27    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 3.645-29                     | 0.035-29                     | 3.645-29                     |
| 28    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 3.745-30                     | 0.035-30                     | 3.745-30                     |
| 29    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 3.845-31                     | 0.035-31                     | 3.845-31                     |
| 30    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 3.945-32                     | 0.035-32                     | 3.945-32                     |
| 31    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 4.045-33                     | 0.035-33                     | 4.045-33                     |
| 32    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 4.145-34                     | 0.035-34                     | 4.145-34                     |
| 33    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 4.245-35                     | 0.035-35                     | 4.245-35                     |
| 34    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 4.345-36                     | 0.035-36                     | 4.345-36                     |
| 35    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 4.445-37                     | 0.035-37                     | 4.445-37                     |
| 36    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 4.545-38                     | 0.035-38                     | 4.545-38                     |
| 37    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 4.645-39                     | 0.035-39                     | 4.645-39                     |
| 38    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 4.745-40                     | 0.035-40                     | 4.745-40                     |
| 39    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 4.845-41                     | 0.035-41                     | 4.845-41                     |
| 40    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 4.945-42                     | 0.035-42                     | 4.945-42                     |
| 41    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 5.045-43                     | 0.035-43                     | 5.045-43                     |
| 42    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 5.145-44                     | 0.035-44                     | 5.145-44                     |
| 43    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 5.245-45                     | 0.035-45                     | 5.245-45                     |
| 44    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 5.345-46                     | 0.035-46                     | 5.345-46                     |
| 45    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 5.445-47                     | 0.035-47                     | 5.445-47                     |
| 46    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 5.545-48                     | 0.035-48                     | 5.545-48                     |
| 47    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 5.645-49                     | 0.035-49                     | 5.645-49                     |
| 48    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 5.745-50                     | 0.035-50                     | 5.745-50                     |
| 49    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 5.845-51                     | 0.035-51                     | 5.845-51                     |
| 50    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 5.945-52                     | 0.035-52                     | 5.945-52                     |
| 51    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 6.045-53                     | 0.035-53                     | 6.045-53                     |
| 52    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 6.145-54                     | 0.035-54                     | 6.145-54                     |
| 53    | 0.000-03.0                   | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 0.000-03                     | 6.245-55                     | 0.035-55                     | 6.245-55                     |

## ALTERNATE BOUNDARY LAYER AEROSOL MODELS

| UPRAN                         | CLEAR                         | HAZY                          |
|-------------------------------|-------------------------------|-------------------------------|
| $\beta_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) |
| *****                         | *****                         | *****                         |
| 1.86E-03                      | 3.51E-02                      | 5.90E-02                      |
| WAPRTIME                      | 2.03E-02                      | 3.63E-01                      |
| *****                         | *****                         | *****                         |
| 1.00E-03                      | 3.59E-04                      | 1.00E-03                      |
| *****                         | *****                         | *****                         |

| WAVELENGTH =<br>FREQUENCY = |  | 4.591333 MICROMETER<br>2177.930 WAVELENGTH |  |  |  |          |  |        |  |           |  |         |  |      |  |
|-----------------------------|--|--------------------------------------------|--|--|--|----------|--|--------|--|-----------|--|---------|--|------|--|
|                             |  |                                            |  |  |  | TROPICAL |  | MIDLAT |  | SUBARCTIC |  | AEROSOL |  | HAZY |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
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|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
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|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |
|                             |  |                                            |  |  |  |          |  |        |  |           |  |         |  |      |  |



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ADN310322  
= 1458373654

[illegible]

TO: SAC, NEW YORK (100-158741) (P)  
FROM: SAC, NEW YORK (100-158741) (P)  
SUBJECT: [REDACTED]

|         | CLEAR                                                        | HATY                                                         |
|---------|--------------------------------------------------------------|--------------------------------------------------------------|
|         | $\beta_1(\text{km}^{-1})$ $\sigma_{\beta_1}(\text{km}^{-1})$ | $\beta_2(\text{km}^{-1})$ $\sigma_{\beta_2}(\text{km}^{-1})$ |
| JORDAN  | *****                                                        | 6.28E-02 6.63E-02                                            |
| ALPHEUS | 9.59E-03 7.87E-02                                            | 2.08E-02 3.12E-01                                            |
| ORION   | 1.79E-04 6.15E-03                                            | *****                                                        |



WAVELENGTH = 3.422618 MICROMETERS  
FREQUENCY = 2921.743 WAVENUMBERS

| Alt(km) | U.S. STANDARD                 |                                | TROPICAL                      |                                | MIDLAT SUMMER                 |                                | MIDLAT WINTER                 |                                | SUBARCTIC WINTER              |                                | SUBARCTIC                     | HAZY                           |
|---------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|         | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) | $\beta_m$ (km <sup>-1</sup> ) | $\sigma_m$ (km <sup>-1</sup> ) |
| 0       | 7.14E-03                      | 7.44E-06                       | 2.31E-02                      | 1.63E-02                       | 4.83E-03                      | 1.04E-02                       | 3.05E-03                      | 1.30E-03                       | 4.50E-03                      | 1.41E-02                       | 7.31E-02                      | 1.41E-02                       |
| 1       | 6.02E-03                      | 7.09E-06                       | 1.78E-02                      | 1.24E-02                       | 4.03E-03                      | 8.14E-03                       | 2.48E-03                      | 1.05E-04                       | 4.81E-03                      | 1.01E-02                       | 2.71E-02                      | 1.01E-02                       |
| 2       | 5.34E-03                      | 6.43E-06                       | 1.09E-02                      | 7.44E-03                       | 2.62E-03                      | 5.04E-03                       | 2.68E-03                      | 1.05E-04                       | 7.74E-04                      | 1.67E-03                       | 5.34E-03                      | 1.67E-03                       |
| 3       | 4.52E-03                      | 5.61E-06                       | 6.01E-03                      | 4.14E-03                       | 1.94E-03                      | 3.23E-03                       | 1.58E-03                      | 6.35E-05                       | 1.21E-03                      | 2.42E-04                       | 1.01E-03                      | 2.42E-04                       |
| 4       | 3.62E-03                      | 4.74E-06                       | 2.89E-03                      | 2.34E-03                       | 1.33E-03                      | 2.03E-03                       | 1.13E-03                      | 4.37E-05                       | 1.55E-04                      | 1.54E-04                       | 5.52E-04                      | 1.54E-04                       |
| 5       | 2.62E-03                      | 3.72E-06                       | 1.63E-03                      | 1.34E-03                       | 9.11E-04                      | 1.23E-03                       | 8.04E-04                      | 7.14E-05                       | 1.20E-04                      | 4.03E-05                       | 2.47E-04                      | 4.03E-05                       |
| 6       | 1.62E-03                      | 2.72E-06                       | 8.73E-04                      | 8.73E-04                       | 5.52E-04                      | 8.37E-04                       | 5.94E-04                      | 2.50E-05                       | 8.32E-05                      | 5.02E-05                       | 1.82E-04                      | 5.02E-05                       |
| 7       | 1.02E-03                      | 1.72E-06                       | 6.73E-04                      | 6.12E-04                       | 4.73E-04                      | 5.55E-04                       | 4.45E-04                      | 1.72E-05                       | 6.77E-05                      | 4.16E-05                       | 1.43E-04                      | 4.16E-05                       |
| 8       | 7.45E-04                      | 1.31E-06                       | 4.54E-04                      | 4.30E-04                       | 3.51E-04                      | 3.94E-04                       | 3.37E-04                      | 1.03E-05                       | 3.73E-05                      | 2.73E-05                       | 9.35E-05                      | 2.73E-05                       |
| 9       | 5.65E-04                      | 1.01E-06                       | 3.25E-04                      | 3.11E-04                       | 2.66E-04                      | 2.88E-04                       | 2.58E-04                      | 6.65E-05                       | 7.40E-05                      | 1.90E-05                       | 6.19E-05                      | 1.90E-05                       |
| 10      | 4.25E-04                      | 8.14E-07                       | 2.34E-04                      | 2.32E-04                       | 2.03E-04                      | 2.14E-04                       | 1.84E-04                      | 7.21E-05                       | 5.51E-05                      | 1.31E-05                       | 5.71E-05                      | 1.31E-05                       |
| 11      | 3.14E-04                      | 6.35E-07                       | 1.74E-04                      | 1.73E-04                       | 1.52E-04                      | 1.53E-04                       | 1.37E-04                      | 6.14E-05                       | 4.63E-05                      | 1.02E-05                       | 7.25E-05                      | 1.02E-05                       |
| 12      | 2.34E-04                      | 4.84E-07                       | 1.32E-04                      | 1.32E-04                       | 1.12E-04                      | 1.13E-04                       | 1.00E-04                      | 5.44E-05                       | 4.32E-05                      | 8.63E-06                       | 6.34E-05                      | 8.63E-06                       |
| 13      | 1.84E-04                      | 3.72E-07                       | 1.05E-04                      | 1.05E-04                       | 8.22E-05                      | 8.67E-05                       | 7.28E-05                      | 4.25E-05                       | 3.94E-05                      | 1.86E-05                       | 5.61E-05                      | 1.86E-05                       |
| 14      | 1.44E-04                      | 2.84E-07                       | 8.43E-05                      | 7.51E-05                       | 6.00E-05                      | 6.44E-05                       | 5.32E-05                      | 3.19E-05                       | 3.09E-05                      | 2.04E-05                       | 1.04E-05                      | 2.04E-05                       |
| 15      | 1.14E-04                      | 2.14E-07                       | 6.74E-05                      | 5.64E-05                       | 4.43E-05                      | 4.83E-05                       | 3.94E-05                      | 2.24E-05                       | 2.44E-05                      | 2.03E-05                       | 1.04E-05                      | 2.03E-05                       |
| 16      | 9.43E-05                      | 1.64E-07                       | 5.64E-05                      | 4.94E-05                       | 3.24E-05                      | 3.64E-05                       | 2.94E-05                      | 1.84E-05                       | 2.04E-05                      | 1.86E-05                       | 9.52E-05                      | 1.86E-05                       |
| 17      | 8.43E-05                      | 1.44E-07                       | 4.94E-05                      | 4.24E-05                       | 2.74E-05                      | 3.14E-05                       | 2.58E-05                      | 1.64E-05                       | 1.84E-05                      | 1.44E-05                       | 8.34E-05                      | 1.44E-05                       |
| 18      | 7.43E-05                      | 1.24E-07                       | 4.24E-05                      | 3.54E-05                       | 2.24E-05                      | 2.64E-05                       | 2.03E-05                      | 1.44E-05                       | 1.64E-05                      | 1.36E-05                       | 7.34E-05                      | 1.36E-05                       |
| 19      | 6.43E-05                      | 1.04E-07                       | 3.54E-05                      | 2.84E-05                       | 1.74E-05                      | 2.14E-05                       | 1.58E-05                      | 1.24E-05                       | 1.44E-05                      | 1.09E-05                       | 6.34E-05                      | 1.09E-05                       |
| 20      | 5.43E-05                      | 9.43E-08                       | 2.84E-05                      | 2.14E-05                       | 1.44E-05                      | 1.74E-05                       | 1.24E-05                      | 1.04E-05                       | 1.14E-05                      | 9.43E-06                       | 5.34E-05                      | 9.43E-06                       |
| 21      | 4.43E-05                      | 8.43E-08                       | 2.14E-05                      | 1.44E-05                       | 1.14E-05                      | 1.44E-05                       | 9.43E-06                      | 8.43E-06                       | 9.43E-06                      | 8.43E-06                       | 4.43E-05                      | 8.43E-06                       |
| 22      | 3.43E-05                      | 7.43E-08                       | 1.44E-05                      | 1.14E-05                       | 8.43E-06                      | 1.14E-05                       | 7.43E-06                      | 7.43E-06                       | 7.43E-06                      | 7.43E-06                       | 3.43E-05                      | 7.43E-06                       |
| 23      | 2.43E-05                      | 6.43E-08                       | 1.14E-05                      | 8.43E-06                       | 6.43E-06                      | 8.43E-06                       | 5.43E-06                      | 5.43E-06                       | 5.43E-06                      | 5.43E-06                       | 2.43E-05                      | 5.43E-06                       |
| 24      | 1.43E-05                      | 5.43E-08                       | 8.43E-06                      | 6.43E-06                       | 5.43E-06                      | 6.43E-06                       | 4.43E-06                      | 4.43E-06                       | 4.43E-06                      | 4.43E-06                       | 1.43E-05                      | 4.43E-06                       |
| 25      | 1.14E-05                      | 4.43E-08                       | 6.43E-06                      | 5.43E-06                       | 4.43E-06                      | 5.43E-06                       | 3.43E-06                      | 3.43E-06                       | 3.43E-06                      | 3.43E-06                       | 1.14E-05                      | 3.43E-06                       |
| 26      | 1.04E-05                      | 4.04E-08                       | 5.43E-06                      | 4.84E-06                       | 3.84E-06                      | 4.84E-06                       | 3.04E-06                      | 3.04E-06                       | 3.04E-06                      | 3.04E-06                       | 1.04E-05                      | 3.04E-06                       |
| 27      | 9.43E-06                      | 3.74E-08                       | 4.84E-06                      | 4.24E-06                       | 3.43E-06                      | 4.24E-06                       | 2.84E-06                      | 2.84E-06                       | 2.84E-06                      | 2.84E-06                       | 9.43E-06                      | 2.84E-06                       |
| 28      | 8.43E-06                      | 3.43E-08                       | 4.24E-06                      | 3.84E-06                       | 3.04E-06                      | 3.84E-06                       | 2.43E-06                      | 2.43E-06                       | 2.43E-06                      | 2.43E-06                       | 8.43E-06                      | 2.43E-06                       |
| 29      | 7.43E-06                      | 3.14E-08                       | 3.84E-06                      | 3.43E-06                       | 2.84E-06                      | 3.43E-06                       | 2.14E-06                      | 2.14E-06                       | 2.14E-06                      | 2.14E-06                       | 7.43E-06                      | 2.14E-06                       |
| 30      | 6.43E-06                      | 2.84E-08                       | 3.43E-06                      | 3.04E-06                       | 2.43E-06                      | 3.04E-06                       | 1.84E-06                      | 1.84E-06                       | 1.84E-06                      | 1.84E-06                       | 6.43E-06                      | 1.84E-06                       |
| 35      | 5.43E-06                      | 2.43E-08                       | 3.04E-06                      | 2.64E-06                       | 2.14E-06                      | 2.64E-06                       | 1.64E-06                      | 1.64E-06                       | 1.64E-06                      | 1.64E-06                       | 5.43E-06                      | 1.64E-06                       |
| 40      | 4.43E-06                      | 2.14E-08                       | 2.64E-06                      | 2.24E-06                       | 1.84E-06                      | 2.24E-06                       | 1.44E-06                      | 1.44E-06                       | 1.44E-06                      | 1.44E-06                       | 4.43E-06                      | 1.44E-06                       |
| 45      | 3.43E-06                      | 1.84E-08                       | 2.24E-06                      | 1.84E-06                       | 1.64E-06                      | 1.84E-06                       | 1.24E-06                      | 1.24E-06                       | 1.24E-06                      | 1.24E-06                       | 3.43E-06                      | 1.24E-06                       |
| 50      | 2.43E-06                      | 1.44E-08                       | 1.84E-06                      | 1.44E-06                       | 1.44E-06                      | 1.44E-06                       | 1.04E-06                      | 1.04E-06                       | 1.04E-06                      | 1.04E-06                       | 2.43E-06                      | 1.04E-06                       |
| 55      | 1.44E-06                      | 1.04E-08                       | 1.44E-06                      | 1.04E-06                       | 1.04E-06                      | 1.04E-06                       | 8.43E-07                      | 8.43E-07                       | 8.43E-07                      | 8.43E-07                       | 1.44E-06                      | 8.43E-07                       |
| 60      | 1.04E-06                      | 8.43E-09                       | 1.04E-06                      | 8.43E-07                       | 8.43E-07                      | 8.43E-07                       | 6.43E-07                      | 6.43E-07                       | 6.43E-07                      | 6.43E-07                       | 1.04E-06                      | 6.43E-07                       |
| 65      | 8.43E-07                      | 7.43E-09                       | 8.43E-07                      | 7.43E-07                       | 7.43E-07                      | 7.43E-07                       | 5.43E-07                      | 5.43E-07                       | 5.43E-07                      | 5.43E-07                       | 8.43E-07                      | 5.43E-07                       |
| 70      | 7.43E-07                      | 6.43E-09                       | 7.43E-07                      | 6.43E-07                       | 6.43E-07                      | 6.43E-07                       | 4.43E-07                      | 4.43E-07                       | 4.43E-07                      | 4.43E-07                       | 7.43E-07                      | 4.43E-07                       |

# ALTERNATE BOUNDARY LAYER AEROSOL MODELS

|               | CLEAR                         |                                | HAZY                          |                                |
|---------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|
|               | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) | $\beta_a$ (km <sup>-1</sup> ) | $\sigma_a$ (km <sup>-1</sup> ) |
| UPPER         | *****                         | *****                          | 6.71E-02                      | 5.61E-02                       |
| MARITIME      | 4.79E-07                      | 3.98E-02                       | 5.22E-02                      | 4.33E-01                       |
| TRPOPOSPHERIC | 4.17E-04                      | 1.49E-03                       | *****                         | *****                          |

| lat(km) | T.S.                       |                              | TROPICAL                   |                            | MIDLAT                     |                            | MIDLAT                     |                            | SUBARCTIC                  |                            | SUBARCTIC                  |                            | AEROSOL                    |                            | HAZY                         |  |
|---------|----------------------------|------------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|------------------------------|--|
|         | $\rho$ (km <sup>-1</sup> ) | $\sigma$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\rho$ (km <sup>-1</sup> ) | $\sigma$ (km <sup>-1</sup> ) |  |
| 0       | 4.94E-03                   | 7.02E-06                     | 1.76E-02                   | 1.24E-12                   | 2.76E-03                   | 7.79E-03                   | 5.89E-04                   | 1.17E-03                   | 6.61E-03                   | 1.29E-02                   | 7.20E-02                   |                            |                            |                            |                              |  |
| 1       | 3.90E-03                   | 6.69E-06                     | 1.36E-02                   | 9.49E-03                   | 2.19E-03                   | 5.85E-03                   | 8.39E-04                   | 7.77E-04                   | 7.77E-03                   | 1.29E-02                   | 7.20E-02                   |                            |                            |                            |                              |  |
| 2       | 2.37E-03                   | 5.07E-06                     | 4.17E-03                   | 6.34E-03                   | 1.37E-03                   | 3.43E-03                   | 5.82E-04                   | 2.17E-03                   | 3.77E-04                   | 1.40E-02                   | 6.31E-03                   |                            |                            |                            |                              |  |
| 3       | 1.34E-03                   | 5.49E-06                     | 4.20E-03                   | 2.74E-03                   | 9.27E-04                   | 1.39E-03                   | 4.27E-04                   | 4.69E-05                   | 1.67E-04                   | 2.47E-04                   | 1.02E-03                   |                            |                            |                            |                              |  |
| 4       | 7.13E-04                   | 4.95E-06                     | 1.90E-03                   | 1.35E-03                   | 4.36E-04                   | 1.19E-03                   | 2.45E-04                   | 8.02E-05                   | 5.65E-04                   | 1.35E-04                   | 5.65E-04                   |                            |                            |                            |                              |  |
| 5       | 3.65E-04                   | 4.66E-06                     | 3.56E-04                   | 6.42E-04                   | 2.11E-04                   | 5.76E-04                   | 1.16E-04                   | 2.95E-05                   | 1.21E-04                   | 7.03E-05                   | 2.83E-04                   |                            |                            |                            |                              |  |
| 6       | 1.84E-04                   | 4.00E-06                     | 4.61E-04                   | 3.12E-04                   | 1.02E-04                   | 2.78E-04                   | 4.87E-05                   | 2.19E-05                   | 9.30E-05                   | 4.65E-05                   | 1.83E-04                   |                            |                            |                            |                              |  |
| 7       | 9.05E-05                   | 3.58E-06                     | 2.22E-04                   | 1.63E-04                   | 4.28E-05                   | 1.24E-04                   | 2.14E-05                   | 1.51E-05                   | 6.20E-05                   | 3.65E-05                   | 1.53E-04                   |                            |                            |                            |                              |  |
| 8       | 4.34E-05                   | 3.20E-06                     | 1.04E-04                   | 8.24E-05                   | 1.58E-05                   | 5.45E-05                   | 7.37E-06                   | 3.46E-05                   | 7.93E-05                   | 2.44E-05                   | 1.03E-04                   |                            |                            |                            |                              |  |
| 9       | 1.80E-05                   | 2.84E-06                     | 4.54E-05                   | 4.03E-05                   | 6.18E-06                   | 1.86E-05                   | 2.72E-06                   | 5.48E-05                   | 7.35E-05                   | 1.79E-05                   | 8.24E-05                   |                            |                            |                            |                              |  |
| 10      | 6.23E-06                   | 2.52E-06                     | 1.77E-05                   | 1.92E-05                   | 2.78E-06                   | 5.77E-06                   | 1.37E-06                   | 7.05E-05                   | 5.45E-05                   | 1.29E-05                   | 6.44E-05                   |                            |                            |                            |                              |  |
| 11      | 2.45E-06                   | 2.23E-06                     | 6.18E-06                   | 2.49E-06                   | 1.63E-06                   | 2.53E-06                   | 1.10E-06                   | 6.01E-05                   | 4.58E-05                   | 1.36E-05                   | 6.36E-05                   |                            |                            |                            |                              |  |
| 12      | 1.37E-06                   | 1.94E-06                     | 2.11E-06                   | 2.30E-06                   | 1.20E-06                   | 1.59E-06                   | 0.                         | 5.15E-05                   | 4.23E-05                   | 1.54E-05                   | 8.01E-05                   |                            |                            |                            |                              |  |
| 13      | 0.                         | 1.66E-06                     | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 5.04E-05                   | 3.95E-05                   | 1.77E-05                   | 9.22E-05                   |                            |                            |                            |                              |  |
| 14      | 0.                         | 1.47E-06                     | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 5.16E-05                   | 4.03E-05                   | 1.97E-05                   | 1.02E-04                   |                            |                            |                            |                              |  |
| 15      | 0.                         | 1.31E-06                     | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 5.15E-05                   | 4.01E-05                   | 1.92E-05                   | 9.65E-05                   |                            |                            |                            |                              |  |
| 16      | 0.                         | 1.03E-06                     | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 6.98E-05                   | 3.97E-05                   | 1.76E-05                   | 9.14E-05                   |                            |                            |                            |                              |  |
| 17      | 0.                         | 6.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 4.22E-05                   | 3.24E-05                   | 1.29E-05                   | 6.63E-05                   |                            |                            |                            |                              |  |
| 18      | 0.                         | 6.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 7.66E-05                   | 2.84E-05                   | 1.03E-05                   | 6.35E-05                   |                            |                            |                            |                              |  |
| 19      | 0.                         | 19                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 7.01E-05                   | 2.48E-05                   | 8.23E-06                   | 4.28E-05                   |                            |                            |                            |                              |  |
| 20      | 0.                         | 20                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 7.59E-05                   | 2.73E-05                   | 5.97E-06                   | 3.42E-05                   |                            |                            |                            |                              |  |
| 21      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 2.15E-05                   | 1.67E-05                   | 5.12E-06                   | 2.65E-05                   |                            |                            |                            |                              |  |
| 22      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 1.72E-05                   | 1.34E-05                   | 3.95E-06                   | 2.04E-05                   |                            |                            |                            |                              |  |
| 23      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 1.36E-05                   | 1.05E-05                   | 3.12E-06                   | 1.62E-05                   |                            |                            |                            |                              |  |
| 24      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 1.05E-05                   | 1.50E-05                   | 2.63E-06                   | 4.13E-05                   |                            |                            |                            |                              |  |
| 25      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 7.24E-06                   | 4.94E-06                   | 5.14E-06                   | 9.41E-06                   |                            |                            |                            |                              |  |
| 30      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 1.60E-06                   | 2.44E-06                   | 2.00E-06                   | 3.05E-06                   |                            |                            |                            |                              |  |
| 35      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 1.20E-06                   | 0.                         | 1.20E-06                   |                            |                            |                            |                              |  |
| 40      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         |                            |                            |                            |                              |  |
| 45      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         |                            |                            |                            |                              |  |
| 50      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         |                            |                            |                            |                              |  |
| 50      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         |                            |                            |                            |                              |  |
| 70      | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         |                            |                            |                            |                              |  |
| 100     | 0.                         | 0.                           | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         | 0.                         |                            |                            |                            |                              |  |

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|          | CLEAR                                | HAZY                                 |
|----------|--------------------------------------|--------------------------------------|
|          | $\lambda_{\text{g}}(\text{km}^{-1})$ | $\lambda_{\text{g}}(\text{km}^{-1})$ |
|          | $\sigma_{\text{g}}(\text{km}^{-1})$  | $\sigma_{\text{g}}(\text{km}^{-1})$  |
| JOBNAME  | *****                                | 6.59E-02 5.65E-02                    |
| DATETIME | 3.59E-01 4.03E-02                    | 3.96E-02 4.39E-01                    |
| PROBNAME | 3.65E-04 1.59E-03                    | *****                                |

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Atmospheric Transmission of Laser Radiation:  
Computer Code LASER

R.A. McClatchey  
A.P. D'Agati

Errata

Insert the following on page 111:

Figures C1 and C2 are based on the U.S. STANDARD  
ATMOSPHERE, 1962 model shown on page 31.

AIR FORCE GEOPHYSICS LABORATORY  
AIR FORCE SYSTEMS COMMAND  
UNITED STATES AIR FORCE  
HANSCOM AFB, MASSACHUSETTS 01731

110A

## Appendix C

### Calculated Transmission Spectra for 10-km Horizontal Paths at Sea Level and 12-km Altitude

Table C1 defines the spectral plots provided. Note that two have been omitted: Figure C1k because it is completely opaque over the entire spectral range and Figure C2c because it is completely transparent over the entire spectral range.

Table C1. Spectral Plots Contained in Figures C1 and C2

| Figure No. | Spectral Range (cm <sup>-1</sup> ) | Figure No. | Spectral Range (cm <sup>-1</sup> ) |
|------------|------------------------------------|------------|------------------------------------|
| C1a        | 740-800                            | C2a        | 740-800                            |
| C1b        | 800-860                            | C2b        | 800-860                            |
| C1c        | 860-920                            | C2c        | 860-920 transparent                |
| C1d        | 920-980                            | C2d        | 920-980                            |
| C1e        | 980-1040                           | C2e        | 980-1040                           |
| C1f        | 1040-1100                          | C2f        | 1040-1100                          |
| C1g        | 1100-1160                          | C2g        | 1100-1160                          |
| C1h        | 1160-1220                          | C2h        | 1160-1220                          |
| C1i        | 1220-1280                          | C2i        | 1220-1280                          |
| C1j        | 1280-1340                          | C2j        | 1280-1340                          |
| C1k        | 1340-1400 opaque                   | C2k        | 1340-1400                          |
| C1l        | 1880-1940                          | C2l        | 1880-1940                          |
| C1m        | 1940-2000                          | C2m        | 1940-2000                          |
| C1n        | 2000-2060                          | C2n        | 2000-2060                          |
| C1o        | 2060-2120                          | C2o        | 2060-2120                          |
| C1p        | 2120-2180                          | C2p        | 2120-2180                          |
| C1q        | 2360-2420                          | C2q        | 2360-2420                          |
| C1r        | 2420-2480                          | C2r        | 2420-2480                          |
| C1s        | 2480-2540                          | C2s        | 2480-2540                          |
| C1t        | 2540-2600                          | C2t        | 2540-2600                          |
| C1u        | 2600-2660                          | C2u        | 2600-2660                          |
| C1v        | 2660-2720                          | C2v        | 2660-2720                          |
| C1w        | 2720-2780                          | C2w        | 2720-2780                          |
| C1x        | 2780-2840                          | C2x        | 2780-2840                          |
| C1y        | 2840-2900                          | C2y        | 2840-2900                          |
| C1z        | 2900-2960                          | C2z        | 2900-2960                          |

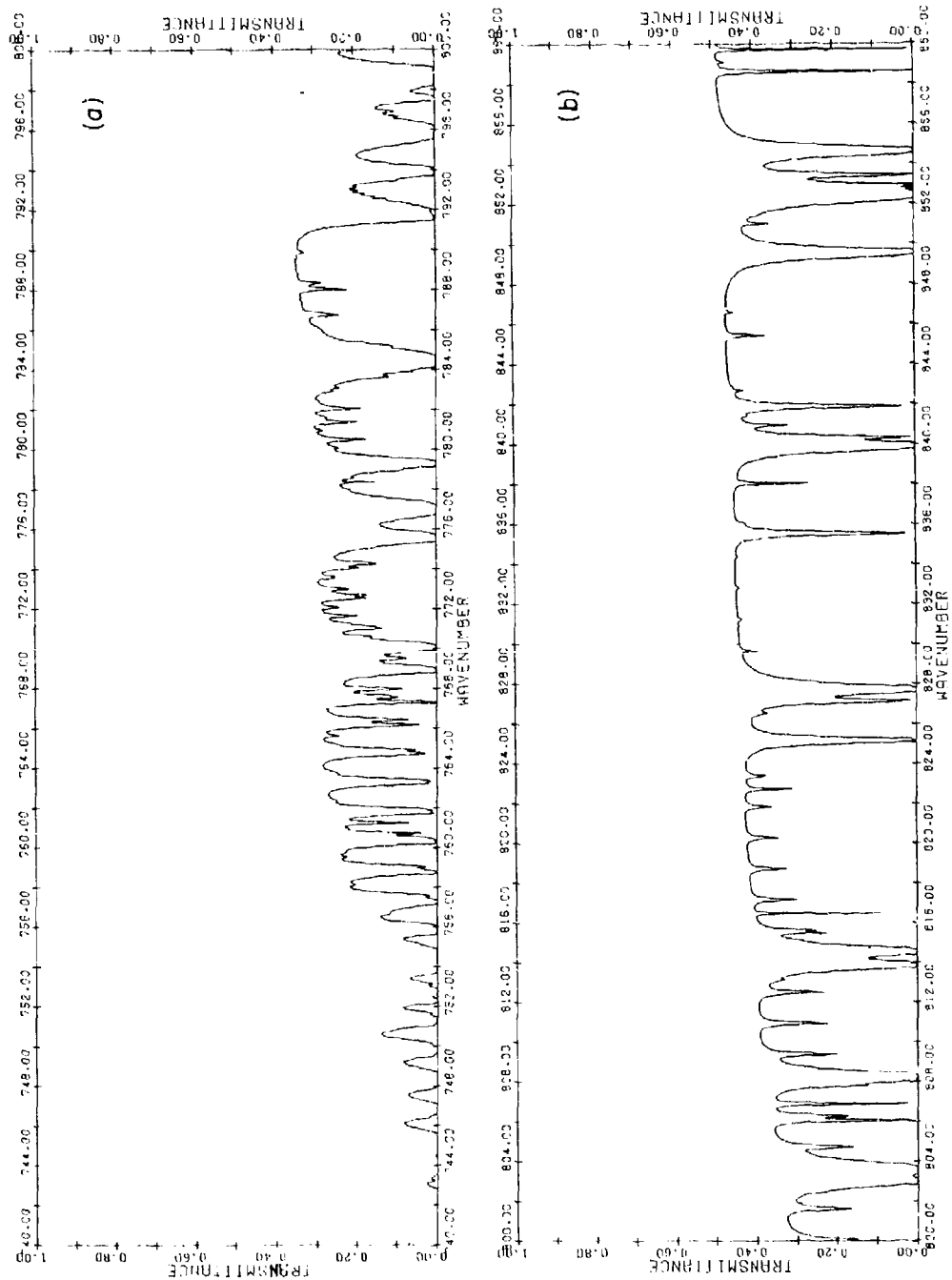


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 cm<sup>-1</sup>.  
BOUND value = 20 cm<sup>-1</sup>

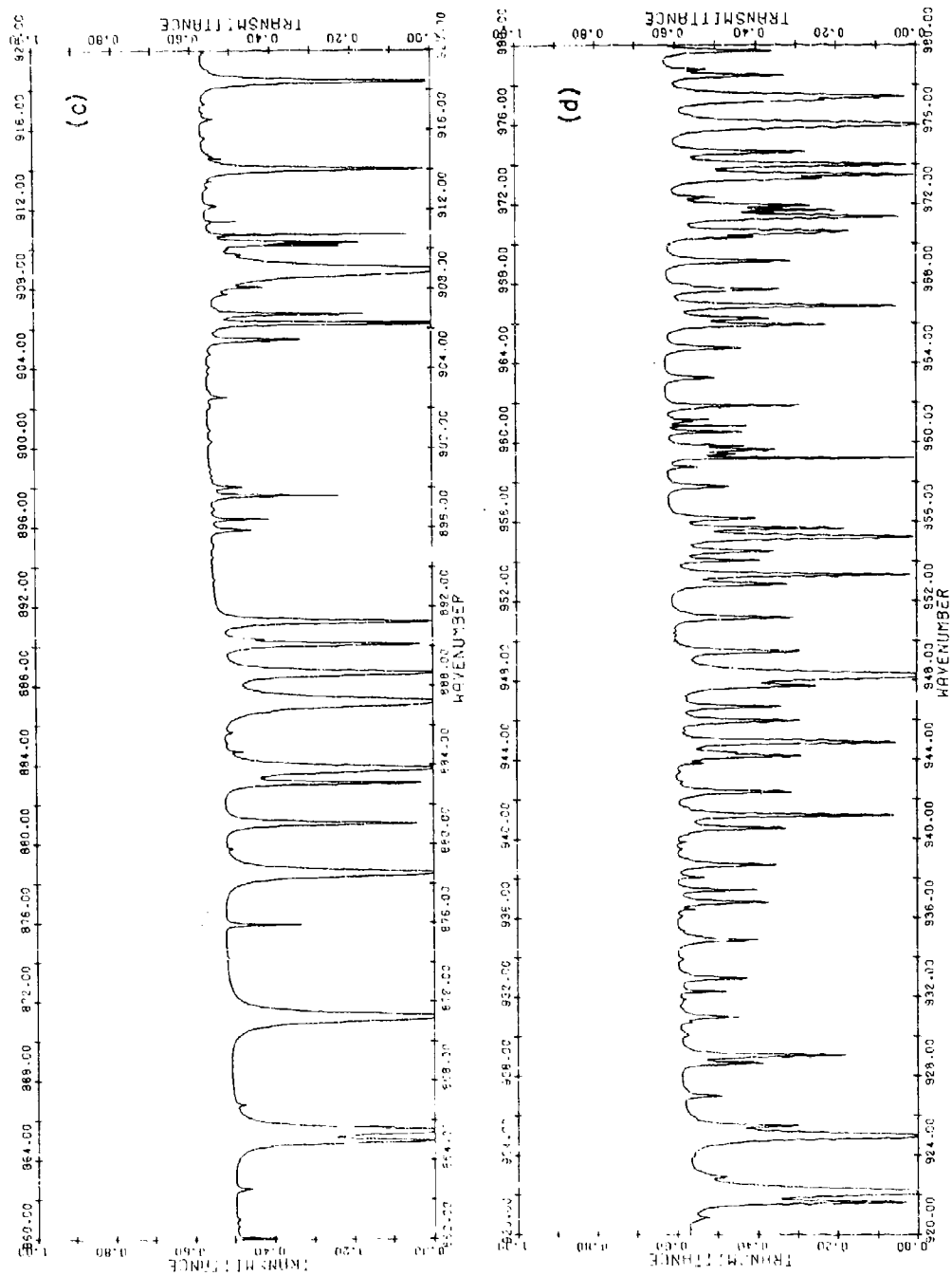


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is  $0.01 \text{ cm}^{-1}$ .  
BOUND value =  $20 \text{ cm}^{-1}$  (Cont.)

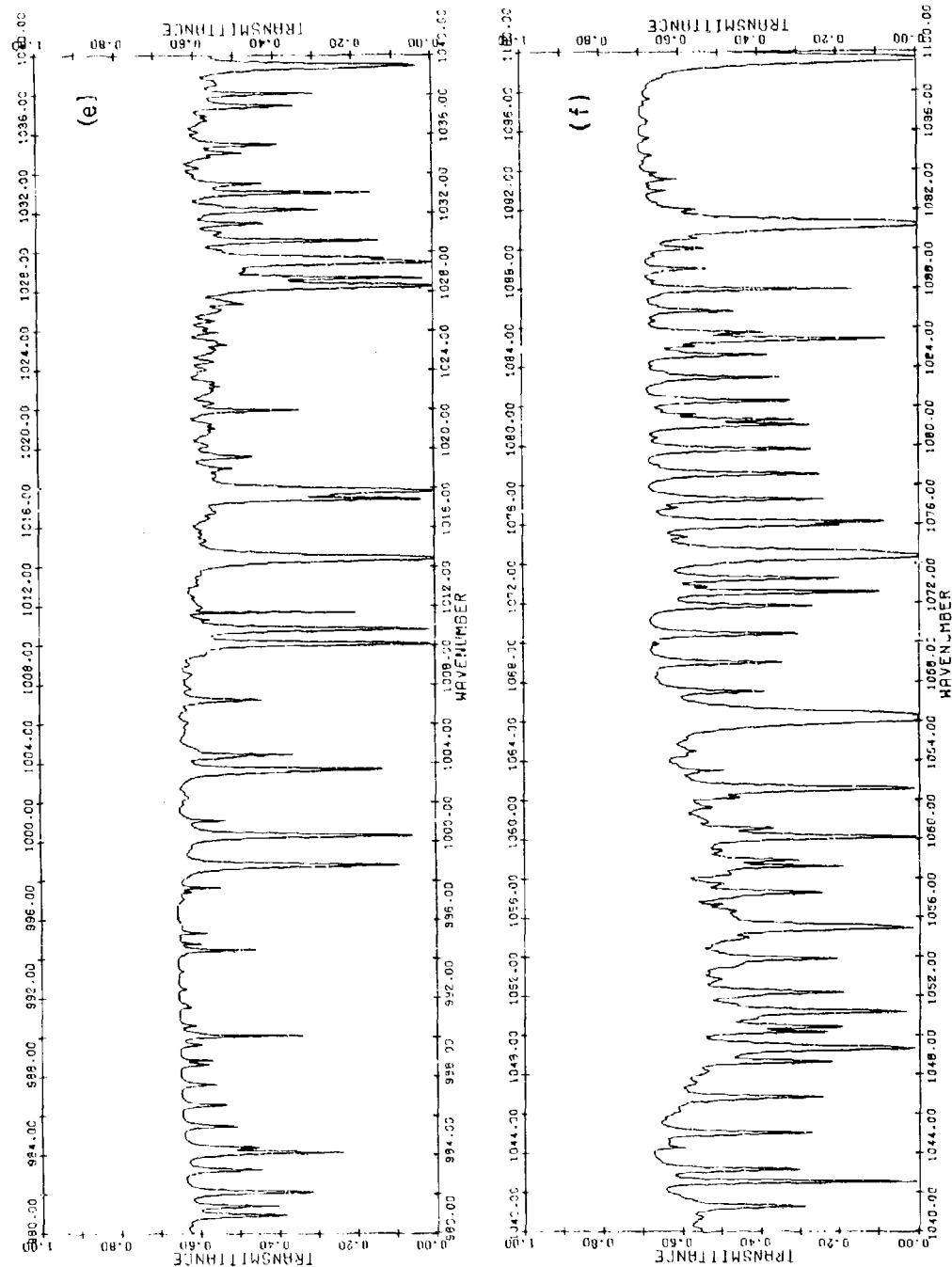


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 cm<sup>-1</sup>.  
BOUND value = 20 cm<sup>-1</sup> (Cont.)

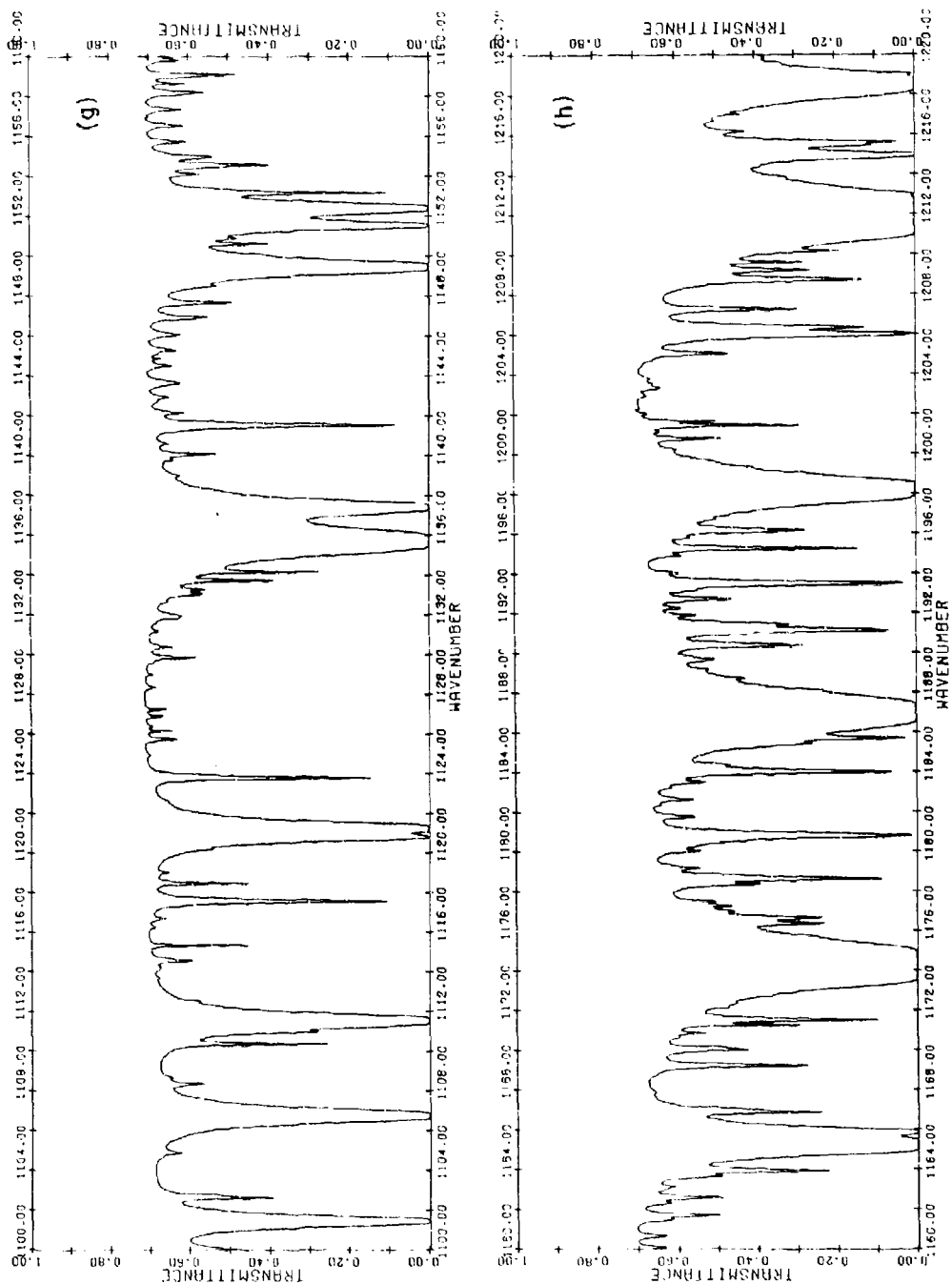


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 cm<sup>-1</sup>.  
BOUND value = 20 cm<sup>-1</sup> (Cont.)

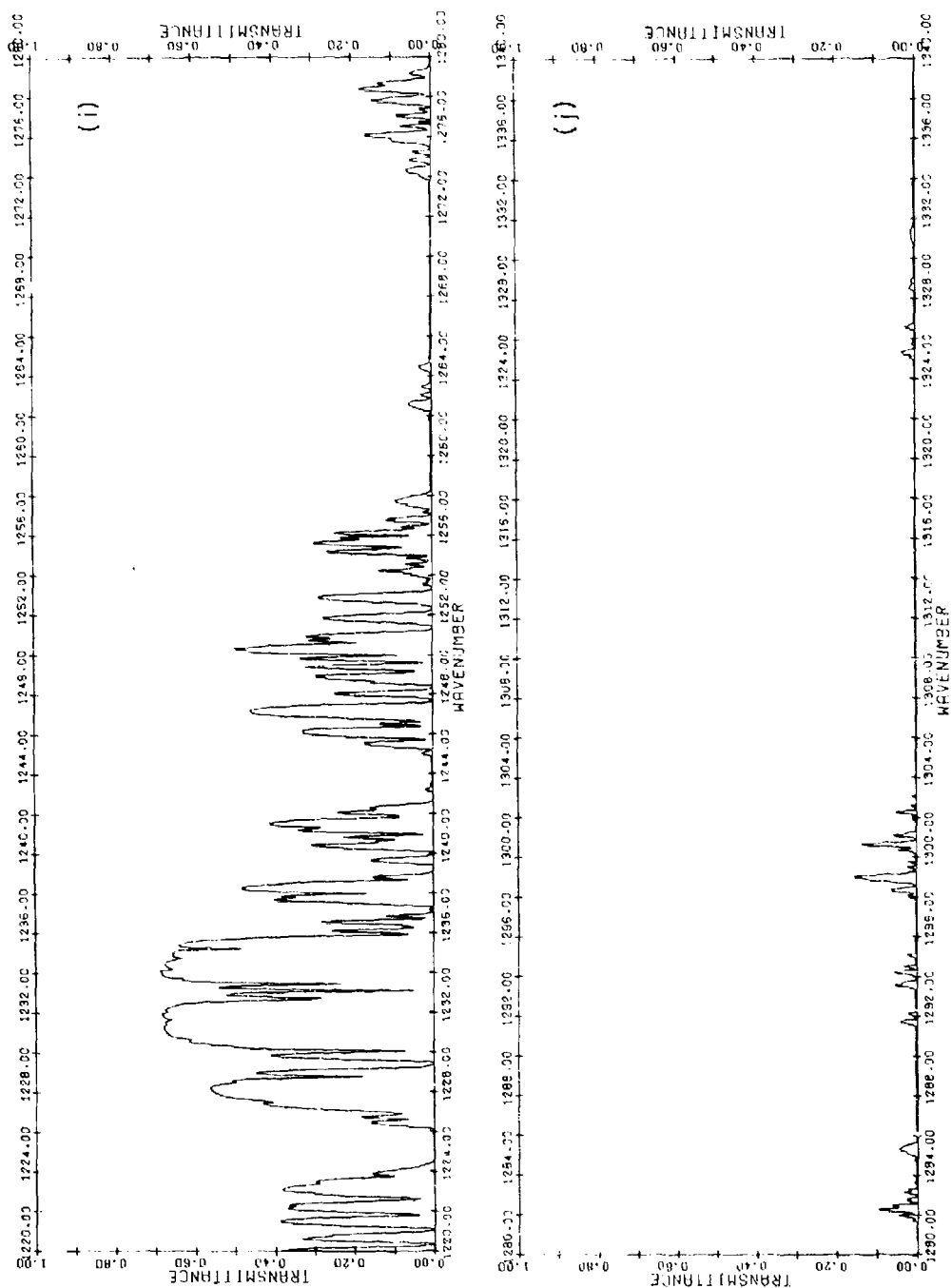


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 cm<sup>-1</sup>.  
BOUND value = 20 cm<sup>-1</sup> (Cont.)

Note that Figure C1k has been omitted as indicated in Table C1 because the plotted spectrum appears opaque for the entire spectral range of the figure.

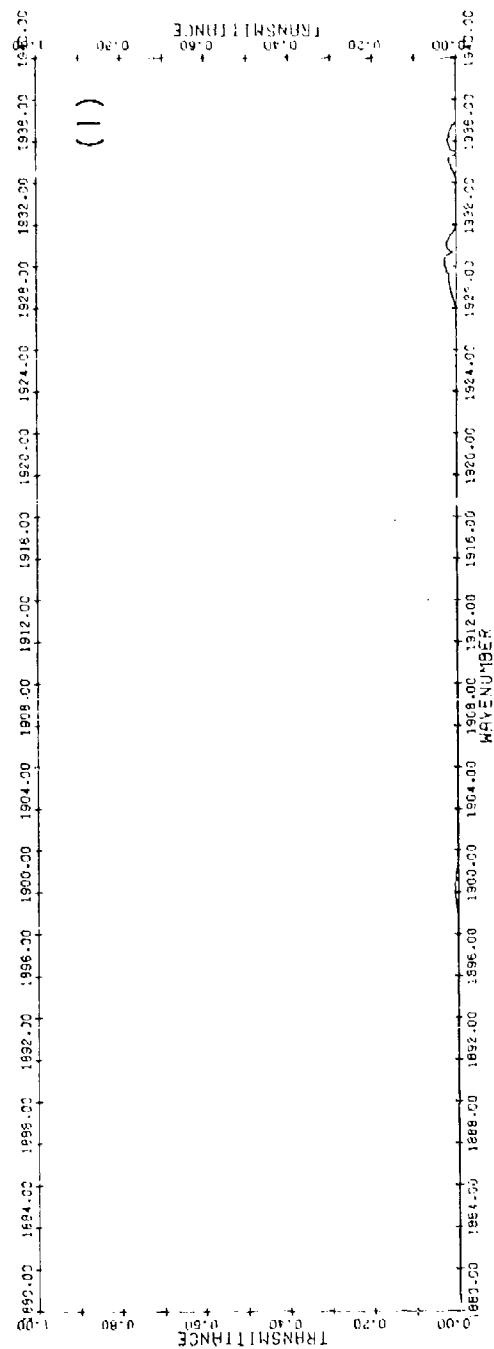


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 cm<sup>-1</sup>. BOUND value = 20 cm<sup>-1</sup> (Cont.)

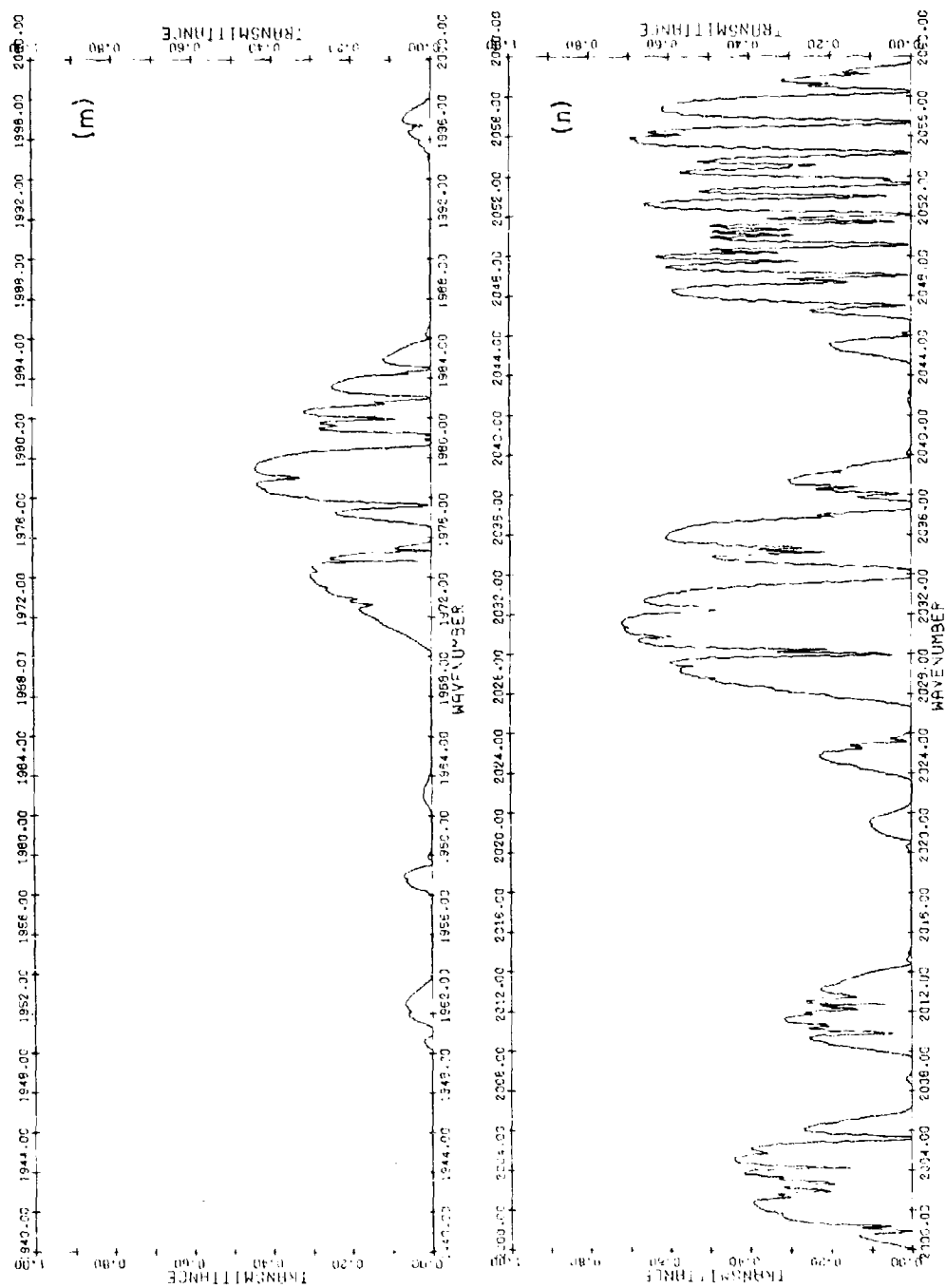


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is  $0.01 \text{ cm}^{-1}$ .  
BOUND value =  $20 \text{ cm}^{-1}$  (Cont.)

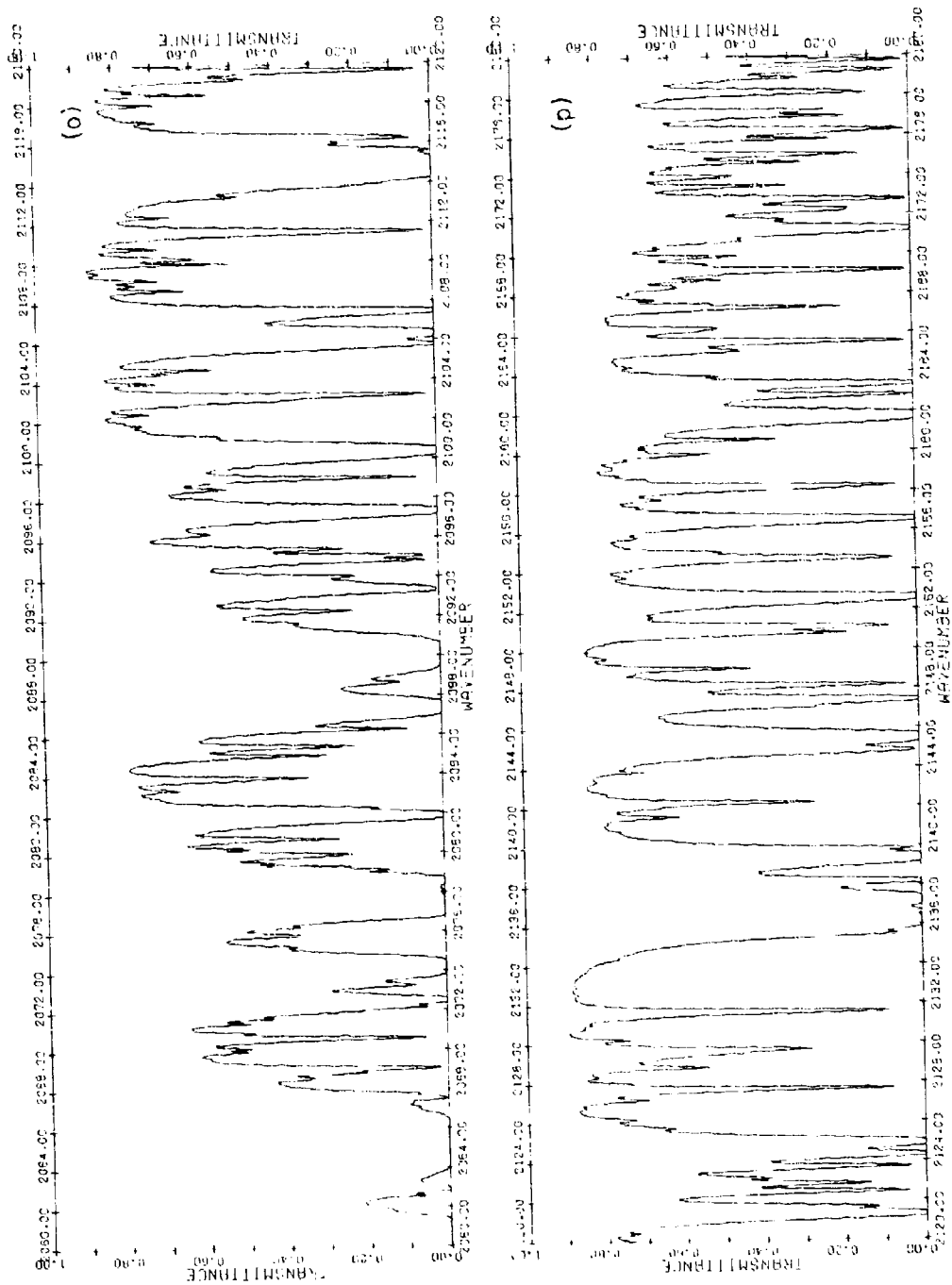


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 cm<sup>-1</sup>.  
BOUND value = 20 cm<sup>-1</sup> (Cont.)

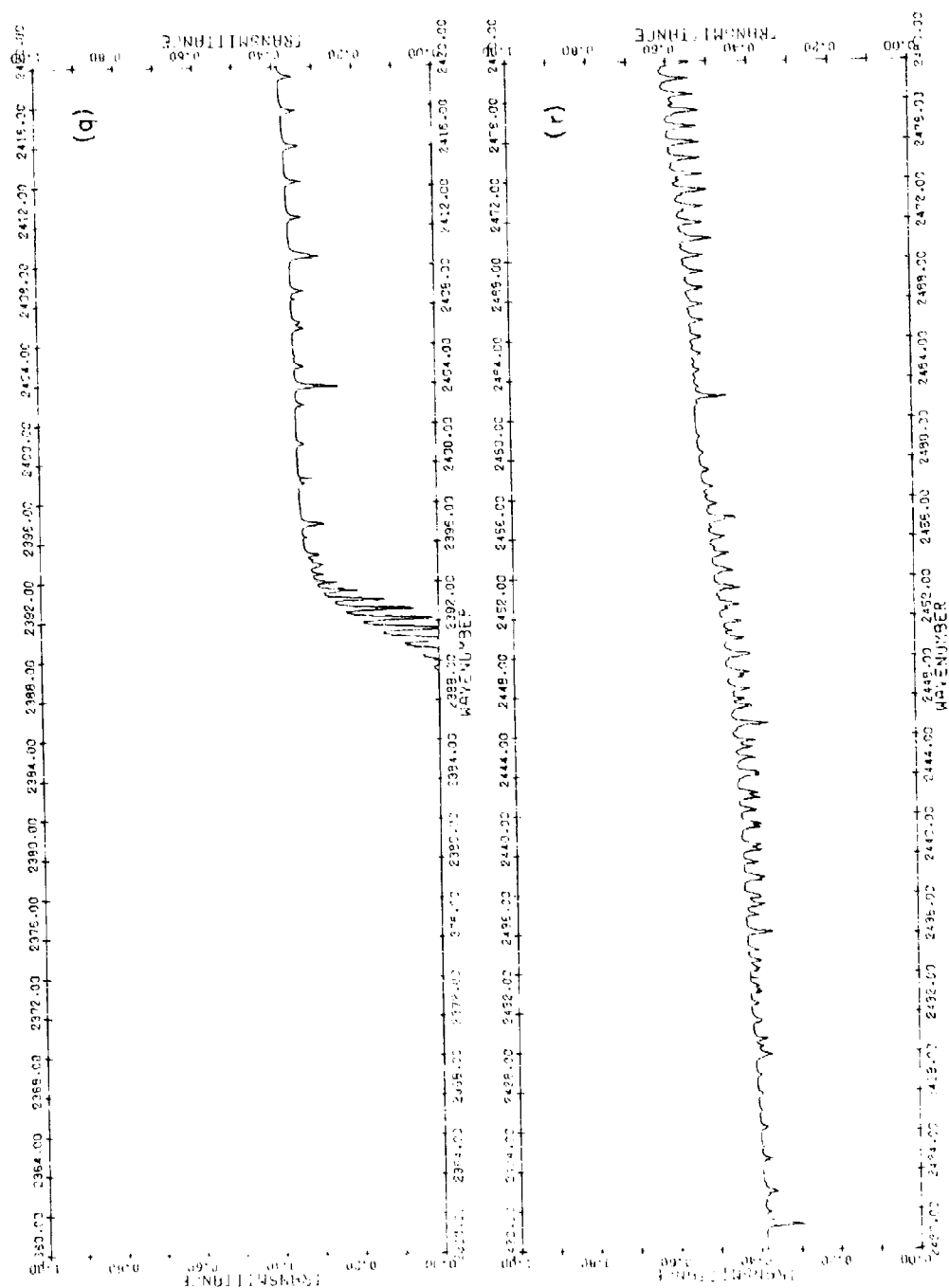


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.91  $\text{cm}^{-1}$ .  
BOUND value = 20  $\text{cm}^{-1}$  (Cont.)

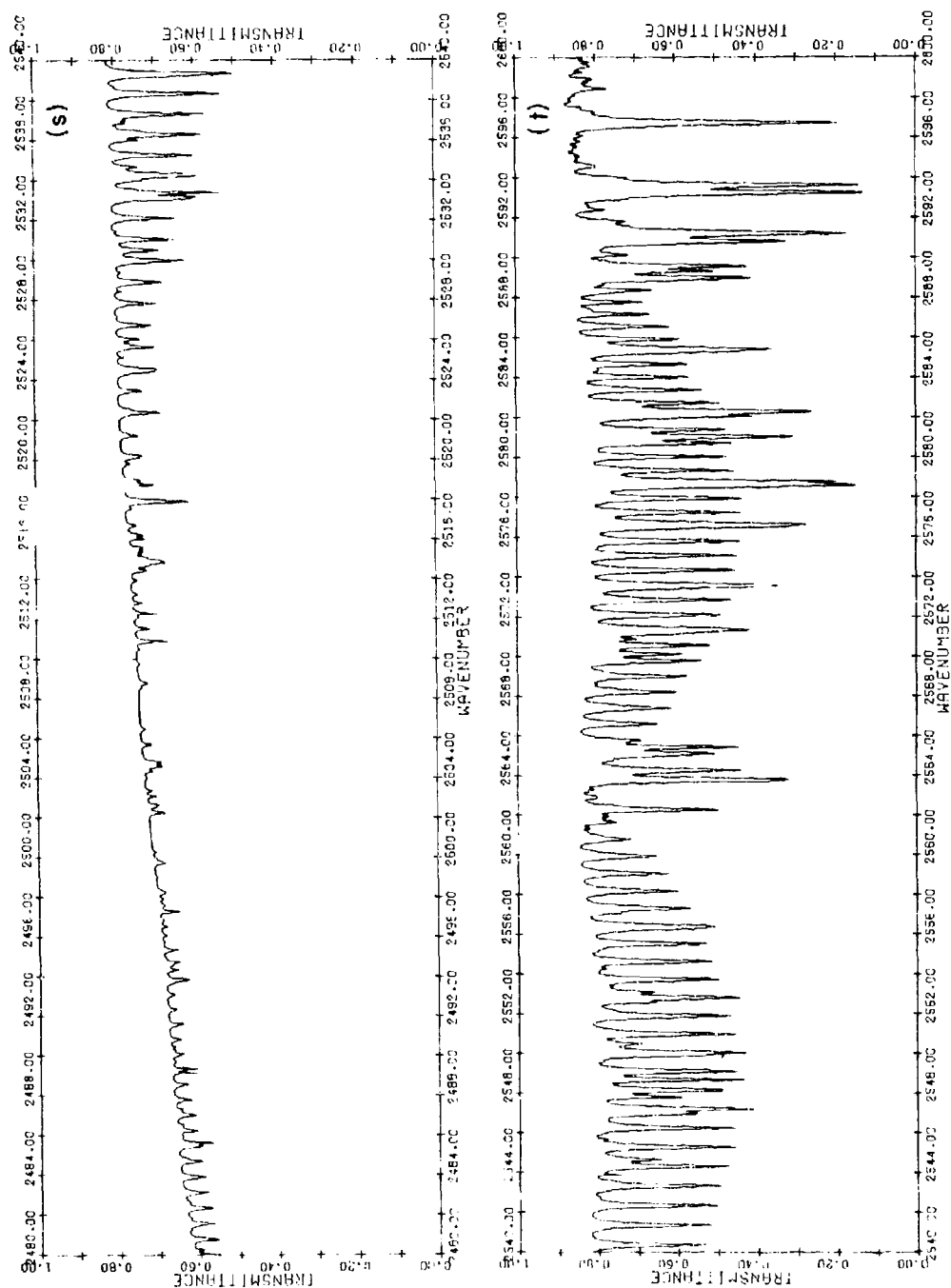


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01  $\text{cm}^{-1}$ .  
BOUND value = 20  $\text{cm}^{-1}$  (Cont.)

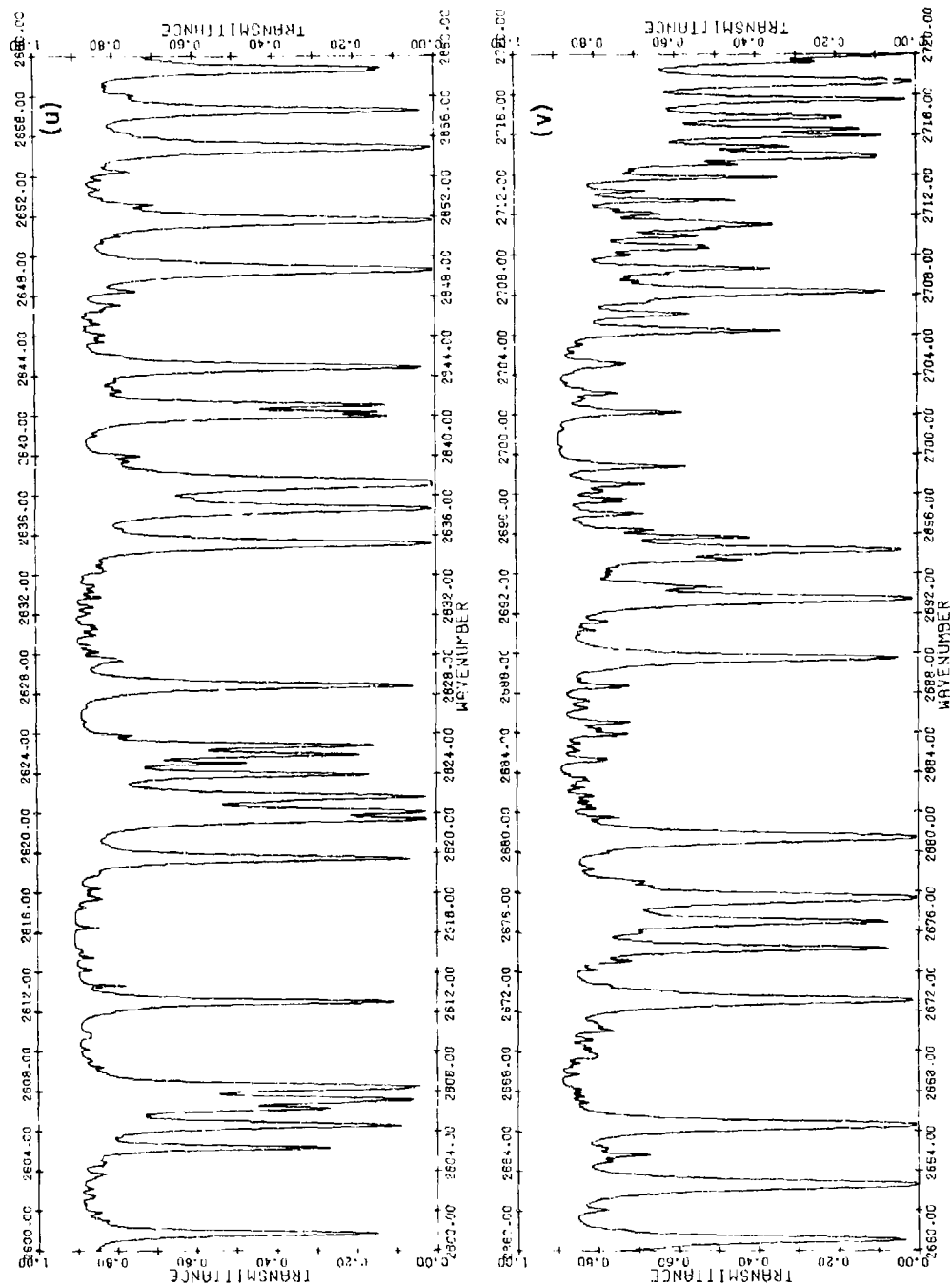


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is  $0.01 \text{ cm}^{-1}$ .  
BOUND value =  $20 \text{ cm}^{-1}$  (Cont.)

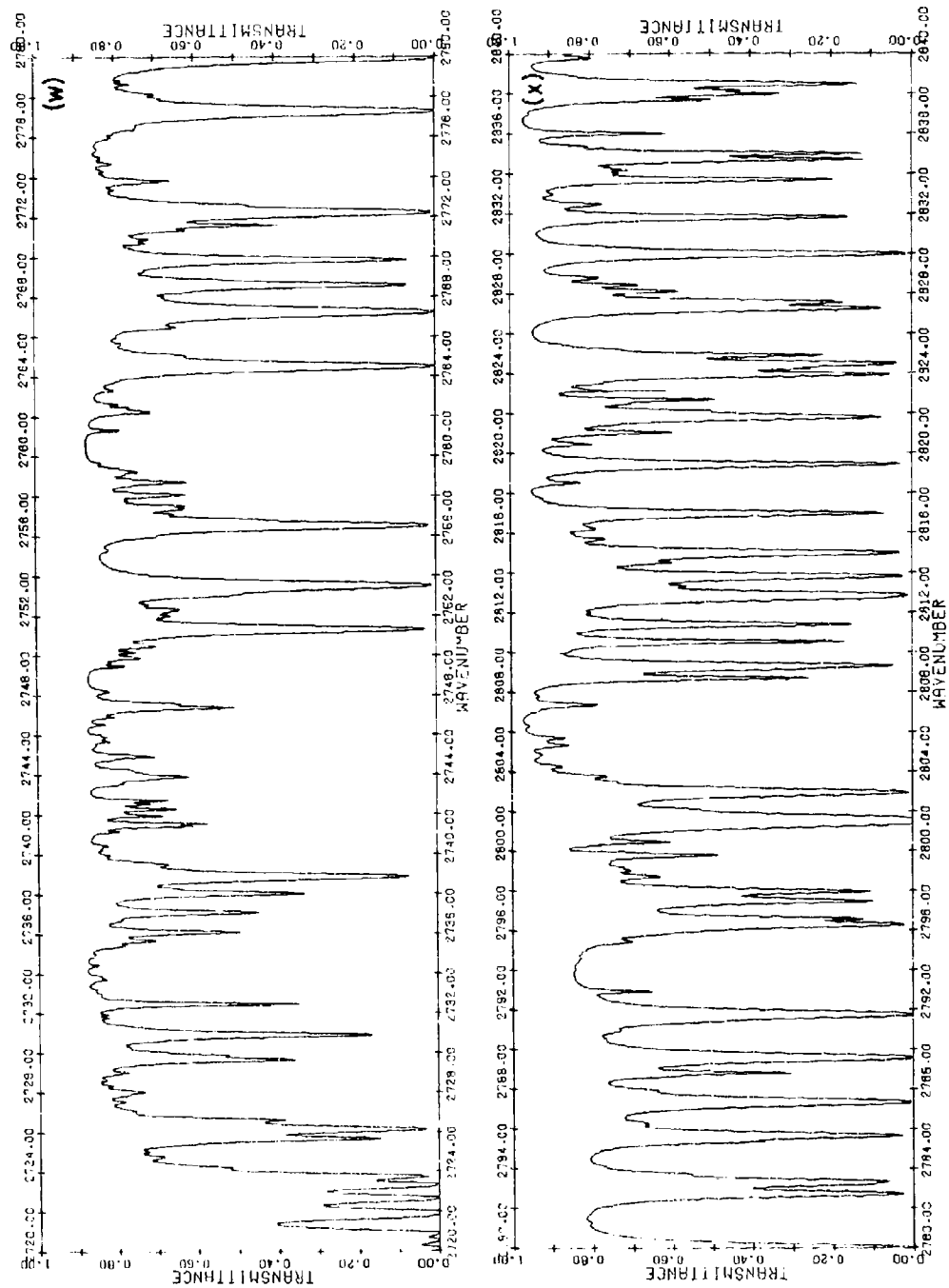


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 cm<sup>-1</sup>.  
BOUND value = 20 cm<sup>-1</sup> (Cont.)

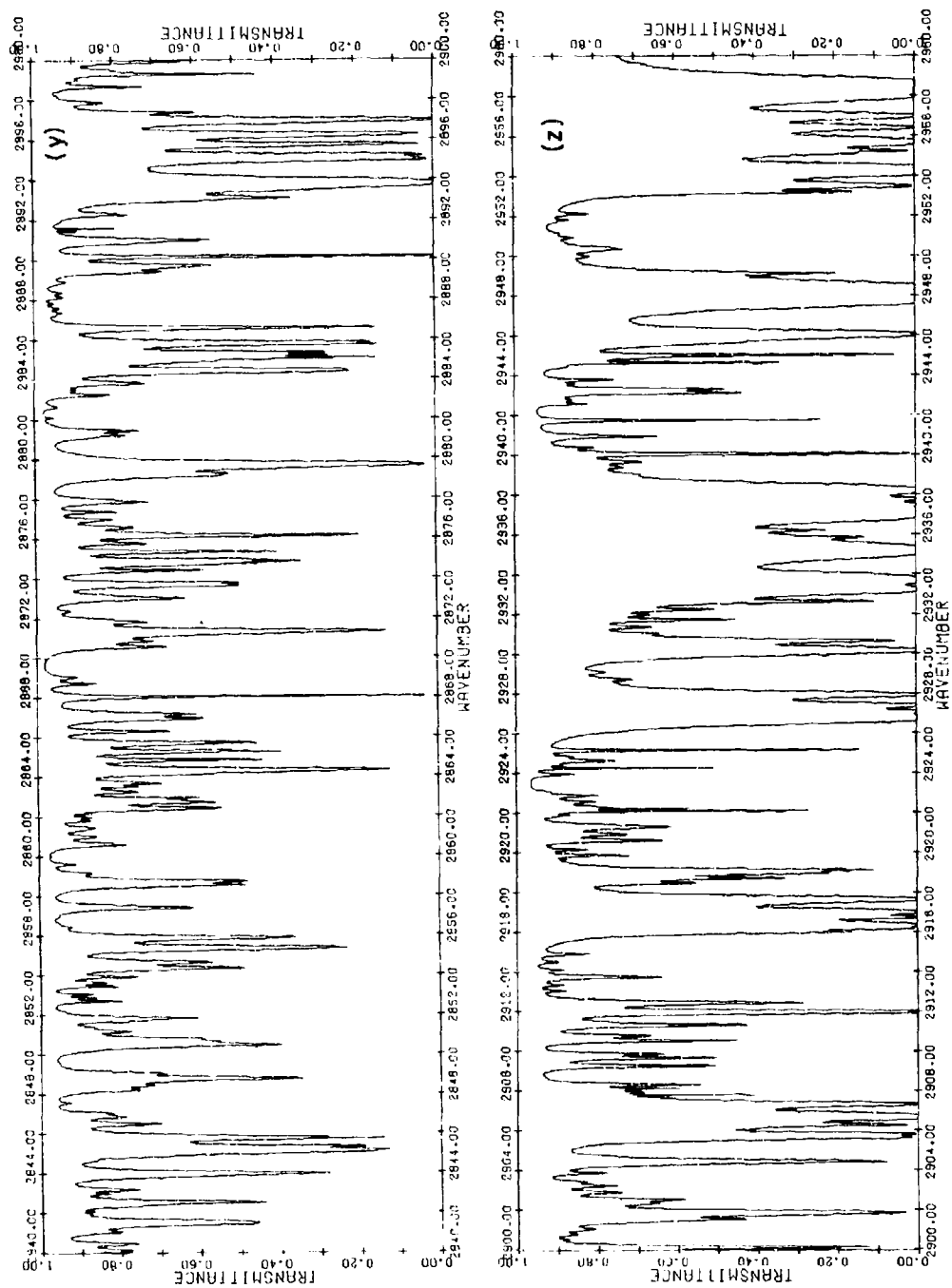


Figure C1. Calculated Spectra for a 10-km Horizontal Sea Level Path. Spectral Resolution is 0.01 cm<sup>-1</sup>.  
BOUND value = 20 cm<sup>-1</sup> (Cont.)

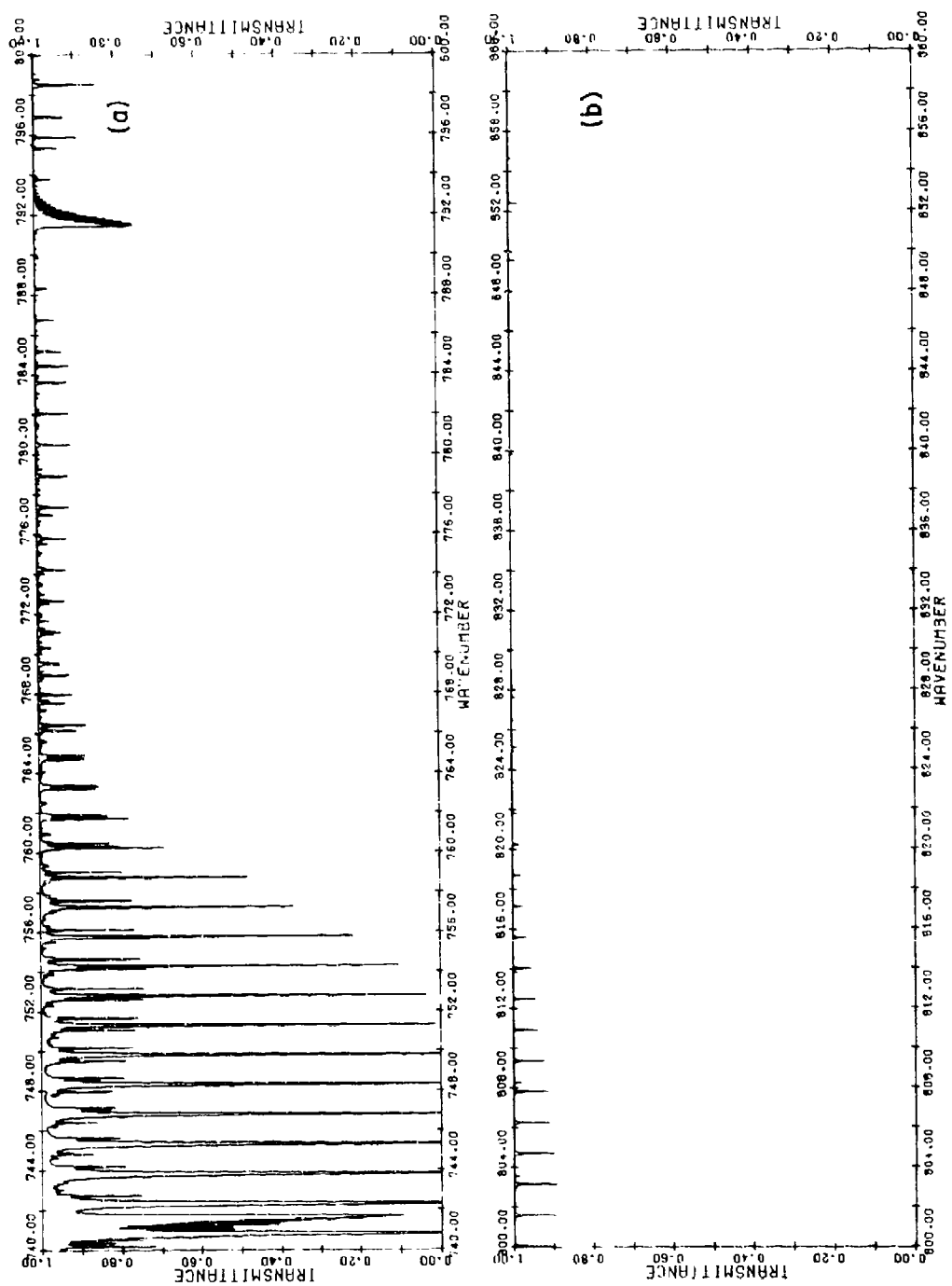


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01  $\text{cm}^{-1}$ ; BOUND value = 20  $\text{cm}^{-1}$

Note that Figure C2c has been omitted as indicated in Table C1 because the plotted spectrum appears transparent for the entire spectral range of the figure.

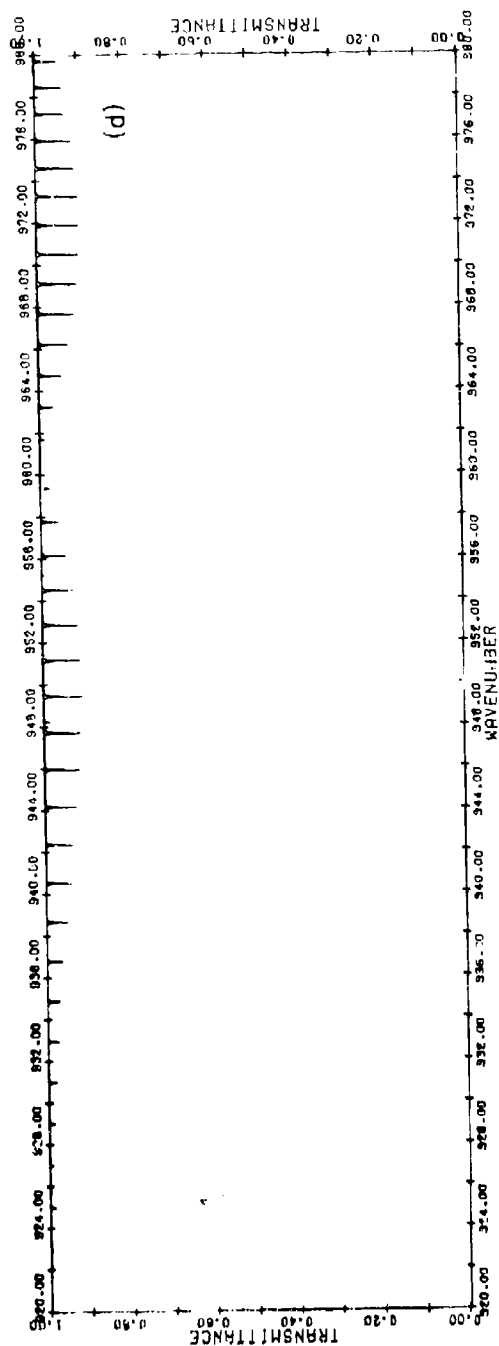


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 cm⁻¹; BOUND value = 20 cm⁻¹ (Cont.)

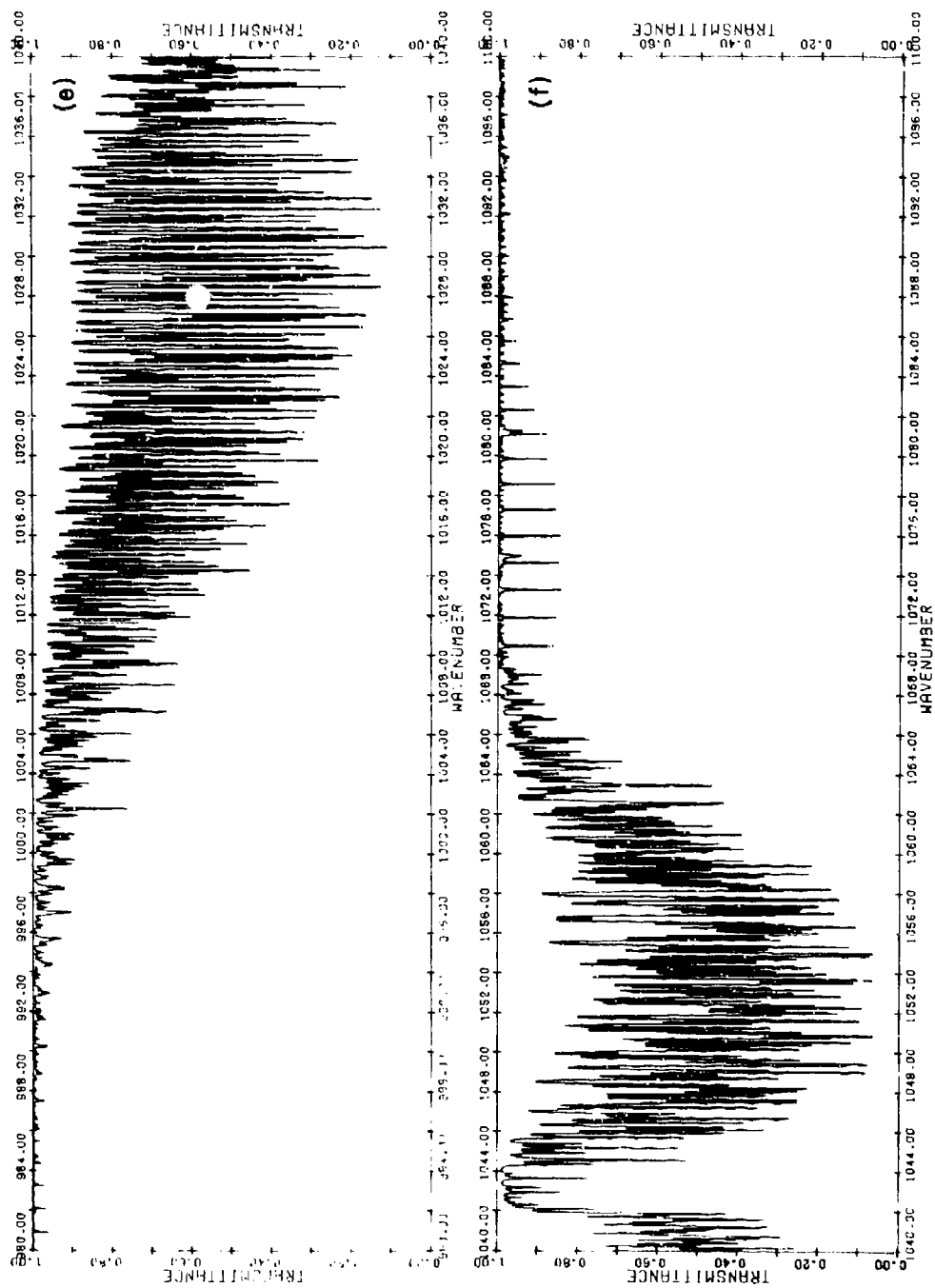


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is  $0.01 \text{ cm}^{-1}$ ; BOUND value =  $20 \text{ cm}^{-1}$  (Cont.)

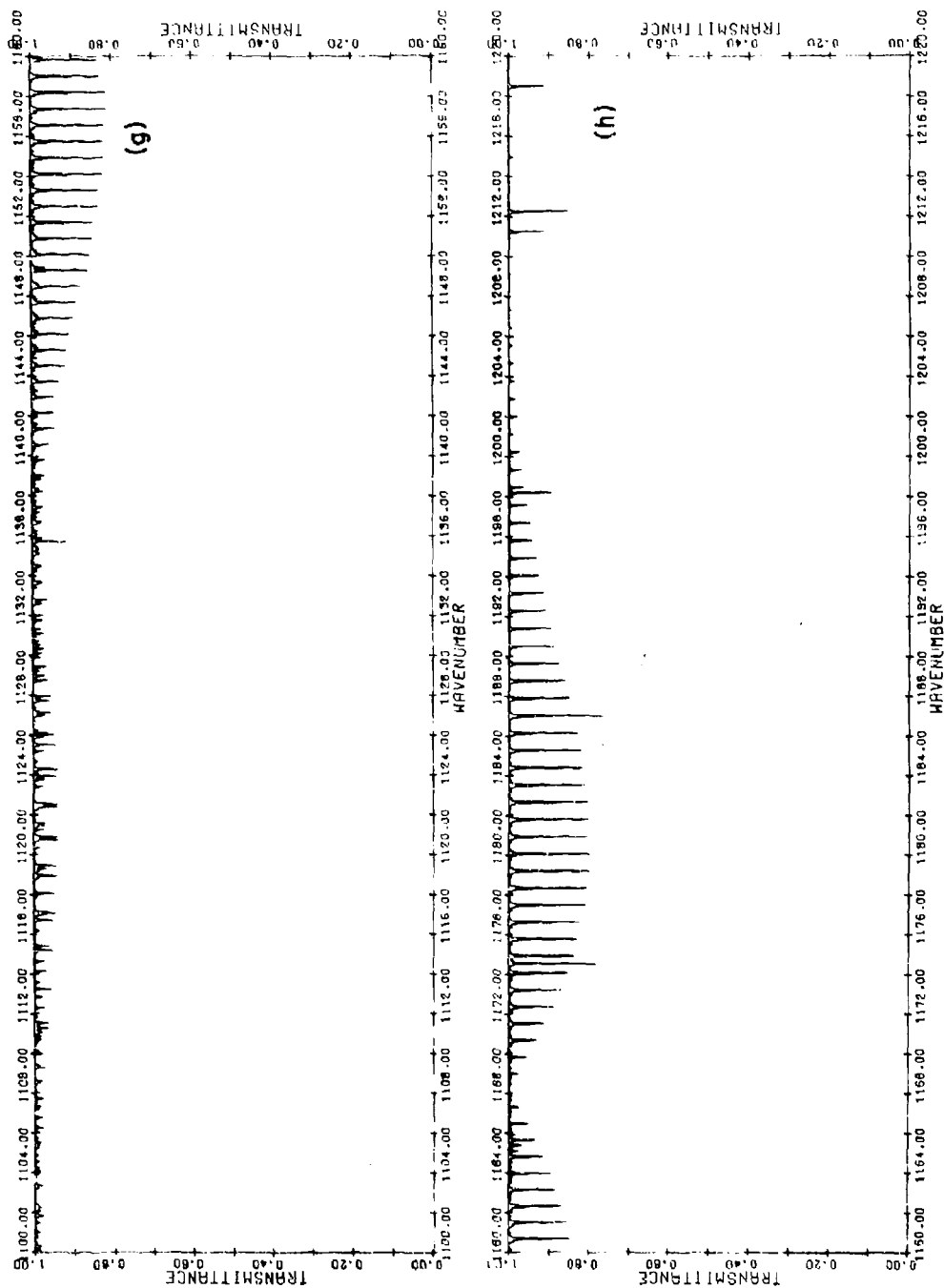


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is  $0.01 \text{ cm}^{-1}$ ; BOUND value =  $20 \text{ cm}^{-1}$  (Cont.)

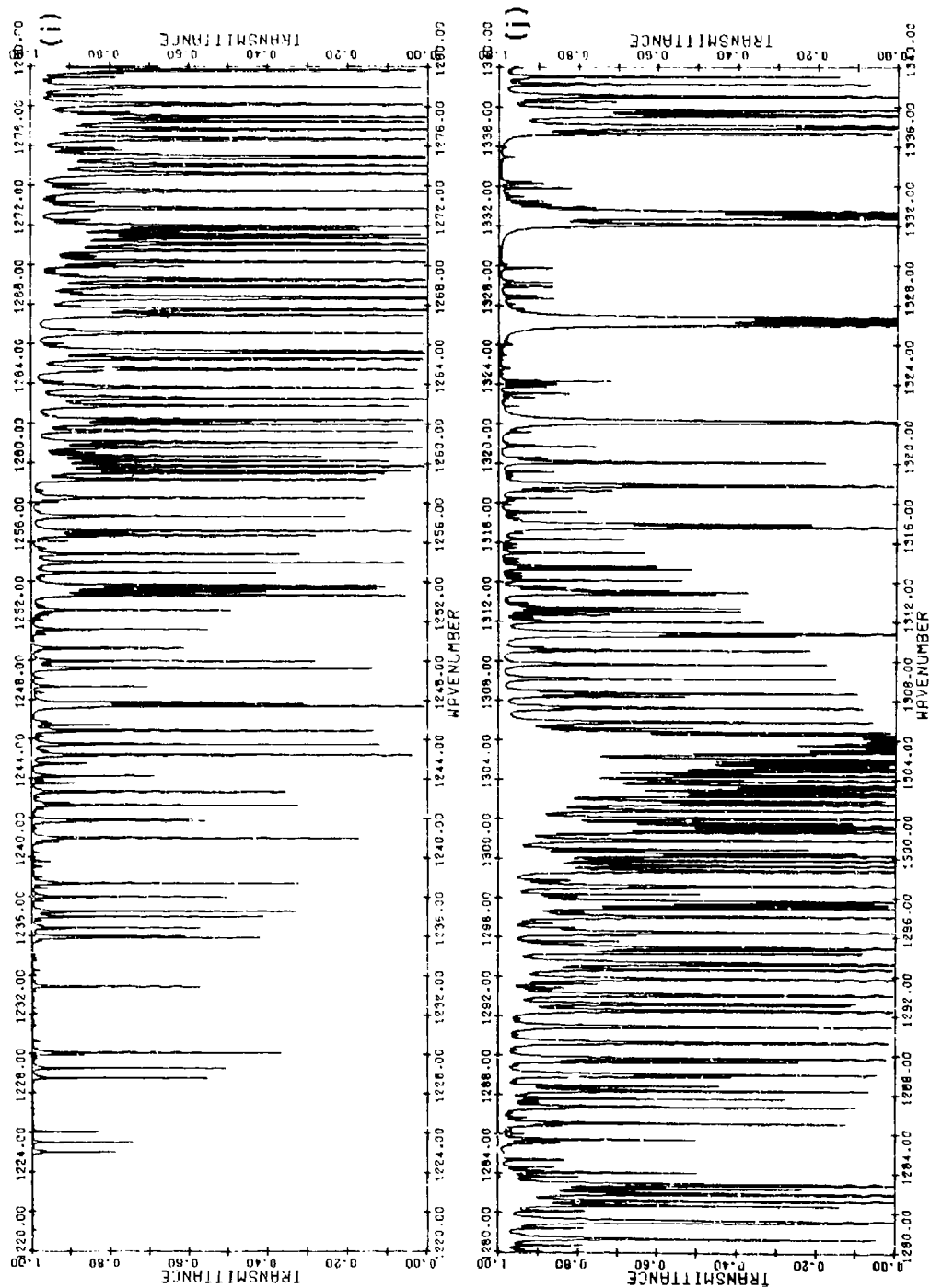


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 cm<sup>-1</sup>; BOUND value = 20 cm<sup>-1</sup> (Cont.)

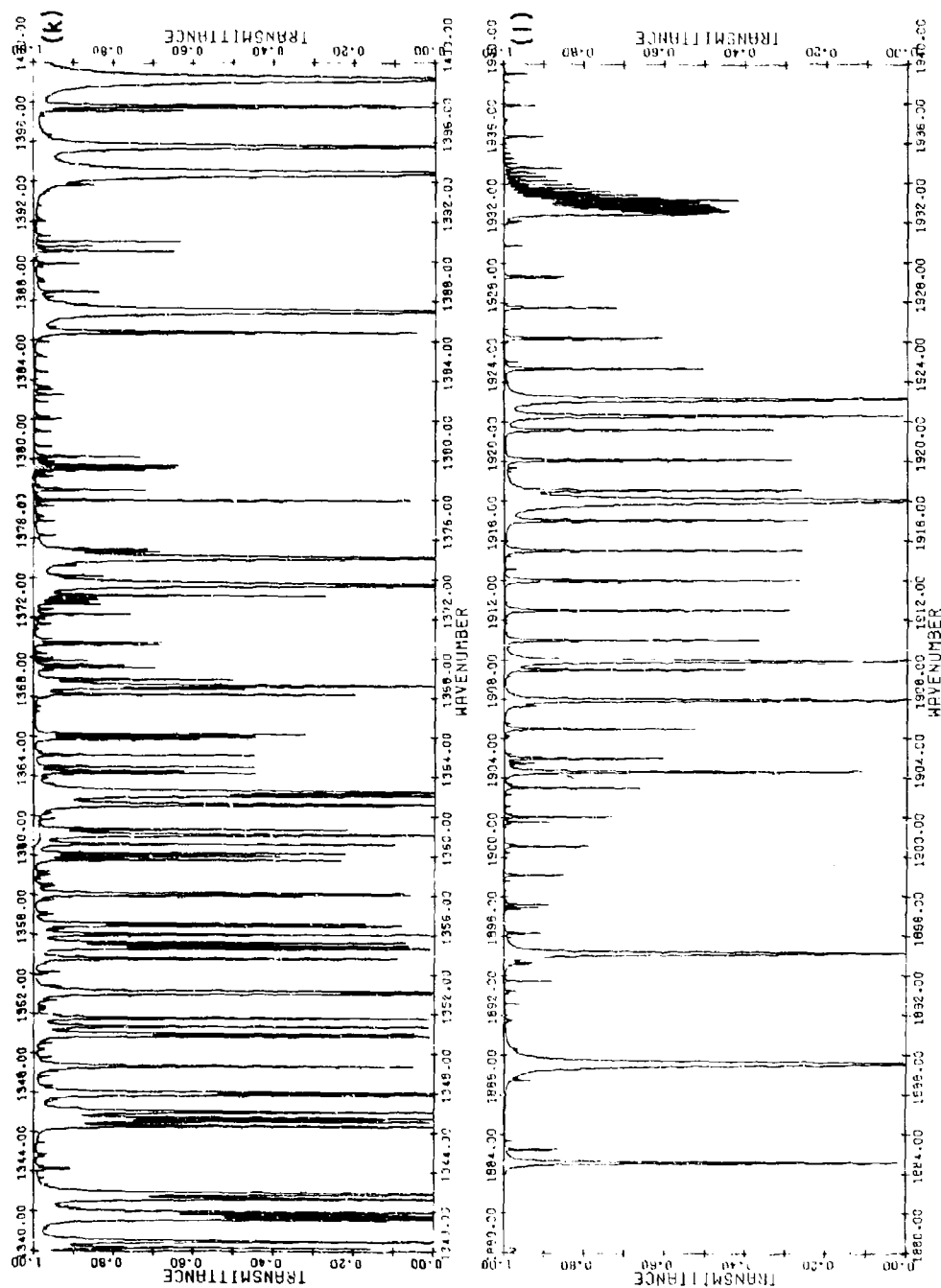


Figure C2.-1. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 cm<sup>-1</sup>; BOUND value = 20 cm<sup>-1</sup> (Cont.)

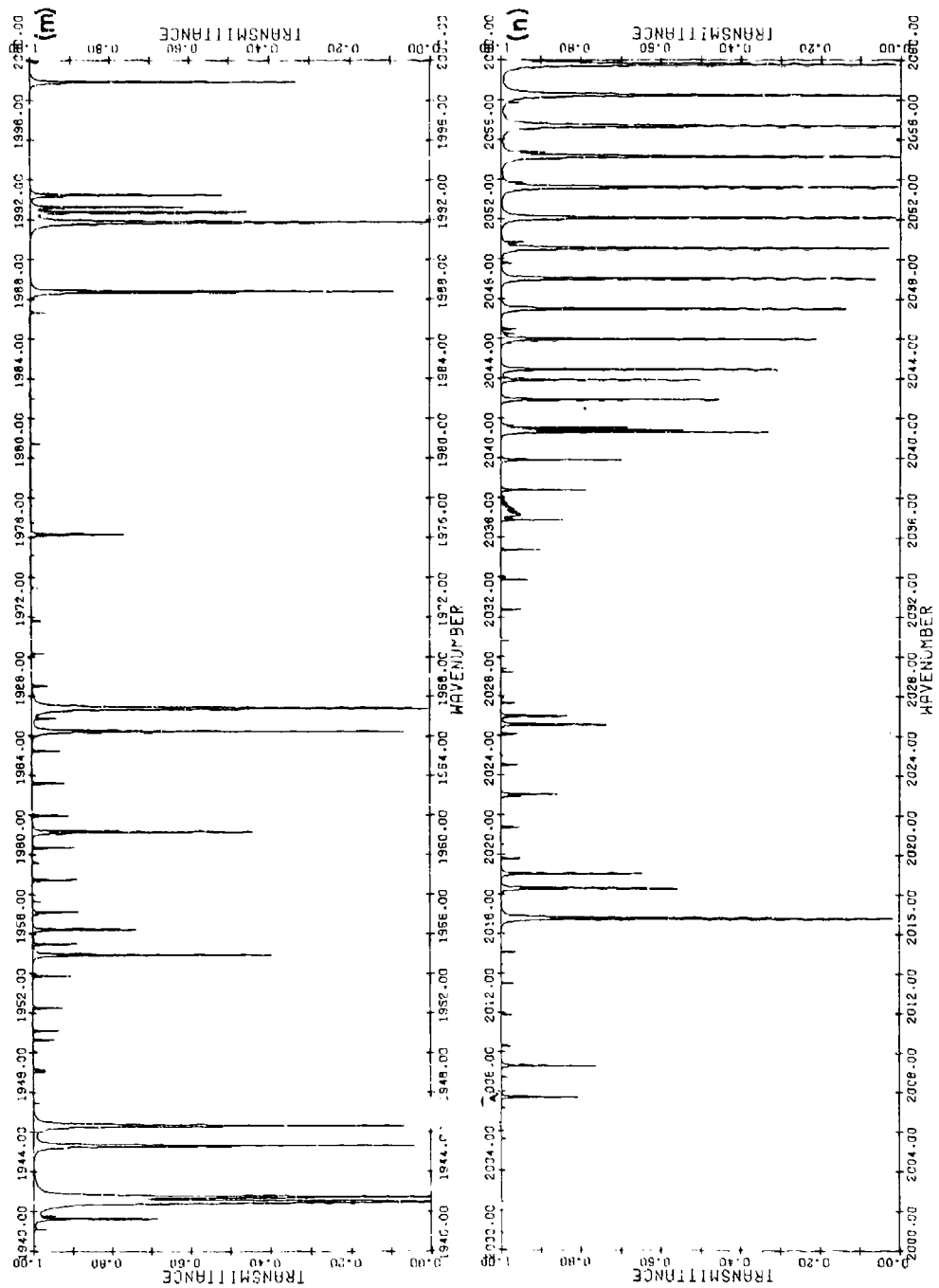


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 cm<sup>-1</sup>; Bound value = 20 cm<sup>-1</sup> (Cont.)

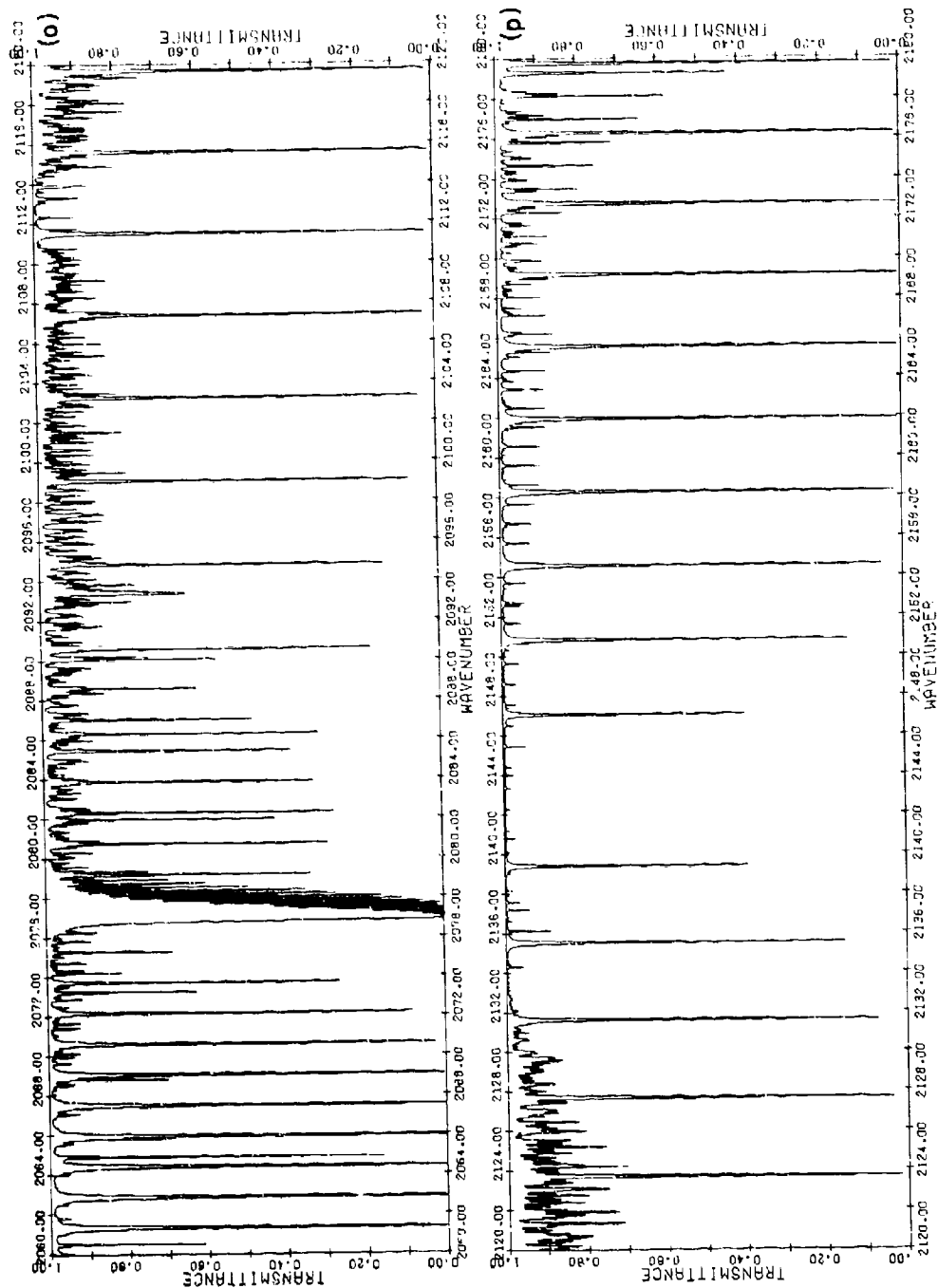


Figure C2. Calculated Spectra for a 19-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01  $\text{cm}^{-1}$ ; BOUND value = 20  $\text{cm}^{-1}$  (Cont.)

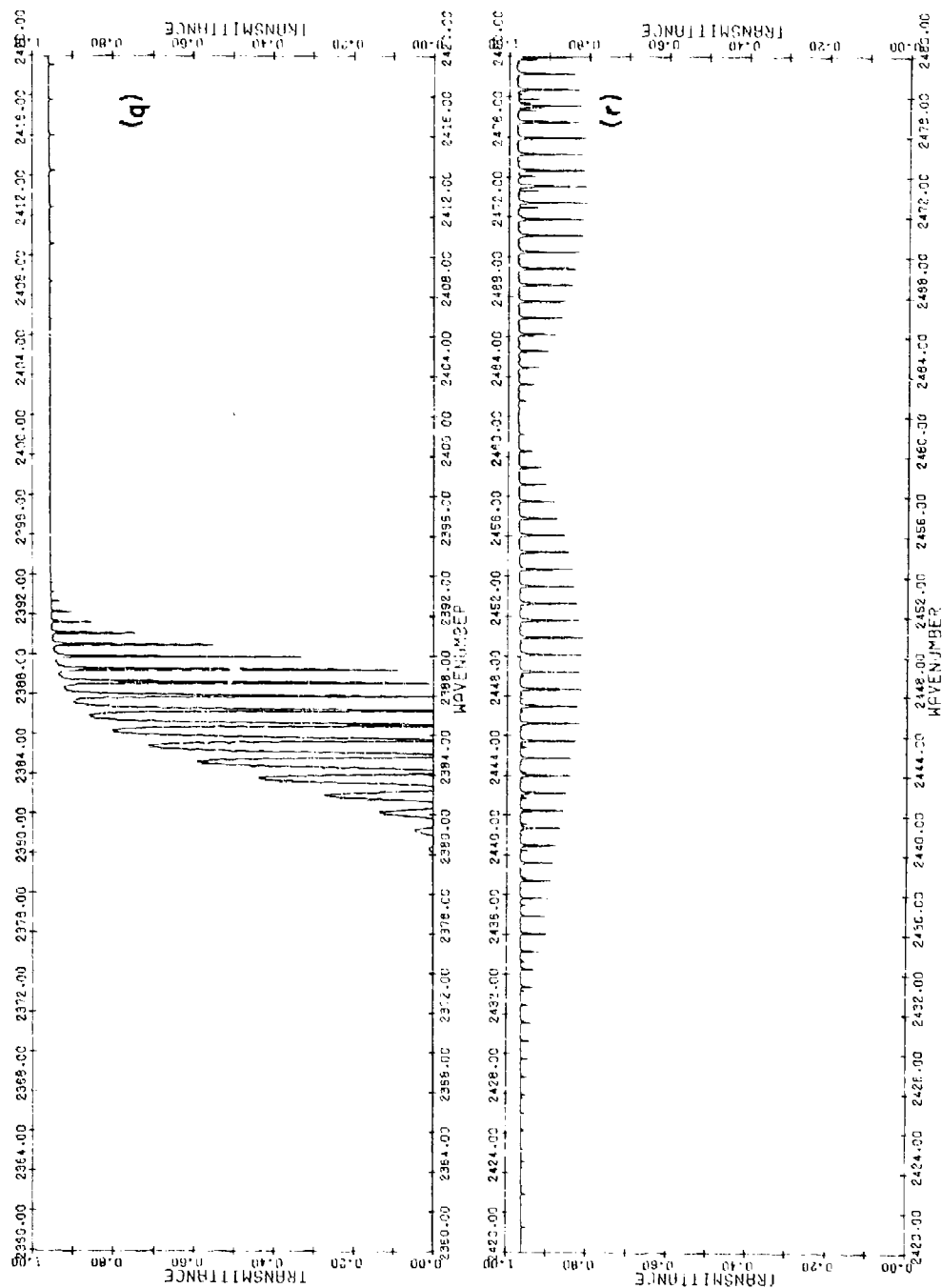


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is  $0.01 \text{ cm}^{-1}$ ; BOUND value =  $20 \text{ cm}^{-1}$  (Cont.)

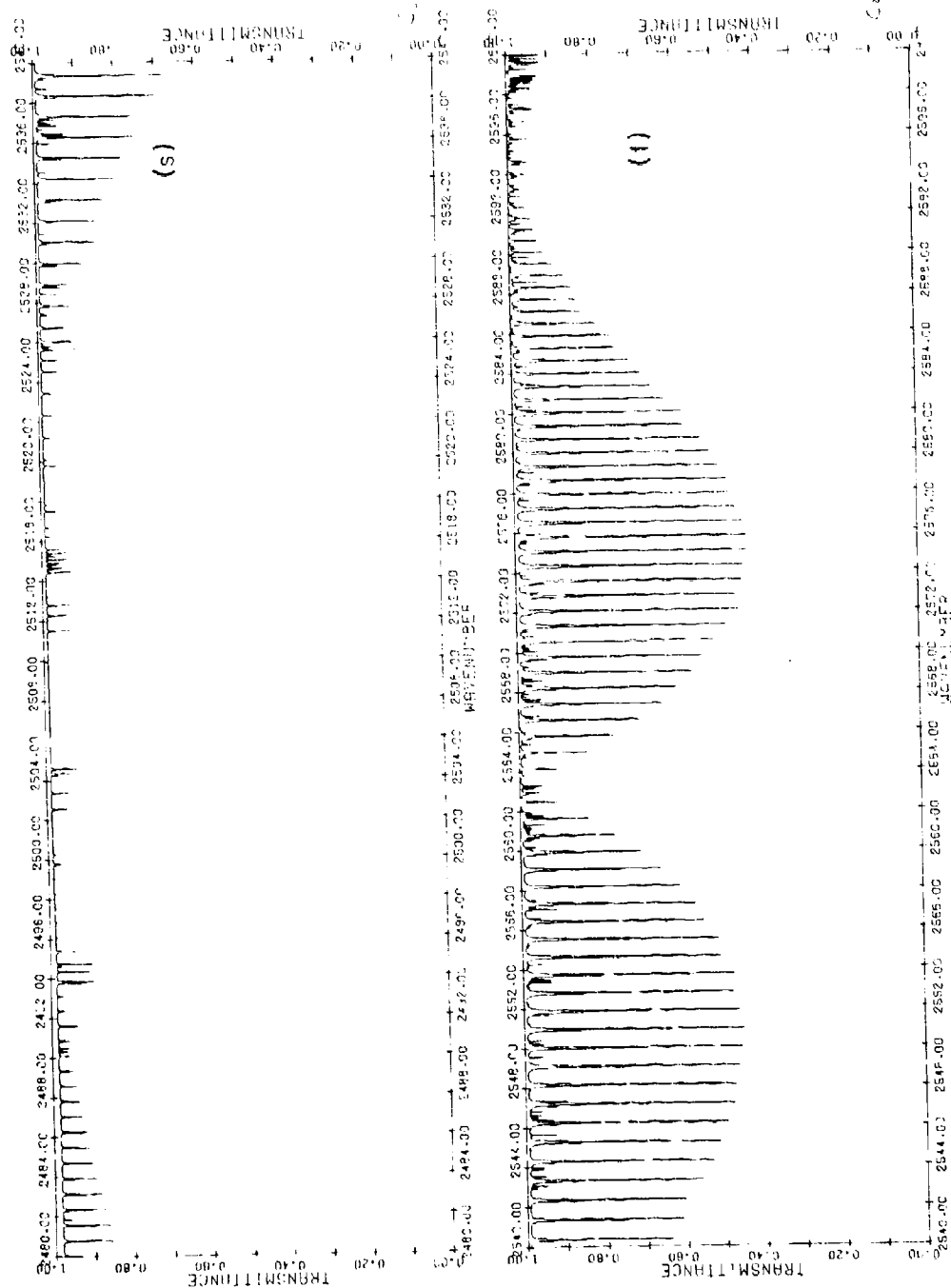


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 cm<sup>-1</sup>; BOUND value = 20 cm<sup>-1</sup> (Cont.)

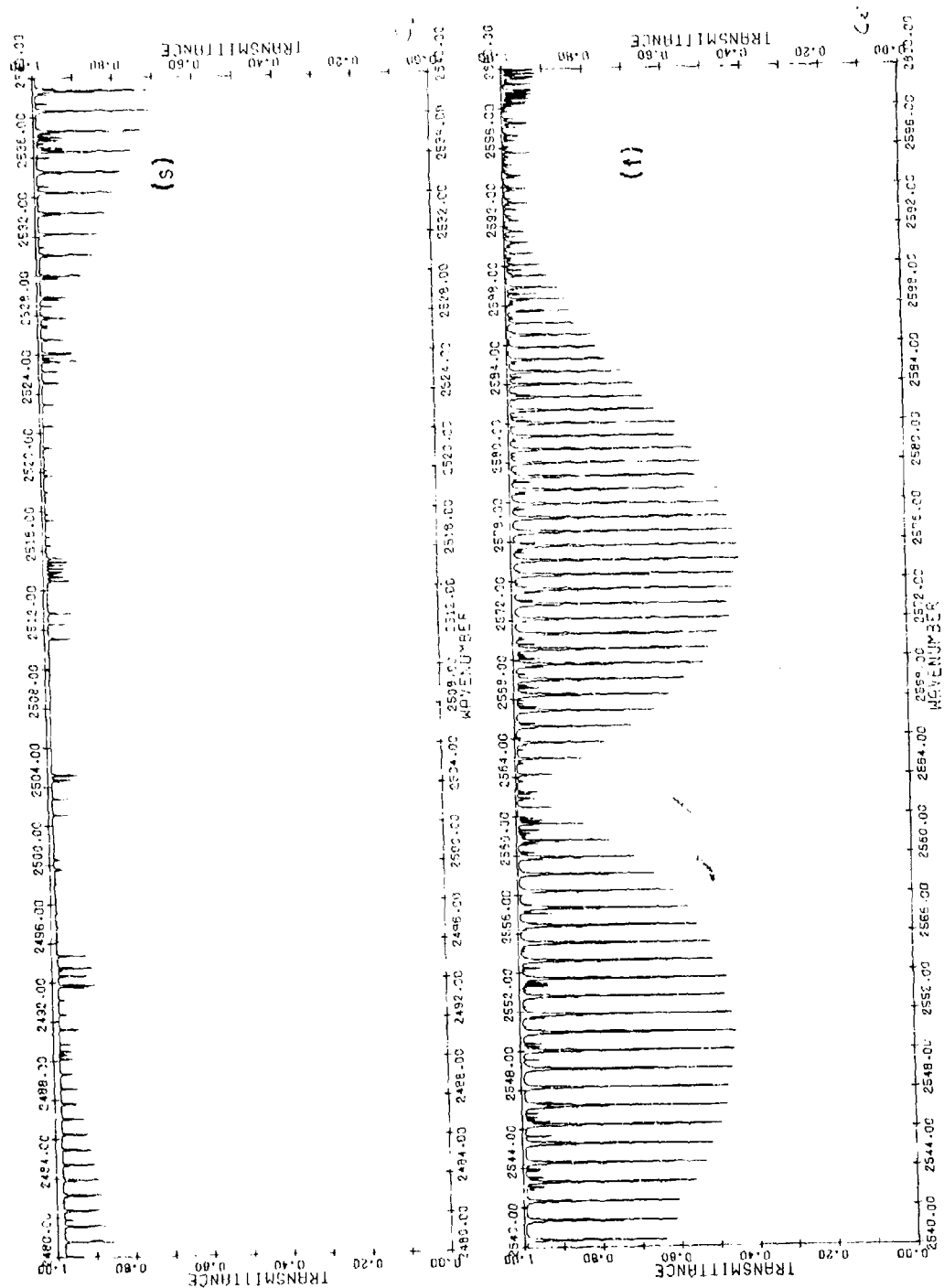


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 cm<sup>-1</sup>; BOUND value = 20 cm<sup>-1</sup> (Cont.)

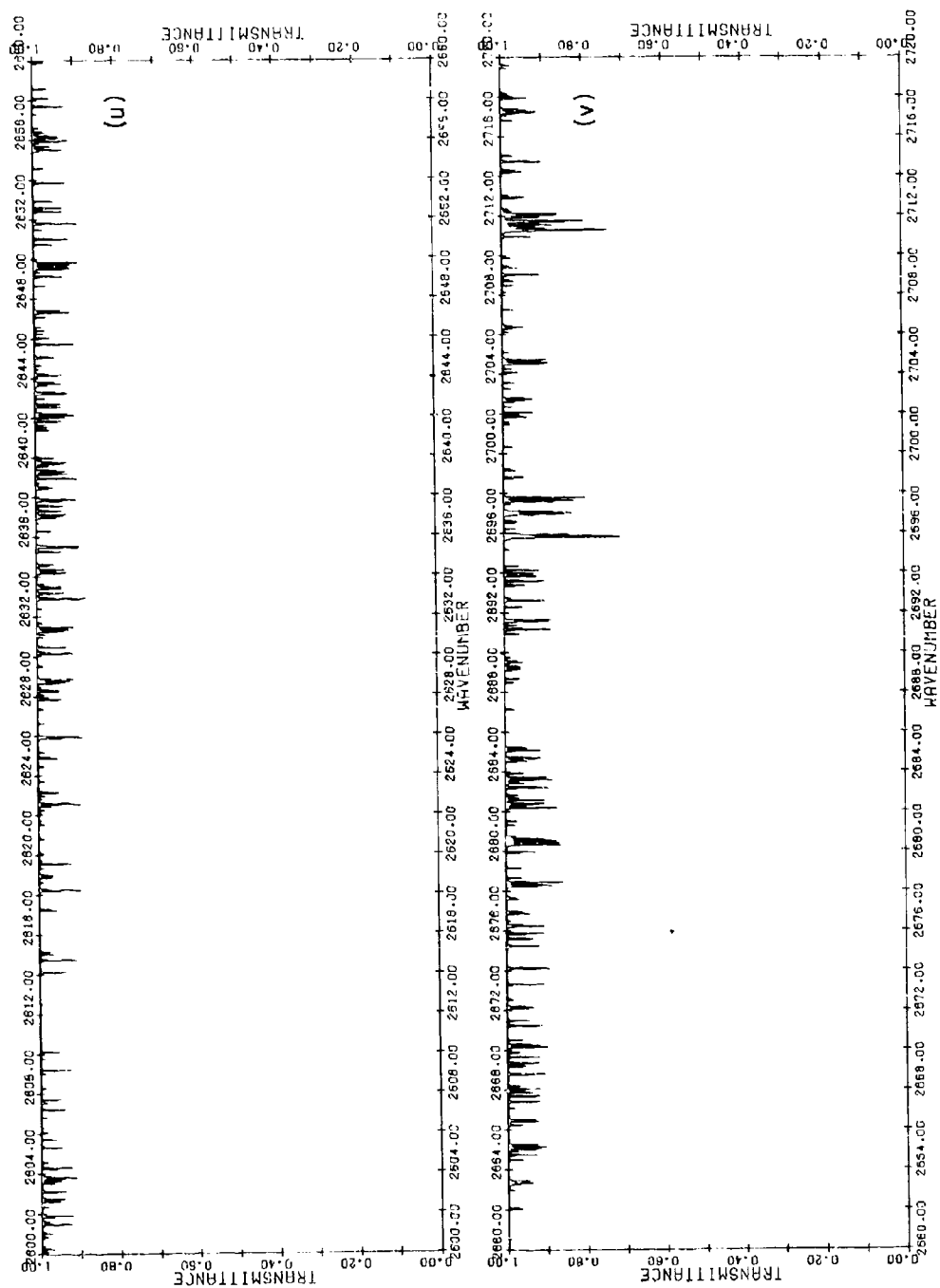


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 cm<sup>-1</sup>; BOUND value = 20 cm<sup>-1</sup> (Cont.)

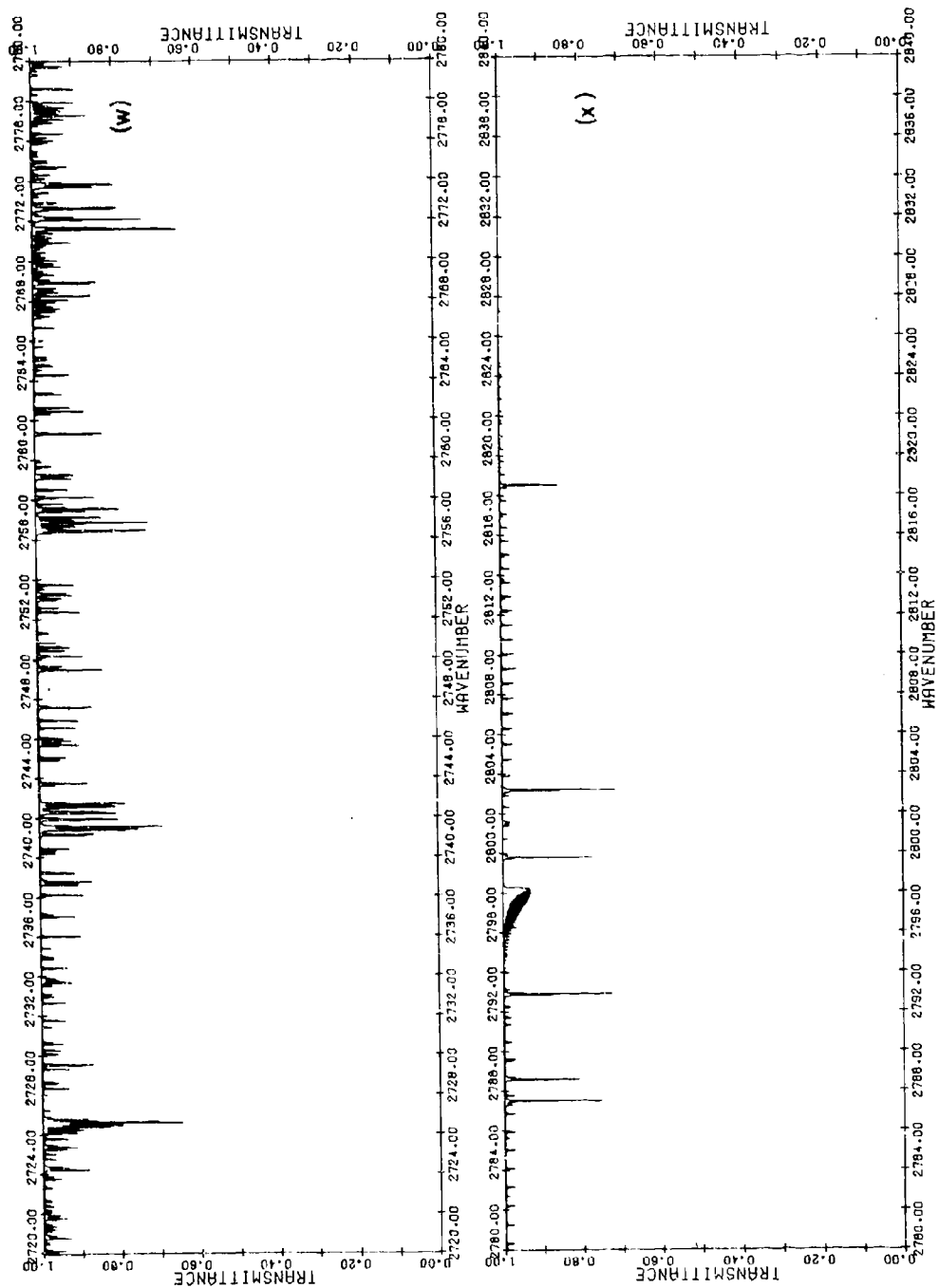


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is 0.01 cm<sup>-1</sup>; BOUND value = 20 cm<sup>-1</sup> (Cont.)

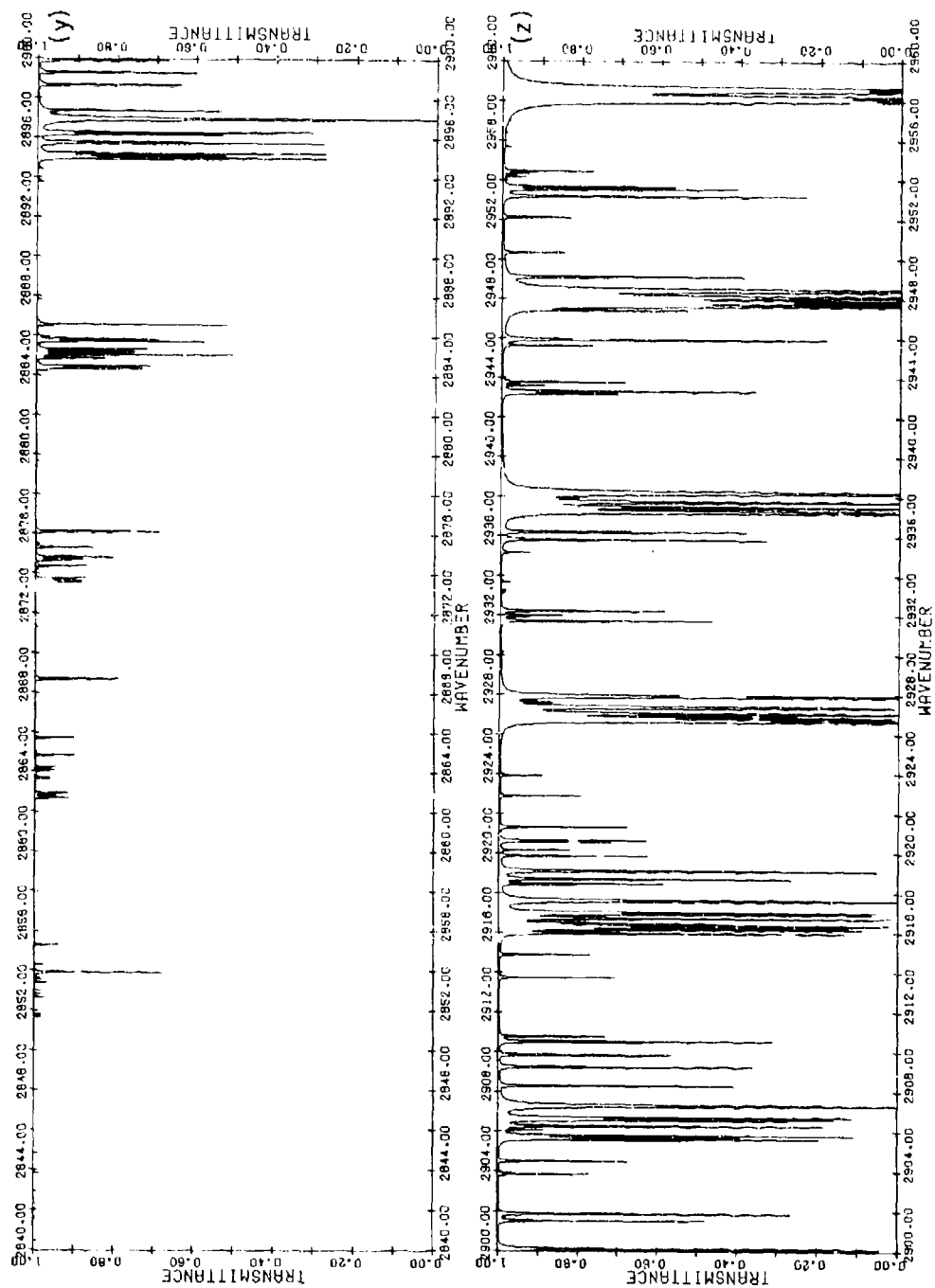


Figure C2. Calculated Spectra for a 10-km Horizontal Path at an Altitude of 12 km. Spectral Resolution is  $0.01 \text{ cm}^{-1}$ ; BOUND value =  $20 \text{ cm}^{-1}$  (Cont.)