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Atmospheric Transmittance/Radiance: Computer Code LOWTRAN 5

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21 February 1980

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20. Abstract (Continued)

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The computer code contains representative (geographical and seasonal) atmospheric models and representative aerosol models with an option to replace them with user-derived or measured values. The program can be run in one of two modes, namely, to compute only atmospheric transmittance or both atmospheric transmittance and radiance for any given slant path geometry.

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Preface

We wish to acknowledge the contributions made by Major Peter Soliz of the Air Force Avionics Laboratory and Major Vernon Bliss of the Foreign Technology Division to the further development of the LOWTRAN model through discussions, comments, and testing of the code presented in this report.

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Atmospheric Transmittance/Radiance: Computer Code LOWTRAN 5

1. INTRODUCTION

This report describes a Fortran computer code, LOWTRAN 5, designed to calculate atmospheric transmittance and radiance for a given atmospheric path at moderate spectral resolution. This code is an extension of the current LOWTRAN atmospheric code, LOWTRAN 4^1 (and its predecessors LOWTRAN 3B, ² LOWTRAN 3, ³ and LOWTRAN 2^4). All the options and capabilities of the LOWTRAN 4 code have been retained. New altitude and relative humidity dependent aerosol models and new fog models have been incorporated into LOWTRAN 5. In addition, extensive restructuring of the code into subroutines has been made for improved logical flow of the program and user understanding.

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- Selby, J. E.A., Kneizys, F.X., Chetwynd Jr., J.H., and McClatchey, R.A. (1978) <u>Atmospheric Transmittance/Radiance: Computer Code LOWTRAN 4</u>, AFGL-TR-78-0053, AD A058 643.
- Selby, J. E.A., Shettle, E. P., and McClatchey, R.A. (1976) <u>Atmospheric</u> <u>Transmittance from 0.25 to 28.5 μm: Supplement LOWTRAN 3B</u>, AFGL-TR-76-0258, AD A040 701.
- Selby, J. E. A., and McClatchey, R.A. (1975) <u>Atmospheric Transmittance</u> <u>from 0.25 to 28.5 μm; Computer Code LOWTRAN 3</u>, AFCRL-TR-75-0255, AD A017 734.
- Selly, J. E.A., and McClatchey, R.A. (1972) <u>Atmospheric Transmittance</u> from 0.25 to 28.5 μm; Computer Code LOWTRAN 2, AFCRL-TR-72-0745, AD 763 721.

The LOWTRAN code calculates atmospheric transmittance and radiance, averaged over 20-cm⁻¹ intervals in steps of 5 cm⁻¹ from 350 to 40,000 cm⁻¹ (0.25 to 28,5 μ m). The code uses a single-parameter band model for molecular absorption, and includes the effects of continuum absorption, molecular scattering and aerosol extinction. Refraction and earth curvature are included in the calculation for slant atmospheric paths. The code contains representative atmospheric and aerosol models, and the option to replace them with user-derived or measured values.

In this report, the model atmospheres and the new aerosol models in the code are described in Sections 2 and 3. Following this is a discussion of the spherical geometry with refraction used in the program. In Sections 5 and 6, a detailed description of the calculation of atmospheric transmittance and radiance is given. The structure of the computer code is presented in Section 7, with a listing of the code in Appendix A and a definition of symbols used in the main program given in Appendix B. User instructions for the LOWTRAN code are given in Section 8. Examples of the output of the program and illustrations of transmittance and radiance spectra calculated from the code are presented in Sections 9 and 10. A comparison of the new LOWTRAN aerosol models with measurements is made in Section 11. In Section 12, an example of the sensitivity of the code to meteorological input parameters is given. Comments on the use and limitations of the code are given in the last section.

In Appendix C, a segmented loader map of the LOWTRAN code run on the AFGL CDC 6600 is given. A discussion of the method used in the program to calculate water vapor density, relative humidity, and dew-point temperature is contained in Appendix D.

An additional set of stratospheric water vapor profiles for use in LOWTRAN is described in Appendix E. In Appendix F, some previous LOWTRAN transmittance and radiance comparisons with measurements have been reprinted.

The LOWTRAN 5 code will be made available from the National Climatic Center, Federal Building, Asheville, NC 28801. It is requested that users receiving the code, remove cards LOW 320, 330 and 340 from the main program (see Appendix A) and keypunch their name, affiliation, and address on these cards. These cards will be used to update the AFGL LOWTRAN mailing list and for notification to users of changes in the code. They should be mailed to F. X. Kneizys, AFGL/OPI, Hanscom AFB, Bedford, MA 01731.

2. MODEL ATMOSPHERES

The altitude, pressure, temperature, water vapor density, and ozone density for the U.S. Standard atmosphere and five seasonal model atmospheres are provided as basic input data for LOWTRAN. The model atmospheres correspond to the 1962 U.S. Standard atmosphere⁵ and the five supplementary models; that is, Tropical (15° N), Midlatitude Summer (45° N, July), Midlatitude Winter (45° N, January), Subarctic Summer (60° N, July), and Subarctic Winter (60° N, January). The different models are digitized in 1-km steps from 0 to 25 km, 5-km steps from 25 to 50 km, then at 70 km and 100 km directly as given by McClatchey et al. ⁶

The water vapor and ozone altitude profiles added to the 1962 U.S. Standard atmosphere by McClatchey et al⁶ were obtained from Sissenwine et al⁷ and Hering et al⁸ respectively, and correspond to mean annual values. The water vapor densities for the 1962 U.S. Standard atmosphere correspond to relative humidities of approximately 50 percent for altitudes up to 10 km, whereas the relative humidity values for the other supplementary models tend to decrease with altitude from approximately 80 percent at sea level to approximately 30 percent at 10-km altitude. The Sissenwine profiles are representative of "moist" stratospheric water vapor content. Alternative "dry" stratospheric water vapor profiles are provided in LOWTRAN using subroutine DRYSTR discussed in Appendix E.

The temperature profiles for the six model atmospheres as a function of altitude are shown in Figure 1. The pressure profiles are given in Figure 2. Figgures 3a and 3b show the water vapor density vs altitude from 0 to 100 km, and an expanded profile from 0 to 30 km. Figures 4a and 4b and Figures 5a and 5b show similar profiles for ozone and for the uniformly mixed gases.

It is assumed in this report that mixing ratios of the gases, CO_2 , N_2O , CH_4 , CO_1 , N_2 , and O_2 remain constant at all altitudes at the following values: 330, 0.28, 1.6, 0.075, 7.905 × 10⁵, and 2.095 × 10⁵ parts per million respectively. These gases as a whole, with the exception of nitrogen, will be referred to as the uniformly mixed gases.

Measurements made from balloon flights⁹, have shown the existence of nitric acid in the earth's atmosphere. Although nitric acid is of only minor importance in atmospheric transmittance calculations, it has been shown to be a significant source of stratospheric emission, particularly in the atmospheric window region from 10 to 12 μ m. Therefore, nitric acid has been added to the model atmospheres as a separate atmospheric absorber.

The concentration of atmospheric nitric acid varies with altitude and also appears to depend on latitude and season. Figure 6 shows the volume mixing ratio

Because of the large number of references cited above, they will not be listed here. See References, page 141.



Figure 1. Temperature vs Altitude for the Six Model Atmospheres



Figure 2. Pressure vs Altitude for the Six Model Atmospheres



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Figure 3a. Water Vapor Density Profiles vs Altitude for the Six Model Atmospheres



Figure 3b. Water Vapor Density Profiles vs Altitude for the Six Model Atmospheres with the Region from 0 to 30 km Expanded







Figure 4b. Ozone Density Profiles vs Altitude for the Six Model Atmospheres with the Region from 0 to 30 km Expanded



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Figure 5a. Profile of (P/P_o) (T_o/T) , the Relative Air Density, vs Altitude for the Six Model Atmospheres. The density of the uniformly mixed gases is proportional to this quantity. $P_o = 1013$ mb and $T_o = 273$ K



Figure 5b. Profile of (P/P_0) (T_0/T) , the Relative Air Density, vs Altitude for the Six Model Atmospheres with the Region from 0 to 30 km Expanded

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Figure 6. Volume Mixing Ratio Profile for Nitric Acid vs Altitude, from the Measurements of Evans, Kerr, and Wardle¹⁰. This single profile is used with all of the six model atmospheres

profile of atmospheric nitric acid as a function of altitude from the measurements of Evans, Kerr, and Wardle.¹⁰ For the purpose of this report, we have chosen this profile to represent a mean nitric acid profile for the six model atmospheres in the LOWTRAN program. This profile appears in a data statement in the program. If a more definitive nitric acid profile for a given latitude and scason is available, the user can change the nitric acid concentration by simply replacing the data statement given in the program.

In addition to the model atmospheres provided in this report, the user has the option of inserting his own model atmosphere (specifically designed for direct insertion of radiosonde data), or of building another model by combining various parts of the six standard models.

Evans, W.F., Kerr, J.B., and Wardle, D.I. (1975) <u>The AES Stratospheric</u> <u>Balloon Measurements Project: Preliminary Results, Atmospheric</u> <u>Environment Service, Downsview, Ontarlo, Canada, Report No.</u> <u>APRB 30 X 4.</u>

3. AEROSOL MODELS

3.1 Introduction

The aerosol models built into LOWTRAN 5 have been completely revised from the earlier versions of the LOWTRAN code. Previous versions of LOWTRAN used the same model for aerosol composition and size distribution at all altitudes, simply changing the concentrations of the aerosols with height which means that the wavelength dependence of the aerosol extinction was independent of altitude.

The variation of the aerosol optical properties with altitude is now modeled by dividing the atmosphere into four height regions each having a different type of aerosol. These regions are the boundary or mixing layer (0 to 2 km), the upper troposphere (2 to 10 km), the lower stratosphere (10 to 30 km), and the upper atmosphere (30 to 100 km).

The earlier versions of LOWTRAN neglected changes in aerosol properties caused by variations in relative humidity. These aerosol models were representative of moderate relative humidities (around 80 percent). The models for the troposphere (rural, urban, maritime and tropospheric) which were previously used in LOWTRAN 3B and 4 have been updated according to more recent measurements and also are now given as a function of the relative humidity. In addition, two different fog models have been introduced into the program.

Only a brief description of the new aerosol models and their experimental and theoretical bases will be presented in this report since they are described elsewhere in detail. $^{11, 12}$

3.2 Vertical Distribution in the Lower Atmosphere

The range of conditions in the boundary layer (up to 2 km) is represented by three different aerosol models (rural, urban, or maritime) for each of several

Shettle, E. P., and Fenn, R. W. (1976) Models of the Atmospheric Aerosols and their Optical Properties, in AGARD Conference Proceedings No. 183 Optical Propagation in the Atmosphere. Presented at the Electromagnetic Wave Propagation Panel Symposium, Lyngby, Denmark, 27-31 October 1975, AGARD-CP-183, aveilable from U.S. National Technical Information Service (No. AD-A028-615).

^{12.} Shettle, E. P., and Fenn, R. W. (1975) <u>Models of the Acrosols of the Lower</u> <u>Atmosphere and the Effects of Humidity Variations on their Optical</u> Properties, AFGL-TR-79-0214, 17 September.

meteorological ranges^{*} between 2 and 50 km, and as a function of humidity. In the boundary layer the shape of the aerosel size distribution and the composition of the three surface models are assumed to be invariant with altitude. Therefore only the total particle number is being varied. Although the total number density of air molecules decreases approximately exponentially with altitude, there is considerable experimental data which show that the acrosol concentration very often has a rather different vertical profile. One finds that, especially under moderate to low visibility conditions, the aerosols are concentrated in a uniformly mixed layer from the surface up to about 1- to 2-km altitude and that this haze layer has a rather sharp top, which appears to be associated with the height of the minimum temperature lapse rate.¹³

The vertical distribution for clear to very clear conditions, or meteorological ranges from 23 and 50 km, is taken to be exponential, similar to the profiles used in previous versions of LOWTRAN. However, for the hazy conditions (10-, 5-, and 2-km meteorological ranges) the aerosol extinction is taken to be independent of height up to 1 km with a pronounced decrease above that height.

Above the boundary layer in the troposphere the distribution and nature of the atmospheric aerosols becomes less sensitive to geography and weather variations. Instead, the seasonal variations are considered to be the dominating factor. The aerosol concentration measurements of Blifford and Ringer¹⁶ and Hoffman et al¹⁷

 $V = \frac{1}{i^3} \ln \frac{1}{\epsilon} = \frac{3.912}{\beta}$

where β is the extinction coefficient, and ϵ is the threshold contrast, set equal to 0.02. As used in the LOWTRAN computer code, the inputs are in terms of meteorological range, with β , the extinction coefficient, evaluated at 0.55 μ m. If only an observer visibility V_{obs} is available, the meteorological range can be estimated as V \approx (1.3 ± 0.3) \cdot V_{obs}.

- 13. Johnson, R.W., Hering, W.S., Gordon, J.L., and Fitch, B.W. (1979) Preliminary Analysis and Modelling Based Upon Project OPAQUE Profile and Surface Data, AFGL-TR-79-0285, November.
- Huschke, R.E. (editor) (1959) <u>Glossary of Meteorology</u>, American Meteorlogical Society, Boston, MA, 638 pp.
- Middleton, W. E. K. (1952) <u>Vision Through the Atmosphere</u>, Univ. of Toronto Press, 250 pp.
- 16. Blifford, I.H., and Ringer, L.D. (1969) The size and number distribution of acrosols in the continental troposphere, J. Atmos. Sci. 26:716-726.
- Hofmann, R.J., Rosen, J.M., Pepin, T.J., and Pinnick, R.G. (1975) Stratospheric aerosol measurements I: Time variations at northern latitudes, <u>J. Atmos. Sci. 32</u>:1446-1456.

³⁶ The terms "meteorological range" and "visibility" are not always used correctly in the literature. Correctly, 14, 15 visibility is the greatest distance at which it is just possible to see and identify with the unaided eye; (a) in the daytime, a dark object against the horizon sky; and (b) at night, a known moderately intense light source. Meteorological range is defined quantitatively, eliminating the subjective nature of the observer and the distinction between day and night. Metelorological range V is defined by the Koschmieder formula

indicate that there is an increase in the particulate concentration in the upper troposphere during the spring and summer months. This is also supported by an analysis of searchlight data by Elterman et al. 18

The vertical distribution of the accosol concentrations for the different models is shown in Figure 7. Between 2 and 30 km, where a distinction on a seasonal basis is made, the spring-summer conditions are indicated with a solid line and fall-winter conditions are indicated by a dashed line.

3.3 Effects of Humidity Variations on Aerosol Properties

The basic effect of changes in the relative humidity on the aerosols, is that as the relative humidity increases, the water vapor condenses out of the atmosphere onto the existing atmospheric particulates. This condensed water increases the size of the aerosols, and changes their composition and their effective refractive index. The resulting effect of the aerosols on the absorption and scattering of light will correspondingly be modified. There have been a number of studies of the change of aerosol properties as a function of relative humidity. ^{12, 19} The most comprehensive of these, especially in terms of the resulting effects on the aerosol properties is the work of Hanel. ^{19, 20}

The growth of the particulates as a function of relative humidity is based on the results tabulated by Hänel¹⁹ for different types of aerosols. Once the wet aerosol particle size is determined, the complex refractive index is calculated as the volume-weighted average of the refractive indices of the dry aerosol substance and water.²¹

3.4 Rural Aerosols

The "rural model" is intended to represent the aerosol conditions one finds in continental areas which are not directly influenced by urban and/or industrial aerosol sources. This continental, rural aerosol background is partly the product of reactions between various gases in the atmosphere and partly due to dust particles picked up from the surface. The particle concentration is largely dependent

Elterman, L., Wexler, R., and Chang, D.T. (1969) Features of tropospheric and stratospheric dust, Appl. Opt. 8:893-903.

^{19.} Hänel, Gottfried (1976) The properties of atmospheric aerosol particles as functions of the relative humidity at thermodynamic equilibrium with the surrounding moist air, in Advances in Geophysics, Vol 19:73-188, Edited by H. E. Landsberg, J. Van Mieghem, Academic Press, New York.

^{20.} Hänel, Gottfried (1972) Computation of the extinction of visible radiation by atmospheric aerosol particles as a function of the relative humidity, based upon measured properties, <u>Aerosol Sci.</u> 3:377-386.

Hale, George M., and Querry, Marvin R. (1973) Optical constants of water in the 200-nm to 200-um wavelength region, Appl. Opt. 12:555-563.



Figure 7a. Vertical Profiles of Aerosol Scaling Factors vs Altitude



Figure 7b. Vertical Profiles of Aerosol Scaling Factors vs Altitude with the Region from 0 to 40 km Expanded

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on the history of the air mass carrying the aerosol particles. In stagnating air masses, for example, under winter-type temperature inversions, the concentrations may increase to values causing the surface layer visibilities to drop to a few kilometers.

The rural aerosols are assumed to be composed of a mixture of 70 percent of water-soluble substance (ammonium and calcium sulfate and also organic compounds) and 30 percent dust-like aerosols. The refractive index for these components is based on the measurements of Volz. 22, 23

The rural aerosol size distribution is parameterized as the sum of two lognormal size distributions, to represent the multimodal nature of the atmospheric aerosols that has been discussed in various studies. These parameters for rural model size distribution fall within what Whitby and Cantrell²⁴ give as a typical range of values for the accumulation (small) and coarse (large) particle modes.

To allow for the dependence of the humidity effects on the size of the dry aerosol, the growth of the aerosol was computed separately for the accumulation and coarse particle components. In computing the aerosol growth, changes in the width of the size distribution was assumed negligible so only the mode radius was modified by humidity changes. The effective refractive indices for the two size components are then computed as function of relative humidity.

Using Mie theory for scattering by spherical particles, the extinction and absorption coefficients for each of several different relative humidities were calculated. Figure 8 shows the resulting values for the different relative humidities which are stored in the LOWTRAN code. The values have been normalized to an extinction coefficient of 1.0 at a wavelength of 0.55 μ , which is the way values are used in the program.

3.5 Urban Aerosol Model

In urban areas the rural aerosol background gets modified by the addition of aerosols from combustion products and industrial sources. The urban aerosol model therefore was taken to be a mixture of the rural aerosol with carbonaceous aerosols. The sootlike aerosols are assumed to have the same size distribution as both components of the rural model. The proportions of the sootlike aerosols and the rural type of aerosol mixture are assumed to be 20 percent and 80 percent

Volz, Frederic E. (1972) Infrared absorption by atmospheric aerosol substances, J. Geophys. Res. 77:1017-1031.

^{23.} Volz, Frederic E. (1973) Infrared optical constants of ammonium sulfate, Sahara dust, volcanic punice, and flyash, Appl. Opt. 12:564-568.

^{24.} Whitby, K.T., and Cantrell, B. (1975) <u>Atmospheric aerosols – characteris-</u> tics and measurement, International Conf. on Environmental Sensing and <u>Assessment</u>, Vol. 2, Las Vegas, Nev., 14-19 September.









respectively. The refractive index of the sootlike acrosols was based on the soot data in Twitty and Weinman's 25 survey of the refractive index of carbonaceous materials.

Figure 9 shows the extinction and absorption coefficients for the urban models vs wavelength. As with the rural model the values are normalized so the extinction coefficient is 1.0, at a wavelength of 0.55 μ .

3.6 Maritime Aerosol Model

The composition and distribution of aerosols of oceanic origin is significantly different from continental aerosol types. These aerosols are largely sea-salt particles which are produced by the evaporation of sea-spray droplets and then have again grown due to accretion of water under high relative humidity conditions. Together with a background aerosol of more or less pronounced continental character they form a fairly uniform maritime aerosol which is representative of the boundary layer in the lower 2 to 3 km of the atmosphere over the oceans, but which also will occur over the continents in a maritime air mass. This maritime model should be distinguished from the direct sea-spray aerosol which exists in the lower 10 to 20 meters above the ocean surface and which is strongly dependent on wind speed.

The matrix the aerosol model, therefore, has been composed of two components; one which developed from sea spray; and a continental component which is assumed identical to the rural aerosol with the exception that the very large particles were eliminated, since they will eventually be lost due to fallout as the air masses move across the oceans. This model is similar to the one suggested by $Junge^{26, 27}$ and is supported by a large body of experimental data. ¹²

The refractive index is the same as that for a solution of sea salt in water, using a volume-weighted average of the refractive indices of water and sea salt. The refractive index of the sea salt is primarily taken from the measurements of Volz.²⁸ The normalized extinction and absorption coefficients vs wavelength for the maritime aerosols are shown in Figure 10 for several relative humidities.

Twitty, J.T., and Weinman, J.A. (1971) Radiative properties of carbonaceous aerosols, <u>J. Appl. Meteor.</u> 10:725-731.

Junge, Christian E. (1963) <u>Air Chemistry and Radioactivity</u>, 382 pp., Academic Press, New York.

Junge, C. E. (1972) Our knowledge of the physico-chemistry of aerosols in the undisturbed marine environment, J. Geophys. Res. 77:5183-5200.

Volz, Frederic E. (1972) Infrared refractive index of atmospheric aerosol substance, Appl. Opt. 11:755-759.







Figure 9b. Absorption Coefficients for the Urban Aerosol Model Corresponding to Figure 9a







Figure 10b. Absorption Coefficients for the Maritime Aerosol Model Corresponding to Figure 10a

3.7 Tropospheric Aerosol Model

Above the boundary layer in the troposphere, the aerosol properties become more uniform and can be described by a general tropospheric aerosol model. The tropospheric model represents an extremely clear condition and can be represented by the rural model without the large particle component. Larger aerosol particles will be depleted due to settling with time. This is consistent with the changes in aerosol size distribution with altitude suggested by Whitby and Cantrell. ²⁴

There is some indication from experimental data, that the tropospheric aerosol concentrations are somewhat higher during the spring-summer season than during the fall-winter period. ^{16, 17} Different vertical distributions are given to represent these seasonal changes (see Section 3.2).

The dependence of the particle size on relative humidity is the same as for the small particle component of the rural model. The resulting normalized extinction and absorption coefficients are shown in Figure 11 for the different relative humidities.

3.8 Fog Models

When the air becomes nearly saturated with water vapor (relative humidity close to 100 percent), fog can form (assuming sufficient condensation nuclei are present). Saturation of the air can occur as the result of two different processes; the mixing of air masses with different temperatures and/or humidities (advection fogs), or by cooling of the air to the point where its temperature approaches the dew-point temperature (radiation fogs). ²⁹

To represent the range of the different types of fog, we use two of the fog models presented by Silverman and Sprague, ³⁰ following the work of Dyachenko.³¹ These were chosen to represent the range of measured size distributions, and correspond to what Silverman and Sprague³⁰ identified as typical of radiation fogs and advection fogs, although they also describe developing and mature fogs, respectively. The normalized extinction and absorption coefficients for the two fog models are shown in Figure 12 as a function of wavelength.

^{29.} Byers, H.R. (1959) General Meteorology, 540 pp., McGraw Hill, New York.

Silverman, B.A., and Sprague, E.D. (1970) Airborne measurement of incloud visibility, 271-276, <u>Second National Conference on Weather Modification</u>, Santa Barbara, CA, 6-9 April 1970, American Meteorological Society.

Dyanchenko, P. V. (1962) Experimental Application of the Method of Mathematical Statistics to Microstructural Fog and Cloud Research, Trans. A.I. Voyekova, Main Geophys. Obser.







Figure 11b. Absorption Coefficients for the Tropospheric Aerosol Model Corresponding to Figure 11a

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3.9 Aerosol Vertical Distribution in the Stratosphere and Mesosphere

Measurement programs carried out over many years show that in the 10- to 30-km region there exists a background aerosol in the stratosphere which has a rather uniform global distribution. T^{+-} background aerosol is considered to be mostly composed of sulfate particles formed by photochemical reactions.

These background levels are occasional solutions of the injection of dust from massive volutions. Once such particles have been injected into the stratosphere they for any out over large portions of the globe by the stratospheric circulation and difful on processes, and it requires months or even years for them to become slowly removed from the stratosphere. 32, 33, 34

There occurs also a seasonal and geographic variation of the stratospheric aerosol layer which is related to the height of the tropopause; a peak in the aerosol mixing ratio (that is, ratio of aerosol to air molecules) occurs several kilometers above the tropopause. ^{17, 35}

The range of possible vertical distributions is represented by four different profiles (background stratospheric, moderate, high and extreme volcanic). Each of these distributions is then modified according to the season. The different scaling factors for these vertical profiles are shown in Figure 7.

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The vertical distribution in the upper atmosphere above 30 to 40 km is very uncertain because of the difficulty of obtaining reliable data. In situ measurements are limited to those obtained by rocket flights, and these altitudes are beyond the normal operational range of most lidar and searchlight systems which provide most of the remotely sensed data up to 30 or 40 km.

The most likely profile for this region is the one labelled as "Normal Upper Atmosphere" in Figure 7; it corresponds to a constant turbidity ratio of ≈ 0.2 above 40 km. This agrees with the aeroscl extinction profile obtained by Cunnold et al³⁶ by inverting measurements of the horizon radiance from an X-15 aircraft.

- Volz, F.E. (1975) Distribution of turbidity after the 1912 Katmei Eruption in Alaska, J. Geophys. Res. 80:2643-2648.
- Volz, F.E. (1975) Burden of volcanic dust and nuclear debris after injection into the stratosphere at 40°-58°N., J. Geophys. Res. 80:2649-2652,
- Rosen, J. M., Hofmann, D.J., and Laby, J. (1975) Stratospheric measurements II: the worldwide distribution, J. Atmos. Sci. 32:1457-1462.
- 36. Cunnold, D.M., Gray, C.R., and Merritt, D.C. (1973) Stratospheric aerosol layer detection, J. Geophys. Res. 78:920-931.

^{32.} Reiter, E.R. (1971) <u>Atmospheric Transport Processes Part 2: Chemical Tracers</u>, U.S. Atomic Energy Commission, Oak Ridge, TN (TID-25314) 382 pp.

Measurements of the solar extinction through the atmospheric limb from the Apollo-Soyuz mission 37 tend to support this model.

Ivlev's^{38, 39} model for the upper atmosphere is shown as the curve labelled "Extreme Upper Atmosphere" in Figure 7. It is largely based on twilight observations⁴⁰ which neglected multiple-scattering effects. As a consequence, the model has to assume very high particulate concentrations in the upper atmosphere in order to be consistent with observations.

Nevertheless, extinction coefficients for the extreme upper-atmospheric model are consistent with the extreme values that have been observed in layers of a few kilometers thickness by lidar, $^{41, 42}$ inferred from rocket observations of skylight, $^{43, 44}$ and studies of noctilucent clouds, 45

3.10 Stratospheric Aerosol Models

3.10.1 COMPOSITION OF BACKGROUND STRATO-SPHERIC AEROSOLS

The background stratospheric aerosols are taken to be a 75 percent solution of sulfuric acid in water following the work of $\operatorname{Rosen}^{46}$ and Toon and Pollack.⁴⁷ The complex refractive index as a function of wavelength is based on the measurements of $\operatorname{Remsberg}^{48, 49}$ and Palmer and Williams.⁵⁰

The size distribution is chosen to be consistent with the concentrations of the particles with diameters greater than 0.3 μ and those greater than 0.5 μ measured by Hofman et al^{17,35} and the concentration of condensation nuclei observed by Rosen et al⁵¹ and Käselau.⁵² The normalized extinction and absorption coefficients are shown in Figure 13.

3.10.2 VOLCANIC AEROSOL MODELS

There are two volcanic size distribution models: a"fresh volcanic model" which represents the size distribution of aerosols shortly after a volcanic eruption; and an "aged volcanic model" representing the aerosol about a year after an eruption. Both size distributions were chosen mainly on the basis of Mossop's⁵³ measurements following the eruption of Mt. Agung.

The refractive index for these models is based on the measurements of Volz.²³ The resulting normalized extinction and absorption coefficients for these two models are shown in Figure 13.

Because of the large number of references cited above, they will not be listed here. See References, page 141.



Figure 13a. Extinction Coefficients for the Upper Atmospheric Aerosol Models (Normalized to 1.0 at 0.55 μ)



Figure 13b. Absorption Coefficients for the Upper Atmospheric Aerosol Models Corresponding to Figure 13a

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3.11 Upper Atmosphere Aerosol Model

The major component of the normal upper-atmospheric aerosols is considered is to be meteoric dust, which is consistent with the conclusions reached by Newkirk and Eddy⁵⁴ and later Rosen⁵⁵ in his review article. Meteoric or cometary dust also form some of the layers occasionally observed in the upper atmosphere. Poultney^{42, 56} has related the lidar observations of layers in the upper atmosphere either to cometary sources of micrometeoroid showers or noctilucent cloud observations. Divari et al⁵⁷ have related observations of increased brightness of the twilight sky to the Orinid meteor shower.

The refractive index of meteoric dust is based on the work of Shettle and Volz^{58} who determined the complex refractive index for a mixture of chondrite dust which represents the major type of meteorite falling on the earth. ⁵⁹

The size distribution is similar in shape to the one developed by Farlow and Ferry⁶⁰ by applying Kornblum's^{61, 62} theoretical analysis (of the micrometeoroid interaction with the atmosphere and their resulting concentration in the mesosphere) to the NASA⁶³ model of the meteoroid influx to the atmosphere. There are two important differences between the present size distribution model and Farlow and Ferry's.⁶⁰ First, the present model has proportionately more smaller particles,

- 54. Newkirk, G. Jr., and Eddy, J.A. (1964) Light Scattering by Particles in the Upper Atmosphere, J. <u>Atmos. Sci.</u> 21:35-60.
- Rosen, J.M. (1969) Stratospheric dust and its relationship to the meteoric influx, Space Sci. Rev. 9:58-89.
- 56. Poultney, S.K. (1974) Times, locations and significance of cometary micrometeoroid influxes in the earth's atmosphere, Space Res. 14:707-708.
- 57. Divari, N.B., Zaginalio, Yu. I., and Koval'chuk, L.V. (1973) Meteoric dust in the upper atmosphere, <u>Solar System Res.</u> 7:191-195. (Translated from Astronomicheskii Vestnik 7:223-230).
- 58. Shettle, E. P., and Volz, F. E. (1976) Optical constants for a meteoric dust aerosol model, in <u>Atmospheric Aerosols: Their Optical Properties and Effects</u>, a Topical Meeting on Atmospheric Acrosols sponsored by Optical Society of America and NASA Langley Research Center, Williamsburg, Virginia, 13-15 December 1976, NASA CP-2004.
- 59. Gaffey, M.J. (1974) <u>A Systematic Study of the Spectral Reflectivity Charac-</u> teristics of the Meteorite Classes with Applications to the Interpretation of Asteroid Spectra for Mineralogical and Petrological Information, Ph.D Thesis, M.I.T.
- 60. Farlow, N.H., and Ferry, G.V. (1972) Cosmic dust in the mesophere, Space Res. 12:369-380.
- Kornblum, J.J. (1969) Micrometeoroid interaction with the atmosphere, J. Geophys. Res. 74:1893-1907.
- 62. Kornblum, J.J. (1969) Concentration and collection of meteoric dust in the atmosphere, J. Geophys. Res. 74:1908-1919.
- 63. National Aeronautics and Space Administration (1969) <u>Meteoroid Environment</u> <u>Model, 1969 (Near Earth to Lunar Surface)</u>, NASA SP-8013 (March 1969).
and second, the number densities for all size ranges are several orders of magnitude larger than in Farlow and Ferry's 60 model. These differences are consistent with rocket observations in the upper atmosphere. $^{60, 64, 65}$

The normalized extinction and absorption coefficients for this meteoric dust model for the aerosols of the upper atmosphere are shown in Figure 13 as a function of wavelength.

3.12 Use of the Aerosol Models

The aerosol models defined in this report are representative of various general types of environments. Yet, the simple question: "Which model should be used for what location and weather situation?" is difficult to answer precisely. Some discussion on this point is necessary to give the user some guidance in choosing the appropriate model for a given condition.

3.12.1 BOUNDARY LAYER MODELS

For the boundary layer of the atmosphere up to 1 to 2 km above the surface, the composition of the aerosol particles is primarily controlled by sources (natural and man-made) at the earth's surface. The aerosol content of the atmosphere at a given location, will therefore depend on the trajectory of the local air mass during the preceding several days, and the meteorological history of the air mass. The amount of mixing in the atmosphere is controlled by the temperature profile and the winds. Precipitation will tend to wash the aerosol out of the atmosphere, although it should be noted that "frontal showers" often mark the boundary between two different air masses with generally different histories and correspondingly different aerosol contents.

The "rural" and the "urban" model are intended to distinguish between aerosol types of natural and man-made origin over a land area. Clearly, the man-made aerosol will be predominantly found in urban-industrial areas. How ver, it is quite likely that after the passage of a cold front, clear polar air also covers an urban area and that therefore the rural aerosol model, which is free of the component of industrial-carbonaceous aerosols, is more applicable. After a few days, as the clean air mass begins to accumulate local pollution however, the urban model will once again become more representative.

Conversely, very often the pollution plume from major urban-industrial areas may, under stagnant weather conditions, diffuse over portions of a continent (for example, Central Europe, Northeastern United States), including its rural sections.

Soberman, R.K., and Hemenway, C.L. (1965) Meteoric dust in the upper atmosphere, J. Geophys. Res. 70:4943-4949.

^{65.} Lindblad, B.A., Arinder, G., and Wiesel, T. (1973) Continued rocket observations of micrometeorites, Space Res. 13:1113-1120.

There is also a distinct difference between the composition of aerosols over the ocean and those over land areas due to the different surface-based sources. Aerosols in maritime environments have a very pronounced component of sea-salt particles from the sea water. Sea-salt particles are formed from sea spray from breaking waves. The larger particles fall out, but the smaller particles are transported up with the atmospheric mixing in the boundary layer. In coastal regions the relative proportions of particles of continental and oceanic origins will vary, depending on the strength and direction of the prevailing winds at time of observation.

While changes in visibility are often associated with changes in the relative humidity, (as the relative humidity approaches 100 percent the visibility tends to decrease), it is not possible to define a unique functional relationship between the visibility and relative humidity in the natural atmosphere. The reason for this is that any change in atmospheric moisture content is generally also associated with a change in the aerosol population itself due to change of the air mass. Only if the aerosol is contained in a closed system, where only the humidity changes, can such a unique relationship be developed. The measurements presented by Filippov and Mirumyants⁶⁶ clearly illustrate the difficulties in defining a simple unique expression relating visibility and relative humidity.

3.12.2 TROPOSPHERIC AEROSOL MODEL

The tropospheric aerosol model has been developed primarily for application in the troposphere, above the boundary layer, where the aerosols are not as sensitive to local surface sources. However, the tropospheric model should be used near ground level for particularly clear and calm conditions (in pollutionfree areas with visibilities greater than 30 to 40 km), where there has been little turbulent mixing for a period of 1 to 2 days, permitting the larger particles to have settled out of the atmosphere without being replaced by dust blown into the air from the surface. (The sedimentation rate of a 10- μ m radius aerosol particle in the lower troposphere is approximately 1 km per day.⁶⁷)

3.12.3 FOG MODELS

The fog models described in Section 3.9 were presented in terms of the atmospheric conditions leading to the development of the fog, so this provides a good basis for deciding which fog model to use. In more general terms, the visibilities will be less than 200 m for thick fogs and the extinction will be virtually

Filippov, V.L., and Mirumyants, S.O. (1972) Aerosol extinction of visible and infrared radiation as a function of air humidity, <u>Izv. Atmos. Oceanic</u> Phys. 8:571-574.

^{67.} Kasten, F. (1968) Falling speed of aerosol particles, J. Appl. Meteor. 7:944-947.

independent of wavelength. For these conditions the advection fog model should be used. For light to moderate fogs, the visibility will be 200 to 1000 m and there will be a noticeable difference between the extinction for visible wavelengths and in the 8- to $12-\mu m$ window. For such cases the radiation fog model should be used. For thin fog conditions where the visibility may be 1 to 2 km, the 99 percent⁻¹ relative humidity aerosol models may represent the wavelength dependence of the atmospheric extinction as well as any of the fog models.

3, 12, 4 STRATOSPHERIC AND UPPER ATMOSPHERE MODELS

The background stratospheric model is representative of present (1980)* stratospheric conditions. At irregular intervals (on the order of years) there are volcanic eruptions which inject significant amounts of aerosols into the stratosphere. For the first few months following such an eruption the fresh volcanic size distribution model would generally be the best one to use, and for the next year or so after that the aged volcanic size distribution model should be used.

The choice of which vertical distribution profile to use would depend on the severity of the volcanic eruption and how long ago it was. The moderate volcanic profile is representative of the stratospheric conditions throughout the Northern Hemisphere during the mid and late 1960's following the eruption of Mt. Agung. It is also typical of conditions during late 1974 and 1975 after the Volcan de Fuego eruption.

The high and extreme volcanic models are somewhat speculative as there have been no direct measurements of the vertical distribution of aerosol for such conditions. They are however consistent with the total optical thickness for aerosols inferred shortly after several major volcanic eruptions, $^{33, 34, 68}$ such as Katmai and Krakatoa, as well as the effects of Mt. Agung in the Southern Hemisphere.

3.12.5 SEASONAL AND LATITUDE DEPENDENCE OF AEROSOL VERTICAL DISTRIBUTION

In the mid-latitudes as the names suggest the spring-summer aerosol vertical profiles are intended to be used during the spring and summer seasons and the fall-winter profiles used during the fall and winter seasons. However, the seasonal changes in aerosol distribution are partially a reflection of the changes in

68. Diermendjian, D. (1973) On volcanic and other turbidity anomalies, Advances in Geophys. 16:267-296.

^{*}Note added in Proof. The eruption of Mt. St. Helens (May 1980) injected significant amounts of volcanic dust into the atmosphere. However, it appears most of it remained in the troposphere where it can be expected to settle out or be washed out within a few weeks. On the basis of the limited quantitative information available at this early date, a best guess would be to use the moderate volcanic profile to represent the amount added to the stratosphere.

Table 1. Typical Conditions for Aerosol Model Applications

- 1. Lower Atmospheric Models
- 1.1 Rural Model
 - 1) Natural environment, midlatitude, overland.
 - 2) Clean air in urban regions, following passage of a cold front.
- 1.2 Urban Mode!
 - 1) Urban industrial aerosol.
 - 2) Stagnant polluted air extending into rural regions.
- 1.3 <u>Maritime Model</u>
 - Mid-ocean (at least 300 km offshore) with moderate winds (above the first 10 to 20 meters).
 - 2) Continental areas under strong prevailing wind from the ocean.
- 1.4 Tropospheric Model
 - Atmospheric region between top of boundary layer (approximately 2 km) and tropopause (8-18 km, depending on latitude and season).
 - 2) Clean, calm air (meteorological range ≥ 40 km) in surface layer over land.
- 1.5 Fog Models
- 1.5.1 Advective Fog
 - 1) Mixing of air masses of different moisture content and temperature, leading to saturation.
 - Lacking specific knowledge on the formation process, for mature fogs with meteorological range: V ≤ 200 meters.
- 1.5.2 Radiation Fog
 - 1) Radiational cooling of the air to the dew point at night.
 - Lacking specific knowledge on the formation process, for developing fogs or meteorological ranges: 200 ≤ V ≤ 1000 meters.
- 1.5.3 99 Percent Relative Humidity Aerosol Models
 - 1) Light fogs ($1 \le V \le 2$ km).
- 2. Stratospheric and Mesopheric Aerosol Models
- 2.1 · Background Stratospheric Model
 - For time periods without any direct influence of volcanic dust contamination, for example, 1977 to present (1980). (See footnote pg. 39)
- 2.2 <u>Moderate Volcanic Profile with Fresh Aged Particle Size</u> <u>Distribution</u>

For optical thickness approximately 0.03, up to a few years after eruption, for example, Northern Hemisphere, 1964 to 1968.

2.3 High Volcanic Profile and Fresh or Aged Particle Size Distribution

For optical thickness approximately 0.1, up to a few months after eruption, for example, Southern Hemisphere, 1964-1965.

2.4 Extreme Volcanic Profile with Fresh Particle Size Distribution

For optical thickness approximately 0.3 or higher, up to a few weeks after a major eruption, for example, 1883 (Krakatoa) or 1912 (Katmai).

the tropopause height (especially for stratospheric aerosols). So in the tropical regions where the tropopause is generally higher, it is recommended that the spring-summer aerosol profile be used. Analogously is the subarctic regions where the tropopause is lower, it is recommended that the fall-winter profile be used.

3.12.6 GENERAL REMARKS ON APPLICABILITY OF THE AEROSOL MODELS

Typical conditions for which the different aerosol models apply as discussed in detail above are summarized in Table I. However, it must be emphasized that these models only represent a simplified version of typical conditions. It is not practical to include all the details of natural aerosol distributions nor are existing experimental data sufficient to describe the frequency of occurrence of the different conditions. While these aerosol models were developed to be as representative as possible of different atmospheric conditions, it should be kept in mind that the "rural" aerosol model does not necessarily exactly reproduce the optical properties in a given rural location at a specific time and date, any more than the midlatitude summer model atmosphere would exactly reproduce the actual temperature and water vapor profiles for that same specific time and location.

4. GEOMETRY

In general, earth curvature has a greater influence on the path length (and hence on the transmittance) than atmospheric refraction. For long slant paths with zenith angles close to 90° in the lower layers of the atmosphere, however, refractive effects can cause a significant increase in the path length (up to 30 percent for a 90° path to space from ground level). Figure 14 shows the effect of atmospheric refraction on defining the minimum height of a path trajectory from space. The minimum height referred to here is also known as the iangent height. In Figure 14 the difference between the geometrical (no refraction) and the actual minimum height is plotted against the actual minimum height for three different model atmospheres. The sketch in the upper right-hand corner of Figure 14 indicates that there is also a discrepancy in the earth center angle β subtended by the trajectory, when refraction is significant. The difference $\beta - \beta'$ shown in Figure 14 is equal to the total angular deviation ψ of the trajectory due to refraction.

For many applications it is necessary to account not only for the effect of refraction and earth curvature on the transmittance over a given path trajectory, but also on the purely geometrical aspects of the trajectory itself. For example, the total deviation ψ , angle of arrival ϕ , or angle β subtended by the path trajectory may be required as illustrated in Figure 15. LOWTRAN calculates the quantities



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Figure 14. The Difference Between Unrefracted and Refracted Tangent Height Positions as a Function of Altitude for Three Model Atmospheres Based on the 33-Layer Model

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Figure 15. General Schematic of a Refracted Path From Altitudes H1 to H2 Showing the Angles Defining the Trajectory

 $\psi,\ \phi,\ \beta$ and slant range on the basis of a layered atmosphere in the following paragraphs.

The earth's atmosphere is assumed to be divided into a series of concentric spherical layers for each of which a mean refractive index is defined. However, the non-sphericity of the earth is taken into account to some extent by using a different earth radius for each latitude (associated with a given model atmosphere).

Consider the trajectory of a ray passing from heights H1 to H2 at an initial zenith angle θ_0 . Let z_i and z_{i+1} define the boundary heights of a given layer, and let θ_i and θ_{i+1} be the local zenith angles at the respective boundaries (see Figure 15). Then at a height of z_{i+1} , the angle of refraction is θ_{i+1} . The angle of incidence α_i at height z_{i+1} can be defined as

$$\sin \alpha_{i} = (R_{0} + z_{i}) \sin \theta_{i} / (R_{0} + z_{i+1}) \quad . \tag{1}$$

Applying Snell's law at boundary z_{i+1} , we have

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$$n_{i} \sin \alpha_{i} = n_{i+1} \sin \theta_{i+1}$$
(2)

where n_i and n_{i+1} are the mean refractive indices of the layers above z_i and z_{i+1} respectively.

Substituting for sin α_i in Eq. (2), we have

$$n_i(R_0 + z_i) \sin \theta_i = n_{i+1} (R_0 + z_{i+1}) \sin \theta_{i+1} .$$
(3)

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It follows from symmetry that

$$n_{i}(R_{o} + z_{i}) \sin \theta_{i} = n_{i-1} (R_{o} + z_{i-1}) \sin \theta_{i-1}$$
$$= n_{o} (R_{o} + H1) \sin \theta_{o}$$
$$= const .$$
(4)

Therefore, the angle of refraction at any level z can be written in terms of the initial input conditions and the refractive index n_0 of the layer above H1 as

$$\sin\theta = n_0 (R_0 + H1) \sin\theta_0 / n(R_0 + z) \quad . \tag{5}$$

The angle β_i subtended at the center of the earth by the intersection of the ray with the layer z_i to z_{i+1} is given by

$$\beta_i = \theta_i - \alpha_i \quad . \tag{6}$$

Thus the total earth center angle subtended by the ray when traversing the atmosphere from H1 to H2 is

$$\beta = \sum_{i}^{m-1} (\theta_i - \alpha_i)$$
(7)

$$= \sum_{i}^{m-1} \left[\sin^{-1} \left\{ A/n_{i}(R_{o} + z_{i}) \right\} - \sin^{-1} \left\{ A/n_{i}(R_{o} + z_{i+1}) \right\} \right]$$
(8)

where m is the number of levels between H1 and H2, and A = $n_0(R_0 + H1) \sin \theta_0$. The angle of arrival ϕ of the ray at H₂ is given by

$$\phi = 180^{\circ} - \sin^{-1} \{A/n_{m-1}(R_{o} + H2)\} \quad . \tag{9}$$

The total angular deviation of the trajector ψ is given by

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$$\psi = \beta - \phi - \theta_{\rm O} + 180 \quad . \tag{10}$$

The effective path length between levels z_i and z_{i+1} is given by

$$DS_{i} = (R_{o} + z_{i+1}) \sin \beta_{i} / \sin \theta_{i} \text{ for } 0^{\circ} < \theta < 180^{\circ}$$
(11)

for $\theta = 0^{\circ}$ and 180° , $DS_i = z_{i+1} - z_i$. If we assume that the equivalent absorber amount per unit path length ω for a given gas varies exponentially with altitude, we can write

$$\int_{z_{i}}^{z_{i+1}} \omega \, dz = H_{i} [\omega(z_{i}) - \omega(z_{i+1})]$$
(12)

where $H_i = (z_{i+1} - z_i)/\log_e [\omega(z_i)/\omega(z_{i+1})]$. The amount of absorber W_i along a path of length DS_i between altitudes z_i and z_{i+1} is therefore given by

$$W_{i} = \int_{0}^{DS_{i}} \omega ds$$

$$= \frac{DS_{i}}{z_{i+1} - z_{i}} \int_{z_{i}}^{z_{i+1}} \omega dz$$

$$= \frac{DS_{i}[\omega(z_{i}) - \omega(z_{i+1})]}{\log_{e}[\omega(z_{i})/\omega(z_{i+1})]} . \qquad (13)$$

The total equivalent absorber amount W for a given atmosphere path is given by the sum of the W_i values for all layers; that is, $W = \sum_{i=1}^{m-1} W_i$ where m is the number of of levels traversed by the path.

4.1 Refractive Index of Air

The following simplified version of Edlen's 69 expression for the refractive index of air is used in LOWTRAN

$$(n_a - 1) \ 10^{+6} = \left(77.46 + \frac{0.459}{\lambda^2}\right) \frac{P}{T} - \frac{{}^{p}H_2O}{1013} \left(43.49 - \frac{0.347}{\lambda^2}\right) , \quad (14)$$

where p_{H_2O} and P refer respectively to the partial pressure of water vapor and atmospheric pressure in millibars, T is atmospheric temperature in degrees Kelvin, and λ is the wavelength in micrometers (μ m).

The above expression has been used over the entire wavelength range 0.2 to 28.5 μ m in LOWTRAN. Although Edlen's ⁶⁹ expression for the refractive index of air is widely used in both the visible and infrared spectral regions, it is questionable how far it should be used into the untraviolet and into the far infrared since the formula is based primarily on measurements made in the visible part of the spectrum from 0.43 to 0.8 μ m.

4.2 Geometrical Path Configurations

When using LOWTRAN, the type of atmospheric path for which a calculation is to be made must be specified according to one of the three broad categories listed below.

TYPE 1. Horizontal path; that is, a constant pressure path where the effects of earth curvature and refraction are negligible.

TYPE 2. Slant paths between two altitudes from H1 to H2.

TYPE 3. Slant paths to space from initial altitude H1.

The variations within the latter two categories for both upward and downward path trajectories can be seen from Figure 16.

It will be noted that two trajectories are possible for a given set of input parameters, H1, H2, and θ for a downward looking path (TYPE 2), provided that H2 lies between H1 and the minimum height, HMIN.

In most instances, the reader will not be aware that two paths are possible for a given set of input conditions. For such a case, LOWTRAN will execute the shorter path condition (Figure 16d) and print out a message to the effect that the case shown in Figure 16e does exist. Should the reader decide to run the latter case, he need only set the parameter LEN equal to unity and resubmit the case.

^{69.} Edlen, B. (1966) Metrologia 2:12.



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Figure 16. Geometrical Path Configurations: (a) Horizontal Paths, (b) Slant Paths Between Two Altitudes H1 and H2, (c) Slant Paths to Space, (d) A Possible Trajectory for a Downward-Looking Short Path where HMIN < H2 < H1, and (e) A Possible Trajectory for a Downward-Looking Long Path Where HMIN < H2 < H1

5, ATMOSPHERIC TRANSMITTANCE

In the LOWTRAN model, the total atmospheric transmittance at a given wavenumber averaged over a 20-cm⁻¹ interval is given by the product of the average transmittances due to molecular band absorption, molecular scattering, aerosol extinction, and molecular continuum absorption. The molecular band absorption is composed of four components; namely the separate transmittances of water vapor, ozone, nitric acid and the uniformly mixed gases (CO₂, N₂O, CH₄, CO, O₂ and N₂).

The average transmittance due to molecular band absorption is represented by a single parameter empirical transmittance function. The argument of the transmittance function is the product of a wavenumber dependent absorption coefficient and "an equivalent absorber amount" for the atmospheric path.

5.1 Molecular Band Transmittance

In the LOWTRAN transmittance model, the average transmittance $\overline{\tau}$ over a 20-cm⁻¹ interval (due to molecular absorption) is represented by a single parameter model of the form

$$\overline{\tau} = f(C_{\perp} \omega * DS)$$
(15)

where C_{ν} is the LOWTRAN wavenumber-dependent absorption coefficient and $\omega *$ is an "equivalent absorber density" for the atmospheric path, DS, defined in terms of the pressure P(z), temperature T(z), concentration of absorber ω and an empirical constant n as follows

$$\omega^* = \omega \left\{ \frac{P(z)}{P_0} \sqrt{\frac{T_0}{T(z)}} \right\}^n$$
(16)

where P_0 and T_0 correspond to STP (1 atm, 273K). If Eq. (16) is substituted in Eq. (15) and n is set to zero and unity, respectively, Eq. (15) reverts to the well-known weak-line and strong-line approximations common to most band models.

The form of the function f and parameter n was determined empirically using both laboratory transmittance data and available molecular line constants. In both cases, the transmittance was degraded in resolution to 20 cm⁻¹ throughout the entire spectral range covered here. It was found that the functions f for H_2O and the combined contributions of the uniformly mixed gases were essentially identical, although the parameter n differed in the two cases. Mean values of n were determined to be 0.9 for H_2O , 0.75 for the uniformly mixed gases, and 0.4 for ozone.

Figures 17a, b and c show the LOWTRAN "equivalent absorber densities" given by Eq. (16) and the true absorber densities vs altitude for water vapor, ozone and the uniformly mixed gases. The profiles shown in these figures are for the 1962 U.S. Standard atmosphere, (MODEL = 6).

Figure 18 shows the LOWTRAN empirical transmittance functions defined by Eq. (15) vs the \log_{10} of the effective optical depth ($C_{\nu}\omega * DS$). The solid function shown is used for water vapor and the uniformly mixed gases. * The dashed function is applicable to ozone.

For sufficiently small values of the argument $C_{\nu}^{\ \omega} * DS$, the transmittance functions f were modified for calculations for atmospheric layers of small optical thickness. For cases where (0.999 $\leq \tilde{\tau} \leq 1$) the transmittance functions have the analytic form

$$\overline{\tau} = 1 - a \left(C_{\mu} \omega * D S \right)^{b}$$
(17)

with a = 0.088 and b = 0.81 for H_2O and the uniformly mixed gases and a = 0.055 and b = 1.03 for ozone. This pseudo-linear approximation in Eq. (17) is used in the computer program for transmittances between 0.999 and 1.

The parameters a and b were determined from a least-squares fit of the empirically derived transmittance function in Eq. (15).

Absorption coefficients for water vapor, ozone, and the combined effects of the uniformly mixed gases, digitized from the spectral curves of McClatchey et al, 6 are included as data for LOWTRAN. The transmittance spectra from which the coefficients were derived were first degraded in resolution to 20 cm⁻¹ and the data points were digitized at steps of 5 cm⁻¹. For the ultraviolet and visible ozone bands, the absorption coefficients were digitized at 500 cm⁻¹ and 200 cm⁻¹ intervals respectively.

The absorption coefficients for water vapor are shown in Figures 19a and b. Figure 19a shows the coefficients in the region from 350 to 5000 cm⁻¹ and Figure 19b the region from 4000 to 24,000 cm⁻¹.

Figures 20a, b, and c show the absorption coefficients for ozone. Figure 20a spans the spectral region from 350 to 5000 cm⁻¹, Figure 20b the region from 4000 to 24,000 cm⁻¹, and Figure 20c the region from 20,000 to 50,000 cm⁻¹.

The absorption coefficients for the uniformly mixed gases are shown in Figures 21a and b. The spectral region from 350 to 5000 cm⁻¹ is shown in Figure 21a and the region from 4000 to 14,000 cm⁻¹ in Figure 21b.

^{*}Gruenzel⁷⁰ has pointed out that in previous versions of LOWTRAN, the value of FW for T = 0.88 was in error. The correct value is 0,4838, not 0.4342,

^{70.} Gruenzel, R.R. (1978) Applied Optics 17:2591.



Figure 17. Profiles of True and "Equivalent" Density vs Altitude, 1962 U.S. Standard Atmosphere: a. water vapor, b. ozone, and c. uniformly mixed gases (relative to STP)



Figure 18. LOWTRAN Empirical Transmittance Functions vs \log_{10} of the Effective Optical Depth ($C_{\mu}\omega * DS$)

5.2 Nitrie Acid

The transmittance due to HNO_3 has been assumed to lie in the weak-line or linear region. Absorption coefficients digitized at 5-cm⁻¹ intervals for the 5.9- μ m, 7.5- μ m, and 11.3- μ m bands of HNO_3 have been incorporated into the LOWTRAN program as a subroutine (Subroutine HNO3). These coefficients were obtained by Goldman, Kyle, and Bonomo⁷¹ by fitting their experimental results with the statistical band model approximation, and are shown in Figure 22.

5.3 Nitrogen Continuum Absorption

The continuum due to collision-induced absorption by nitrogen in the $4-\mu m$ region, is included in LOWTRAN based on the measurements of Reddy and Cho⁷² and Shapiro and Gush⁷³ (see also McClatchey et al⁶) and is shown in Figure 23.

^{71.} Goldman, A., Kyle, T.G., and Bonomo, F.W. (1971) Statistical band model parameters and integrated intensities for the 5.9-μ, 7.5-μ, and 11.3-μ bands of HNO₃ vapor, <u>Appl. Opt.</u> 1:65.

^{72,} Reddy, S.R., and Cho, C.W. (1965) Canad. J. Physics 43:2331.

^{73.} Shapiro, M.M., and Gush, H.P. (1966) Canad. J. Physics 44:949.





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Figure 21. Absorption Coefficient C_p for the Uniformly Mixed Gases: a. from 350 to 5000 cm⁻¹, b. from 4000 to 14,000 cm⁻¹



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Figure 22. Absorption Coefficient C_{ν} for Nitric Acid, from 500 to 2000 $\rm cm^{-1}$



Figure 23. Absorption Coefficient C_{ν} for the Nitrogen Continuum, from 2000 to 3000 cm $^{-1}$

The transmittance due to continuum absorption is assumed to follow a simple exponential law.

5.4 Molecular Scattering

The attenuation coefficient (km⁻¹) due to molecular scattering, ABS(6), is introduced into LOWTRAN via the following expression

ABS(6) =
$$\nu^4 / (9.26799 \times 10^{18} - 1.07123 \times 10^9 \times \nu^2)$$
 (18)

where ν is in wavenumbers (cm⁻¹). The above expression was obtained from a least-square fit to molecular scattering coefficients published by Penndorf⁷⁴ and is shown in Figure 24. This function is a change from the previous LOWTRAN codes and improves the fit in the ultraviolet. The errors in the new function are now less than 1/2 percent from 0.2 to 20 μ .



Figure 24. Attenuation Coefficient C_{ν} Due to Molecular Scattering, from 4000 to 54,000 cm^{-1}

^{74.} Penndorf, R. (1957) Tables of the Refractive Index for Standard Air and the Rayleigh Scattering Coefficient for the Spectral Region between 0.2 and 20 μ and Their Application to Atmospheric Optics, J. Opt. Soc. Amer. 47:176-182.

5.5 Water Vapor Continuum

The attenuation due to the water vapor continuum still eludes a complete theoretical explanation. At present, it appears that it results from the accumulated attenuation of the distant wings of H_2O absorption lines, emanating principally in the far infrared part of the spectrum. This attenuation due to molecular line broadening occurs as a result of collisional interactions between molecules; that is, collisions between two H_2O molecules and those of other gases (principally $H_2O:N_2$ collisions). Other postulates, such as the phenomenon being caused by other absorption mechanisms involving H_2O dimers, remain possibilities yet to be proven.

However, all that can be done at present is to account for the water vapor continuum phenomenon empirically, based on limited experimental measurements, until better line shape theories become available. It should be emphasized that further accurate and well-controlled measurements are urgently required in order to account for this phenomenon in real atmospheric situations with confidence.

The general formulation used to account for the water vapor continuum attenuation at a fixed temperature, has been to define the transmittance $\overline{\tau}(\nu)$ for a path length, DS, as follows

$$\overline{\tau}(v) = e^{-k(v)DS}$$

where the attenuation coefficient k(v) is given by

$$k(\nu) = [C_{S}P_{H_{2}O} + C_{N}(P_{T} - P_{H_{2}O})]\omega$$
(19)

or

$$\mathbf{k}(\nu) = \mathbf{C}_{\mathbf{S}} \left[\mathbf{P}_{\mathbf{H}_{2}\mathbf{O}} + \frac{\mathbf{C}_{\mathbf{N}}}{\mathbf{C}_{\mathbf{S}}} \left(\mathbf{P}_{\mathbf{T}} - \mathbf{P}_{\mathbf{H}_{2}\mathbf{O}} \right) \right] \boldsymbol{\omega}$$

where P_{H_2O} and P_T refer to the water vapor partial pressure and the ambient pressure respectively (atm), and ω defines the quantity of water vapor per unit path length (gm cm⁻² km⁻¹). The quantities C_S and C_N are generally referred to as the self- and foreign (nitrogen)-broadening coefficients for water vapor.

5.5.1 8- TO 11-µm H₂O CONTINUUM

Recently, a review of available water vapor continuum experimental measurements were made by Roberts et al⁷⁵ in the 10- μ m region. These workers found

75. Roberts, R.E., Selby, J.E.A., and Biberman, L.M. (1976) Infrared continuum absorption by atmospheric water vapor in the 8-12 μ m window, Applied Optics 14:2085.

that an empirical expression of the form given in Eq. (20) (below), provided a good fit to the wavenumber dependence of the measured water vapor continuum attenuation coefficients at 296 K. Also, the water vapor continuum attenuation coefficient has been found to have a significant temperature dependence. Based on the laboratory measurements of Burch⁷⁶ using samples of water vapor at elevated temperatures, an approximate empirical expression was obtained by Roberts et al 75 for the temperature dependence which is given in Eq. (21) below. It was found that the attenuation coefficient due to the water vapor continuum increases as the temperature decreases. That is, for a fixed amount of water vapor in a given path, one would expect more absorption at colder temperatures and less absorption at warmer temperatures. This is a somewhat unusual phenomenon. In practice one finds less water vapor in the atmosphere under cold conditions. therefore, the effect of temperature on the attenuation in the 8- to 14- μ m region plays two competing roles, through the total water content of the path and the attenuation coefficient.

The empirical fits to the wavenumber and temperature dependence of the water vapor continuum described in Roberts et al⁷⁵ have been used in LOWTRAN with the appropriate conversion of units, as follows: The attenuation coefficient $C_s \text{ gm}^{-1} \text{ cm}^{+2} \text{ atm}^{-1}$ at 296 K is given by the

following expression in the 8- to $14-\mu m$ region

$$C_{\rm g}(\nu, 296) = 4.18 + 5578 \exp(-7.87 \times 10^{-3} \nu)$$
 (20)

where ν is the wavenumber in cm⁻¹ (note that $\nu = 10^4 / \lambda$, where λ is the wavelength in μm).

Figure 25a shows a plot of $C_{s}(\nu, 296)$ vs wavenumber in the 8- to 14- μ m region.

The temperature dependence of the coefficient C_s was found to vary as

$$C_{s}(\nu, T) = C_{s}(\nu, 296) \exp\left[1800 \left(\frac{1}{T} - \frac{1}{296}\right)\right]$$
 (21)

where T is the temperature in degrees Kelvin.

Equation (21) can be rewritten as follows

$$C_{s}(\nu, T) = C_{s}(\nu, 296) \exp \left[6.08 \left(\frac{296}{T} - 1 \right) \right]$$
 (22)

^{76.} Burch, D. E. (1970) <u>Semiannual Technical Report: Investigation of the</u> <u>Absorption of Infrared Radiation by Atmospheric Gases</u>, Aeronutronic Report U-4784, ASTLA (AD 702117).



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Figure 25. Water Vapor Continuum Attenuation Coefficient C_g at 296 K: a. in the 8- to $12-\mu$ region, b. in the 3.5- to $4.2-\mu$ region

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The second term in Eq. (19), defined as C_N/C_S , represents the ratio of the foreign (nitrogen)-broadening coefficient to the self-broadening coefficient.

In LOWTRAN, a value at 296 K of 0.002 for the parameter C_N/C_S is used, based on the review of the measurements. It is assumed that C_N/C_S does not vary with temperature (since no supporting measurements are available).

The transmittance due to the water vapor continuum in the 8- to $14-\mu m$ region is calculated for a horizontal path of length DS (km) at altitude z using the following expression in LOWTRAN

$$\vec{\tau}(\nu) = \exp\left[-C_{0}(\nu, 296)W(z)DS\right]$$
 (23)

where W(z) is the effective H_2O absorber amount per unit path lengh (in gm cm⁻² atm km⁻¹) at altitude z, and $C_s(\nu, 296)$ is the water vapor (self-broadened) attenuation coefficient obtained from laboratory measurements at a temperature of 296 K.

The quantity W(z) is given by

W(z) = w(z)
$$\left\{ P_{H_2O} \exp \left[6.08 \left(\frac{296}{T(z)} - 1 \right) \right] + 0.002 \left(P_T - P_{H_2O} \right) \right\}$$
 (24)

where

w(z) = gm cm⁻²/km of H_2O in the path at temperature T, $P_{H_2O} = H_2O$ partial pressure (atm) at altitude z, $P_T =$ ambient (total) pressure (atm) at altitude z, and

T(z) = ambient temperature at altitude z (degrees Kelvin).

Note that the temperature dependence of the attenuation coefficient $C_s(\nu, T)$ given in Eq. (22) has been incorporated into the expression for W in Eq. (24). The reason for this is so that the temperature variation over a given atmospheric siant path is weighted equally with the water content along the path.

5, 5, 2 3, 5- TO 4, 2-µm H₂O CONTINUUM

Using the laboratory measurements of Burch et al, 77 an empirical expression was obtained for the temperature dependence of the attenuation coefficients in the 3- to 5- μ m region. The measurements reported in Burch et al 77 were for samples of pure water vapor made at elevated temperatures, and have been confirmed independently by White et al. 78

^{77.} Burch, D.E., Gryvnak, D.A., and Pembrook, J.D. (1971) Philco Ford Corp. Aeronutronic Report U-4897, ASTLA (AD 882876).

White, K.O., Watkins, W.R., Tuer, T.W., Smith, F.G., and Meredith, R.E. (1975) J. Opt. Soc. Amer. 65:1201.

It was found that

$$C_{s}(\nu, T) = C_{s}(\nu, 296) \exp \left[4.56 \left(\frac{296}{T} - 1\right)\right]$$
 (25)

provides an approximate fit to the measurements for pure water vapor extrapolated to a temperature of 296 K.

The attenuation coefficients at 296 K used in LOWTRAN for the 3.4- to 4.2- μ m region have been digitized directly from the extrapolations reported by Burch et al, ⁷⁷ and are shown in Figure 25b.

From the limited measurements available, it appears that the temperature dependence of the water vapor continuum (due to self broadening) in the 3.5- to 4.2- μ m region is not as strong as that in the 8- to 14- μ m region.

A value for the nitrogen-broadening coefficient of 0.12 was obtained by Burch et al⁷⁷ for a temperature of 428 K. Since no other measurements are available at the time of writing, this value will be used in LOWTRAN with the same temperature correction as is applied to the self-broadening term (see Eq. (26)).

As for the 8- to 14- μ m region, the transmittance for a horizontal path of length DS (km) can be calculated using Eq. (23), where the parameter W(z) is now given by the following expression for the 3.5- to 4.2- μ m region

$$W(z) = w(z) \left[P_{H_2O} + 0.12 (P_T - P_{H_2O}) \right] \exp \left[4.56 \left(\frac{296}{T(z)} - 1 \right) \right]$$
(26)

As in Eq. (24), the temperature dependence of the attenuation coefficient has been incorporated into Eq. (26). It will be noted that the nitrogen-broadening coefficient in the 4- μ m region is more significant relative to the self-broadening term than in the 10- μ m region. Again it should be emphasized that the above expressions are approximate and further measurements are required to determine the temperature dependence of the nitrogen-broadening coefficient, as well as more accurate values for the wavelength dependence of the self-broadening coefficient at ambient temperatures (for example, 296 K) and its temperature dependence.

5.6 Aerosol Transmittance

Within a given atmospheric layer of path length, DS, in km, the transmittance, $\overline{\tau}(\nu)$, due to aerosol extinction is given by

$$\overline{\tau}(\nu) = \text{EXP}\left[-\text{EXTV}(\nu) \times \text{HAZE} \times \text{DS}\right]$$
(27)

where $EXTV(\nu)$ is the normalized extinction coefficient for the wavenumber ν of the appropriate aerosol model and altitude. HAZE is the aerosol scaling factor (see Section 3).

 $EXTV(\nu)$ is found by interpolation of the values stored in the code for the required wavenumber and relative humidity. HAZE is determined by interpolation of the appropriate aerosol scaling factor profiles according to the meteorological range and season.

6. ATMOSPHERIC RADIANCE

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The LOWTRAN program has the option to calculate atmospheric and earth radiance. A numerical evaluation of the integral form of the equation of radiative transfer is used in the program. The emission from aerosols and the treatment of aerosol and molecular scattering is considered only in the zeroth order, Additional contributions to atmospheric emission from radiation scattered one or more times are neglected. Local thermodynamic equilibrium is assumed in the atmosphere.

The average atmospheric radiance (over a 20-cm^{-1} interval) at the wavenumber, ν , along a given line-of-sight in terms of the LOWTRAN transmittance parameters is given by

$$I(\nu) = \int_{\overline{\tau}_{a}^{b}}^{1} d\overline{\tau}_{a} B(\nu, T) \overline{\tau}_{s} + B(\nu, T_{b}) \overline{\tau}_{t}^{b}$$
(28)

where the integral represents the atmospheric contribution and the second term is the contribution of the boundary, (for example, the surface of the earth or a cloud top) and

 $\overline{\tau}_{a}$ = average transmittance due to absorption,

= average transmittance due to scattering,

 $\overline{\tau}_{t} = \overline{\tau}_{a} \overline{\tau}_{s}$ = average total transmittance,

 $\overline{\tau}_{c}$

 $\overline{\tau}_{a}^{b}, \overline{\tau}_{t}^{b}$ = average total transmittances from the observer to boundary,

B(v, T) = average Planck (blackbody) function corresponding to the frequency v and the temperature T of an atmospheric layer.

T_h = temperature of the boundary.

The emissivity of the boundary is assumed to be unity.

The LOWTRAN band model approach used here assumes that since the blackbody function is a slowly varying function of frequency we can represent the average value of the radiance in terms of the average values of the transmittance and the blackbody function. $\overline{\tau}_{a}$, $\overline{\tau}_{s}$, and $\overline{\tau}_{t}$ vary from 1 to $\overline{\tau}_{a}^{b}$, $\overline{\tau}_{s}^{b}$, and $\overline{\tau}_{t}^{b}$ along the observer's line-of-sight. For lines of sight which do not intersect the earth or a cloud layer, the second term in Eq. (28) is omitted.

), No.

The numerical analogue to Eq. (28) has been incorporated in the LOWTRAN computer program. The numerical integration of the radiance along a line-of-sight for a given model atmosphere defined at N levels is given by

$$I(\nu) = \sum_{i=1}^{N-1} (\overline{\tau}_{a}(i) - \overline{\tau}_{a}(i+1)) B\left(\nu, \frac{T(i) + T(i+1)}{2}\right) \left(\frac{\overline{\tau}_{s}(i) + \overline{\tau}_{s}(i+1)}{2}\right) + B(\nu, T_{b})\overline{\tau}_{t}^{b}, \qquad (29)$$

Thus, the spectral radiance from a given atmospheric slant path (line-of-sight) can be calculated by dividing the atmosphere into a series of isothermal layers and summing the radiance contributions from each of the layers along the line-of-sight, that is, numerically evaluating Eq. (28). This can be clearly seen from the following simple example.

Neglecting scattering, consider a three-layered atmosphere characterized by temperatures T_1 , T_2 , and T_3 as shown in Figure 26. Let $\overline{\tau}_1$, $\overline{\tau}_2$, and $\overline{\tau}_3$ be the transmittances from the ground to the boundaries of each of the layers respectively (see Figure 26a). Figure 26b shows the corresponding case for an observer in space (distinguished by primed $\overline{\tau}$ values). Then from Eq. (29) the total downward spectral radiance for an observer on the ground (looking upwards) is given by

$$\mathbf{I}(\nu) \downarrow = (1 - \overline{\tau}_1)\mathbf{B}(\nu, \mathbf{T}_1) + (\overline{\tau}_1 - \overline{\tau}_2)\mathbf{B}(\nu, \mathbf{T}_2) + (\overline{\tau}_2 - \overline{\tau}_3)\mathbf{B}(\nu, \mathbf{T}_3) \quad . \tag{30}$$

Similarly for an observer looking down from the top of the atmosphere (see Figure 26b), the total upward spectral radiance is given by

$$I(\nu) \dagger = (1 - \tau_1')B(\nu, T_3) + (\tau_1' - \tau_2')B(\nu, T_2) + (\tau_2' - \tau_3')B(\nu, T_1) + \tau_3' B(\nu, T_b) .$$
(31)

A comparison of Eqs. (30) and (31) shows that in addition to the boundary contributions to the total upward spectral radiance, the total downward and the total upward spectral radiances from the same atmospheric layers are not the same but depend on the position of the observer relative to a given atmospheric slant path. In the LOWTRAN radiance program, the position of the observer is always defined by the input parameter, H1.



Figure 26. Upward and Downward Atmospheric Paths Through a Three-Layered Atmosphere for Radiance Calculations

It should be emphasized that in the calculation of radiance as given by Eq. (28), scattering is treated only as a loss mechanism and is not included as a source.

In a recent paper by Ben-Shalom et al, ⁷⁹ it has been noted that for certain atmospheric paths of high optical depth where multiple-scattered radiation is significant, the algorithm used in LOWTRAN underestimates the background radiation. The authors have proposed a "conservative scattering" solution for these cases where only the total extinction is used for the radiative transfer calculations. However, no assessment of the validity of the "conservative scattering" method proposed vs the "zero scattering" algorithm in LOWTRAN for the various paths encountered in the atmosphere has been made.

Until a general multiple-scattering solution for radiative transfer is available in the code, it is recommended that users of LOWTRAN examine the scattering contribution along a given atmospheric path. For scattering in the linear region, the present LOWTRAN algorithm should be appropriate. For high-scattering conditions, users might consider modifying the radiance algorithm as Ben-Shalom et al⁷⁹ have proposed.

7. PROGRAM STRUCTURE

In addition to the inclusion of new acrosol models and new acrosol extinction coefficients into the LOWTRAN code, extensive reprograming of the code has been made for improved logical flow of the program and user understanding. As shown in Figure 27, the LOWTRAN code structure consists of a main program, LOWEM, and 19 subroutines. A listing of the code is given in Appendix A. The data file,

^{79.} Ben-Shalom, A., Barzilia, B., Cabib, D., Devir, A.D., Lipson, S.G., and Oppenheim, U.P. (1980) <u>Applied Optics Vol. 19</u>, No. 6, p. 838.



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Figure 27. LOWTRAN Program Structure

TAPE5, used in previous LOWTRAN codes has been eliminated. The information from this file has been incorporated into the code in data statements.

In the main program, LOWEM, four control cards are read in for standard execution of the code. New aerosol control parameters have been added to these cards, as will be explained in the instructions for using the code in Section 8.

The transmittance and radiance output tables are also written to the mass storage file, TAPE7, declared on the PROGRAM LOWEM card. The subroutines, MDTA, NSMDL, HPROF, GEO, EXABIN, PATH, and TRANS are called from the main program. A definition of symbols in PROGRAM LOWEM is given in Appendix B.

Subroutine MDTA, called from the main program, contains the altitudes, pressure, temperature, water vapor and ozone density profiles of the six model atmospheres. The nitric acid volume mixing ratio profile is also stored in the subroutine.

Subroutine NSMDL is called from the main program for user defined model atmospheres or aerosol models (MODEL = 0 or MODEL = 7). The input cards and options for the user defined models are explained in Section 8. Subroutine AERPRF is called from this subroutine. Subroutine HPROF, called from the main program, sets up the appropriate HORIZONTAL PROFILES of molecular and aerosol-absorber densities in LOWTRAN units, using either the model data from MDTA or the user-defined model data from NSMDL. Subroutine AERPRF is also called from this subroutine.

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Subroutine AERPRF, called from either NSMDL or HPROF, sets up the appropriate aerosol HORIZONTAL PROFILES for the model selected. Subroutine PRFDTA, called from AERPRF, contains the altitude-dependent profiles of the aerosol models allowed by the program, stored in data statements.

Subroutine GEO, called from the main program, is the spherical geometry subroutine, with correction for refraction, used to calculate the absorber amounts along the atmospheric slant path. The VERTICAL PROFILES and the equivalent absorber amounts are determined in this subroutine. The matrix, WLAY, is also defined in this subroutine for use with subroutine PATH, for radiance calculations. Subroutine ANGL and POINT are called from this subroutine.

Subroutine ANGL is called from GEO to calculate the initial zenith angle for the atmospheric slant path, when the initial and final altitudes and the earth center angle are specified. Subroutine POINT is also called from ANGL.

Subroutine POINT, called from GEO and ANGL, is used to compute the mean refractive index above and below a given altitude and to interpolate exponentially the equivalent absorber densities at that altitude.

Subroutine EXABIN is called from the main program to load the extinction and absorption coefficients for the four aerosol altitude regions appropriate to the aerosol model selected by the user. Interpolation of the boundary layer aerosol coefficients based on relative humidity is performed in this subroutine. Subroutine EXTDTA is called from EXABIN.

The aerosol extinction and absorption coefficients and wavelengths of all the aerosol models are stored in subroutine EXTDTA, called from EXABIN.

Subroutine PATH, called from the main program for radiance calculations, loads the cumulative absorber amounts along the atmospheric slant path into the matrix, WPATH. This data is transferred to PATH from GEO through the vertical profile matrix, WLAY.

Subroutine TRANS, called from the main program, calculates the transmittance and radiance between the wavenumbers, V1 and V2, in steps of DV for the atmospheric slant path. Subroutines TRFN, AEREXT, HNO3, C1DTA, C2DTA, C3DTA, and C4DTA are called by TRANS.

The LOWTRAN transmittance functions for water vapor, ozone, and the uniformly mixed gases are stored in data statements in subroutine TRFN.

Subroutine AEREXT interpolates the aerosol extinction coefficients for the four altitude regions to obtain the proper values at the wavenumber, ν .

Subroutine HNO3 determines the nitric acid absorption coefficient at the wavenumber, ν , from the arrays stored in the subroutine. The molecular water vapor absorption coefficient is determined at a specified wavenumber from the array, C1, stored in subroutine C1DTA.

The absorption coefficient for the uniformly mixed gases at a specified wavenumber is determined from the array, C2, stored in subroutine C2DTA.

The infrared absorption coefficient for ozone at the wavenumber, ν , is obtained from the array, C3, stored in subroutine C3DTA.

Subroutine C4DTA, called from TRANS, contains data arrays for the nitrogen continuum absorption (C4), the 4- μ m water vapor continuum absorption (C5), and the ozone ultra-violet and visible absorption (C8).

With the new code structured into subroutines, the program has been run on the AFGL CDC6600, using segment loading of computer code to reduce central memory storage requirements. A load map using the segment option is shown in Appendix C.

With segment loading of the code, the core storage requirements for execution are reduced by approximately a factor of two over conventional loading of the program. Similar type segment loading of the LOWTRAN code would allow possible use of the code on minicomputers.

8. INSTRUCTIONS FOR USING LOWTRAN 5

The instructions for using LOWTRAN 5 are similar to those for previous LOWTRAN codes. New control parameters defining the aerosol profiles and extinction coefficients have been added to the first input card. Changes have also been made in the input of aerosol models in user-defined atmospheres (MODEL = 7). As mentioned previously, the data file, TAPE 5, has been eliminated and made part of the Fortran code.

In general, for standard atmospheric models, only four input cards are required to run the program for a given problem. The formats for these four cards and definitions of the input parameters on these cards are given below.

8.1 Input Data and Formats

The data necessary to specify a given problem are given on the four cards as follows:

CARD 1 MODEL, IHAZE, ITYPE, LEN, JP, IM, M1, M2, M3, ML, IEMISS, RO, TBOUND, ISEASN, IVULCN, VIS FORMAT (1113, 2F10. 3, 213, F10. 3) CARD 2 H1, H2, ANGLE, RANGE, BETA FORMAT (5F10. 3)

CARD 3	V1,	V2,	DV
CARD 4	IХY		

FORMAT (3F10.3) FORMAT (I3)

Definitions of the above quantities will be discussed in Section 8.2.

If the quantity MODEL, given in CARD 1 is set equal to 0 or 7 (which is the case if meteorological data are used as input to the program), then the above card sequence (and format for CARD 2) is changed. These cases will be described in Section 8.3.

8.2 Basic Instructions

The various quantities to be specified on each of the four control cards (summarized in Section 8.1) will be discussed in this section.

8.2.1 CARD 1 - MODEL, IHAZE, ITYPE, LEN, JP, IM, M1, M2, M3, ML, IEMISS, RO, TBOUND, ISEASN, IVULCN, VIS

The parameter MODEL selects one of six geographical model atmospheres or specifies that user-defined meteorological data are to be used in place of the standard models. ITYPE and LEN determine one of three types of atmospheric paths for a given problem. JP is a user option to suppress printing of profiles and tables in the output. IEMISS selects the mode of program execution (transmittance or radiance). IM, M1, M2, M3, M1, RO, and TBOUND are additional input parameters for non-standard cases. IHAZE, ISEASN, IVULCN, and VIS are control parameters used to select the profiles and types of extinction coefficients for the aerosol models (N.B. VIS is now specified on CARD1).

MODEL = 0 if meteorological data are specified (for horizontal paths only)^{*}.

- = 1 selects TROPICAL MODEL ATMOSPHERE.
- = 2 selects MIDLATITUDE SUMMER.
- = 3 selects MIDLATITUDE WINTER.
- = 4 selects SUBARCTIC SUMMER.
- = 5 selects SUBARCTIC WINTER.
- = 6 selects 1962 U.S. STANDARD
- = 7 if a new model atmosphere (or radiosonde data) is to be inserted.
- ITYPE = 1 for a horizontal (constant-pressure) path.
 - = 2 for a vertical or slant path between two altitudes.
 - = 3 for a vertical or slant path to space.

The TYPE 1 path should not be confused with a long 90° path where the local height of the end of the trajectory is at a significantly different height. In such a case, specify the path according to ITYPE = 2.

^{*}In these cases the format for Card 2 changes (see non-standard conditions, Section 8.3).

LEN = 0 for normal operation of program.

= 1 selects the downward TYPE 2 LONG path.

The parameter LEN can be ignored (that is, left blank) for the majority of cases. It need only be used for a downward-looking path (H2 < H1) when two paths are possible for the same input parameters. In such a case, a computer printout statement will be given indicating that the user has two choices for the problem and that the shorter path has been executed. Set LEN = 1 for the longer case.

JP = 0 for normal operation of program.

= 1 to suppress printing of transmittance table/or radiance table and horizontal and vertical profiles.

The control parameter, IEMISS, determines the mode of execution of the program. IEMISS = 0 for program execution in transmittance mode.

= 1 for program execution in radiance mode.

A message is printed to the user on the output file indicating the mode of program execution.

Table 2A summarizes the use of these five control parameters specified on CARD1. For non-standard cases, provision is made on CARD1 for additional user options with the parameters 1M, M1, M2, M3, ML, RO, and TBOUND.

- IM = 0 for normal operation of program or when <u>subsequent</u> calculations are to be run with MODEL = 7.
 - = 1 when radiosonde data are to be read in initially.
- ML = Number of levels to be read in for MODEL = 7.

Note that IM and ML are only used when MODEL = 7 and then only on the first calculations when the data are read in.

M1 = M2 = M3 = 0 for normal operation of program.

The parameters M1, M2, and M3 can each take integer values between 0 and 6 and are used to modify or supplement the altitude profiles of temperature and pressure, water vapor, and ozone respectively, for any given atmospheric mode! specified by MODEL.

For example:

- M1 = 1 selects the TROPICAL temperature and pressure altitude profiles.
 - = 2 selects the MIDLATITUDE SUMMER temperature and pressure altitude profiles.
 - = 6 selects the 1962 U.S. STANDARD temperature and pressure altitude profiles.
- M2 = 1 selects the TROPICAL water vapor altitude profile,
 - = 2 selects the MIDLATITUDE SUMMER water vapor altitude profile.
 - = 6 selects the 1962 U.S. STANDARD water vapor altitude profile,

CARD	RD 1 MODEL, IHAZE, ITYPE, LEN, JP, IM, M1, M2, M3, ML, IEMISS, RO, TBOUND, ISEASN, IVULCN, VIS FORMAT (1113, 2F10,3, 213, F10,3)									
CQL 3	MODEL		COL <u>ITYPE</u>		COL 12	LEN	COL. 15	<u>٩</u> ٢	COL 33	IEMISS
0	USER * DEFINED		1	HOR I ZONTAL PATH	0	SHORT PATH	D	Normal Output	O	TRANS- MITTANCE
1	TROPICAL		2	SLANT PATH H1 TO H2	1	long Path	1	SHORT OUTPUT	1	RADIANCE
2	MIDLATI	I TUDE {	3	SLANT PATH H1 TU SPACE						
3	MIDLATITUDE WINTER									
4	SUBARCTIC SUMMER]							•
5	SUBARC WINTER	ĮIC]							
6	1962 U ST/NDAF	.ŝ.								
7	USER DEF INEI	• D]							
* OFTIONS FOR NON-STANDARD MODELS										
IM, M1, M2, M3, ML, RO, TECUND LEFT BLANK FOR STANDARD CASES										

Table 2a. LOWTRAN CARD 1 Input Parameters: MGDEL, ITYPE, LEN, JP, IEMISS

M3 = 1 selects the TROPICAL ozone altitude profile.

= 2 selects the MIDLATITUDE SUMMER ozone altitude profile.

= 6 selects the 1962 U.S. STANDARD ozone altitude profile,

RO = radius of the earth (km) at the particular geographical location at which the calculation is to be performed.

If RO is left blank, the program will use the midlatitude value of 6371.23 km if MODEL is set equal to 0 or 7. Otherwise the earth radius for the appropriate standard model atmosphere (specified by MODEL) will be used.

TBOUND = temperature of the earth (0 K) at the location at which the calculation is to be performed.

TBOUND is only used in the radiance mode of the program for slant paths which intersect the earth. If TBOUND is left blank, the program will use the temperature of the first atmospheric layer as the boundary temperature. IHAZE, ISEASN, IVULCN, and VIS select the altitude- and seasonal-dependent aerosol profiles and aerosol extinction coefficients. IHAZE specifies a horizontal meteorological range and specifies the type of extinction for the boundary-layer aerosols (0 to 2 km). The relative humidity dependence of the boundary-layer aerosol extinction coefficients is based on the water vapor content of the model atmosphere selected by MODEL. ISEASN selects the seasonal dependence of the profiles for both the tropospheric (2 to 10 km) and stratospheric (10 to 30 km) aerosols. IVULCN is used to select both the profile and extinction type for the stratospheric aerosols and to determine transition profiles above the stratosphere to 100 km. VIS, the meteorological range, when specified, will supersede the default meteorological range in the boundary-layer aerosol profile set by IHAZE.

IHAZE = 0 no aerosol attenuation included in the calculation.

- = 1 RURAL extinction, 23-km VIS.
- = 2 RURAL extinction, 5-km VIS.
- = 3 MARITIME extinction, 23-km VIS.
- = 4 MARITIME extinction, 5-km VIS.
- = 5 URBAN extinction, 5-km VIS.
- = 6 TROPOSPHERIC extinction, 50-km VIS.
- = 7 USER-DEFINED extinction, 23-km VIS. (Read into the program immediately after CARD1. Refer to the main program LOWEM in Appendix A for the input format of the coefficients).
- = 8 FOG1 (Advection Fog) extinction, 0.2-km VIS.
- = 9 FOG2 (Radiation Fog) extinction, 0.5-km VIS.

As noted above, IHAZE selects the type of extinction and a default meteorological range for the boundary-layer aerosol models only. If VIS is also specified on CARD1 it will override the default IHAZE value. Interpolation of the extinction coefficients based on relative humidity is performed only for the RURAL, MARI-TIME, URBAN, and TROPOSPHERIC coefficients used in the boundary layer (0 to 2-km altitude).

JSEASN = 0 season determined by the value of MODEL;

SPRING-SUMMER for MODEL = 0, 1, 2, 4, 6, 7

FALL-WINTER for MODEL = 3, 5

- = 1 SPRING-SUMMER
- = 2 FALL-WINTER

ISEASN selects the appropriate seasonal aerosol profile for both the tropospheric and stratospheric aerosols. Only the tropospheric aerosol extinction coefficients are used with the 2- to 10-km profiles. IVULCN = 0, 1 BACKGROUND STRATOSPHERIC profile and extinction

- = 2 MODERATE VOLCANIC profile and AGED VOLCANIC extinction
- = 3 HIGH VOLCANIC profile and FRESH VOLCANIC extinction
- = 4 HIGH VOLCANIC profile and AGED VOLCANIC extinction
- = 5 MODERATE VOLCANIC profile and FRESH VOLCANIC extinction

The parameter IVULCN controls both the selection of the aerosol profile as well as the type of extinction for the stratospheric aerosols. It also selects appropriate transition profiles above the stratosphere to 100 km. Meteoric dust extinction coefficients are always used for altitudes from 30 to 100 km.

VIS = meteorological range (km) (when specified, supersedes default value set by IHAZE)

Table 2B summarizes the use of aerosol control parameters on CARD 1.

		olen, vio	-								
CARD 1 MODEL, IHAZE, ITYPE, LEN, JF, IM, M1, M2, M3, ML, IEMISS, RJ, TBOUND, ISEASN, IVULCN, VIS FORMAT (1113, 2F10.3, 213, F10.3)											
IHAZE				<u>I SEASN</u>		IVULCN					
COL 6	VIS* (KM)	EXTINCTION	CUL 56	GEASON	60L 59	SEASON	PROFILE	EXTINCTION	PROFILE		
0	~	NO AEROSOLS									
1	23	OUDA	0	SET BY MODEL		SET BY MODEL			METEORIC		
2	5	KUKAU.	1	SPRING- Summer		SFRING- Summer		EXTINCTION			
3	23	MARITIME	2	FALL- WINTER		FALL- WINTER					
4	5						BACKGROUND STRATU- SPHERIC	BACKGROUND STRATO- SPHERIC	NORMAL		
5	5	URBAN	TROPUSPHERIC		1				PROFILE		
6	50	TRJPOSPHERIC	TRU	PROFILEZ TROPOSPHERIC EXTINCTION	2		MODERATE VOLCANIC	AGED VOLCANIC			
7	23	USER DEFINED	1		3		HIGH VOLCANIC	FRESH VOLCANJC	TRANSITION PROFILES -VOLCANIC TO NORMAL		
8	0.2	F0G 1]				HIGH VOLCANIC	AGED VOLCANIC			
9	0.5	F0G 2			5		MODERATE VOLCANIC	FRESH VOLCANIC			
<i>←</i>	<u>C</u>) ТО>	· K1	2 TU —>	>		- 10 TU 30 KM	>	\leftarrow $\frac{50}{100}$ KM \rightarrow		
••••••		•	V1S>0.	OVERRIDES D	EFAULT	MET, RANGE					

Table 2b. LOWTRAN CARD 1 Input Parameters: IHAZE, ISEASN, IVULCN, VIS

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In the case where MODEL = 7, the new atmosphere (model or radiosonde data) is inserted between CARDS 1 and 2 (see Section 8.3).

8.2.2 CARD 2 - H1, H2, ANGLE, RANGE, BETA

CARD 2 is used to define the geometrical path parameters for a given problem.

H1 = initial altitude (km)

H2 = final altitude (km)

It is important to emphasize here that in the radiance mode of program execution (IEMISS=1), H1, the initial altitude, always defines the position of the observer (or sensor). H1 and H2 cannot be used interchangeably as in the transmittance mode.

ANGLE = initial zenith angle (degrees) as measured from H1

RANGE = path length (km)

BETA = earth center angle subtended by H1 and H2 (degrees)

It is <u>not</u> necessary to specify every quantity given above; only those that adequately describe the problem according to the parameter ITYFE (as described below)

(1) Horizontal Paths (ITYPE = 1)

(a) specify H1, RANGE

(b) If non-standard meteorological data are to be used, that is, if MODEL = 0 on CARD 1, then refer to Section 8.3 for parameters and format of CARD 2.

(2) Slant Paths to Space (ITYPE = 3)

(a) specify H1, ANGLE

(b) specify H1, HMIN (for limb-viewing problem where HMIN is the required tangent height or minimum altitude of the path trajectory.

(3) Slant Paths Between Two Altitudes (ITYPE = 2)

- (a) specify H1, H2, ANGLE
- (b) specify H1, ANGLE, RANGE
- (c) specify H1, H2, RANGE

For cases (b) and (c), the program will calculate H2 and ANGLE respectively, assuming no refraction; then proceed as for case (a). This method of defining the problem should be used when refraction effects are not important; for example, for ranges of a few tens of km at zenith angles less than 80° . It can also be used for larger angles (including 90°) provided that the path lies within one atmospheric layer.

(d) specify H1, H2, BETA. Leave ANGLE and RANGE blank in this case. This method can be used when the geometrical configuration of the source and receiver is known accurately, but the initial zenith angle is not known precisely due to atmospheric refraction effects. Beta is most frequently determined by the user from ground range information. In the cases of 2(b) and 3(d) above, the subroutine ANGLE is called in the program to determine the appropriate input zenith angle by an iterative technique taking into account atmospheric refraction.

In the case where MODEL = 7, the new model atmosphere (or radiosonde data) is inserted between CARDS 1 and 2.

Table 3 lists the options on CARD 2 provided to the user for the different types of atmospheric paths.

CARD 2	H1, H2, ANGLE, FORMAT (SF10.3	RANGE, BETA			
	<u>H1</u> (KM)	<u>H2</u> (KM)	ANGLE (^O)	RANGE (KM)	<u>BETA</u> (⁰)
<u>I TYPE</u>	_				
1	X			Х	
	X	<u>X</u>	x		
2	X		X	X	
2	X	X		X	
	X	<u>x</u>			x
3	X		X		
	X	X (HMIN)		 	
X - PARAM	ETER MUST BE DEF	TINED			

Table 3. LOWTRAN CARD 2 Input Parameters: H1, H2, ANGLE, RANGE, BETA

8.2.3 CARD 3 - V1, V2, DV

The spectral range over which transmittance data are required and the spectral increments at which the data are to be printed out is determined by CARD 3.

- V1 = initial frequency in wavenumbers (cm⁻¹)
- V2 = final frequency in wavenumbers (cm⁻¹) where V2 > V1

DV = frequency increment (or step size) (cm⁻¹)

(Note that $\nu = 10^4 / \lambda$ where ν is the frequency in cm⁻¹ and λ is the wavelength in microns, and that DV can only take values which are a multiple of 5.)

8.2.4 CARD 4 – IXY

The control parameter IXY can cause the program to recycle, so that a series of problems can be run with one submission of LOWTRAN. Five values of IXY can be used to provide the options given on the following pages.

IXY = 0 or blank card to end of program

- = 1 to select a new CARD 3 and CARD 4 only (assuming other parameters are unchanged)
- = 2 to select a new data sequence (CARDS 1, 2, 3, and 4)
- = 3 to select a new CARD 2 and CARD 4 only (assuming other parameters are unchanged)
- = 4 to select a new CARD 1 and CARD 4 only (assuming other parameters are unchanged)

Thus, if for the same model atmosphere and type of atmospheric path the reader wishes to make further transmittance calculations in different spectral intervals V1' to V2' etc. and for a different step size (DV' etc.), then IXY is set equal to 1. In this case, the card sequence is as follows and can be repeated as many times as required.

CARD 4 IXY = 1 CARD 5 V1' V2' DV' CARD 6 IXY = 1 CARD 7 V1'' V2'' DV'' CARD 8 IXY = 0

The final IXY card should always be a blank or zero. When using the IXY = 1 option, the wavelength dependence of the refractive index is not changed (use IXY = 2 option if this is required).

To make successive transmittance computations where just the geographical model atmosphere is changed and/or with or without aerosol attenuation, set IXY = 4 and construct a data card sequence along the same lines as given above. This sequence of recycling can be repeated successively.

When a series of problems is to be executed (with one submission of LOWTRAN) involving the standard atmospheric models (MODEL = 1 to 6) as well as cases involving MODEL = 0 and MODEL = 7, then the order in which the data are set up becomes very important. Note the following sequence.

1. Run all problems using MODEL = 1 through 6 first.

2. Secondly, run all problems involving the use of MODEL = 0.

3. Run all problems involving the use of MODEL = 7 last. The reason for running MODEL = 7 cases last is that when a new atmospheric model is read in,

the altitudes may not correspond with those given in the standard models and the program will erase them. Similarly, if a MODEL = 0 case is run following a MODEL = 7 case, the first level of MODEL 7 is erased.

Table 4 summarizes the user-control parameters on CARD 3 and CARD 4.

CARI) 3	V1, V2, DV FORMAT (3F10,	3)		
		<u>V1</u> (CM-1)	<u>V2</u> (CM-1)	<u>DV</u> (CM-1)	DV VALUES MULTIPLE OF 5 CM-1
CARI	<u>D 4</u>	1XY FORMAT (13)			
CQL				XY	
0	END C	DF PROGRAM.			
1	READ	NEW CARDS 3 AND) 4.	_	
2	READ	NEW CARDS 1, 2,	3. AND 4.		
3	READ	NEW CARDS 2 AND) 4.		
4	RE.AD	NEW CARDS 1 AND) 4.		

Table 4. LOWTRAN CARD 3 and CARD 4 lnput Parameters: V1, V2, DV, IXY

8.3 Non-Standard Conditions

Three options are available if atmospheric transmittance calculations are required for non-standard conditions. Here non-standard refers to conditions other than those specified by the six model atmospheres provided by LOWTRAN, which are selected by the parameter MODEL on CARD 1. The three options enable the user to insert:

(1) His own model atmosphere(s) in place of any (or all) of the six standard models, provided that the data are in exactly the same format and are specified at the same altitudes as in the DATA statements in the LOWTRAN code (Subroutine MDTA). In this case the appropriate print statements in LOWTRAN (that identify the atmospheric model used) must be changed correspondingly.

(2) An additional atmospheric model (MODEL 7), which can be in the form of radiosonde data. The data need not be specified at the same altitudes as in the standard models.

(3) Meteorological conditions for a given horizontal path calculation (MODEL = 0 case).

The first of these options requires the most effort and needs no further discussion here, other than a reference to Appendix A for a summary of the standard model atmosphere parameters, units, and formats.

8.3.1 ADDITIONAL ATMOSPHERIC MODEL (MODEL = 7)

New model atmospheres can be inserted between CARDS 1 and 2 provided the parameters MODEL and IM are set equal to 7 and 1 respectively on CARD 1. The number of atmospheric levels to be inserted (ML) must also be specified on CARD 1. New altitude-dependent aerosol control options have been added to the MODEL = 7 cards to provide more flexibility to the user in modeling aerosol extinction.

The appropriate meteorological parameters and format for the atmospheric data are given below

<u>Z</u> ,	<u>P</u> ,	<u>T</u> ,	<u>DP</u> ,	<u>R</u> Н,	₩ <u>H</u> ,	wo,	AFAZE,	VIS1,	IHA1,	ISEA1,	IVULI
	\mathbf{F}	OR]	MAT	(3F10	0.3, 2	F5.1.	3E10.3.	F7.3.	311)		

- Z = altitude (km)
- P = pressure (mb)

T = ambient temperature (^OC)

- DP = dew-point temperature $(^{\circ}C)$
- RII = relative humidity (%)
- WH = water vapor density (gm m^{-3})
- WO = ozone density (gm m^{-3})
- AHAZE : aerosol number density (normalized by the user to the required meteorological range using the LOWTRAN extinction coefficients)
- VIS1 = meteorological range (km) for the altitude, Z
- IHA1 = acrosol extinction and meteorological range control for the altitude, Z
- ISEA1 = aerosol season control for the altitude, Z
- IVUL1 = aerosol profile and excinction control for the altitude, Z

Note that it is only necessary to specify those quantities underlined with a full line and one of the quantities underlined with the dashed line.

If the ozone density (WO) is not known then a value can be obtained from one of the standard atmospheric models (for the appropriate latitude and season) by using the parameter M3 on CARD 1. Also note that for M1 > 0 on CARD 1, both pressure and temperature are now interpolated from the model atmosphere (MODEL=M1) for the altitude Z.

For the modeling of the aerosol profiles and extinction coefficients, if AHAZE, VIS1, ISEA1 and IVUL1 are left blank on the MODEL 7 input card, then the aerosol control parameters, IHAZE, ISEASN, IVULCN and VIS on CARD 1 will control the modeling of the altitude-dependent aerosol parameters as described in Section 8.2. LOWTRAN will use the aerosol models contained in the program and inter-polate the profiles to the same altitudes as the radiosonde (or new model atmosphere) data.

The additional aerosol options on the MODEL 7 card have been added primarily to provide more user flexibility in modeling altitude-dependent aerosols such as low ground fogs where finer altitude resolution is required to specify the aerosol profile. These options are categorized as follows:

(a) AIIAZE > 0, VIS1 = IHA1 = ISEA1 = IVUL1 = 0

For this case, the program will use the value of AHAZE at the altitude, Z, to define the aerosol profile. The parameters on CARD 1 will be used only to select the type of aerosol extinction coefficients to be used in the (0-2 km), (2-10 km), (10-30 km), and (30-100 km) altitude regions as in the MODEL=1 to six cases. VIS on CARD 1 is not used. The user must scale the AHAZE values to the proper sea-level meteorological range.

(b) AHAZE > 0, either IHA1 > 0 or IVUL1 > 0, ISEA1 = 0

where IHA1 = 1 to 9 with the same extinction coefficient options as IHAZE in Section 8.2, and IVUL1 = 1 to 5 with the same extinction coefficient options as IVULCN in Section 8.2. When IHA1 is defined, it will select the type of extinction coefficient to be used with AIIAZE at the altitude, Z, and correspondingly when IVUL1 is defined. Only four different altitude regions are allowed for the aerosols in the program. The boundary altitudes are determined from the altitude, Z, on the MODEL 7 card when either IHA1 or IVUL1 changes value. These boundaries do not necessarily have to correspond to the default values in the standard models.

(c) AHAZE = 0, either one or all of the parameters VIS1, IHA1, ISEA1 and IVUL1 defined

where ISEA1 = 1 or 2 with the same seasonal profile options as ISEASN in Section 8.2. The aerosol profiles and extinction coefficients will be determined by the values of these parameters at each altitude Z. Again, as in (b) only four altitude regions for the aerosols are allowed in the program, with the boundaries of the regions determined by the altitude Z when the control parameters change. Note also that IHA1 takes precedence over IVUL1 in the selection of the type of extinction coefficients. Examples of the use of these aerosol options are shown in Section 9.

Although data for cloud extinction is not provided in the LOWTRAN code, these additional aerosol options do allow for user cloud modeling in the atmosphere with the aerosol control parameters on the MODEL 7 card.

Note that IHAZE must be defined to some initial value greater than zero to calculate aerosol extinction and that at least two altitudes are needed to define an aerosol altitude region.

8.3.2 HORIZONTAL PATHS (MODEL = 0)

If meteorological data are to be used for horizontal path atmospheric transmittance calculations, then set MODEL = 0 on CARD 1. The following parameters can then be specified on CARD 2.

CARD 2 <u>H1</u>, <u>P</u>, <u>T</u>, <u>DP</u>, <u>RH</u>, <u>WH</u>, WO, <u>RANGE</u> (FORMAT 3F10.3, 2F5.1, 2E10.3, F10.3) where the above parameters refer to altitude (km), pressure (mb) ambient temperature ($^{\circ}$ C), dew-point temperature ($^{\circ}$ C), relative humidity (%), water vapor density (gm m⁻³), ozone density (gm m⁻³), and path length (km) respectively.

The format for the above card is similar to that for inputting radiosonde data (MODEL = 7). Again, it is only necessary to specify the quantities underlined with the solid line and <u>one</u> of the quantities underlined with the dashed line. The ozone density WO can be specified using the parameter M3 on CARD 1 if measurements are not available. In the latter case, a value will be calculated at altitude H1 based on the appropriate model atmosphere selected by M3.

The aerosol control parameters for the MODEL = 0 cases are on CARD1 as described in Section 8.2.

9. EXAMPLES OF PROGRAM OUTPUT

Seven cases, representative of different types of atmospheric slant paths, mode of program execution, and atmospheric and aerosol models are presented in this section. The input cards to the program for these cases are listed in Table 5. A description of the program output for each of the cases, calculated from LOWTRAN, follows.

<u>Case 1.</u> Calculate the transmittance from 900 to 1145 cm^{-1} in steps of 5 cm⁻¹ for a slant path from 20 km to space at a zenith angle of 90° , for the U.S. Standard model atmosphere, and a 23-km meteorological range for the rural aerosol model.

The output for Case 1 is given in Table 6. A message indicating the mode of execution of the program is printed as the first line of output. For this problem, execution will be in the transmittance mode.

The parameters defining the atmospheric slant path, model atmosphere, aerosol model, and wavenumber range are next printed out.

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Table 5. Input Cards for the Seven Test Cases

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Table 6. Program Output for Case 1

0.000 POGRAM MIL BE ERECUTED IN THE TRANSMISSION MODE 6 1 3 2 0 2 5 6 6 0.000 2 20.000 9.000 0.000 9 20.000 1145,000 5.000 SLANT PATH TO SPACE FROM ALTITUDE H1 = 26.000 KM, ZENITH ANGLE = 90.040 CEGREES

HP75 MCDEL = 23.0 KH VISUAL PAHGE AT SEA LEVEL

MODEL ATMORPHERE 6 * 1362 US STANDARD

VIS= 23,0KH HATE WOTTL 1 = RURAL

SEASPH = SPRIG SUMM

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				T. 7126-01	7.7765-05	2, 3A 75-1	6.0145-01	3.8226-83	8.604E-01	2.35 3E-04	2,520E-D?	
u P			275 100	2.1245-01	5. 40 OF-01	2-2846-03	4.8755-01	2.127E-03	7. 7926-01	2.129E-04	2.520E-03	
•			264.700	1.202-01	5 - 37 35 - 01	2.021E-03	3.9295-01	9.947E-04	7.D37E-C1	1.5215-04	2,3335-13	
f 16		616.600	262.200	7-1575-02	4.437E-01	1. 7756-03	3.1526-01	4.5046-04	5.342E-J1	2.729E-34	29-345772	
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15	9.00	308.000	220.700	2.77775-03	1.5806-01	2.131E-Q3	9.5906-02	4.079E+DE	3.616E-C1	5-752E-05	3. 3135-03	
	10.00	265.000	227.209	5.#97E-04	1.263E-01	2.556E-03	7.4126-82	1.1816-D6	2.201E-G1	6.654E-C5	4.20(E-C)	
2	11.60	227.000	216.000	2.362E-04	1.003E-01	3.4936-03	5. 681E+82	4.288E-07	2. 8236-G1	7.5256~U5	6.JE-C.	
14	12.00	194.000	216.650	9°226- 15	7.627E-02	4.0385-03	4.155E-62	1.543E-07	2.415E-C1	6.434E-05	7.45/6-05	
12	13-00	165-800	216.600	7.9195-05	5.794E-02	50-3620*M	3.0356-82	6.159E-DE	2.064E-01	5.4996-05	7.4335-02	
	14.00	141.700	216.605	1.5885-05	4.402E-02	4.2296-03	2.217E-02	2.415E-00	1.7645-01	4.694E-05	6.6675-01	
4	15.00	121-100	216.5C	1.1825-05	3.3445-02	4.389E-03	1.619E-82	1.769E-08	1.5C8E-C1	4.0166-35	6 - 2002 - 5	
-	16.00	107-500	216.450	P.591E-0E	2,5406-02	4.711E-03	1.1875-02	1.281E-G8	1.2665-01	3°433E-05	1.12002	
	17.03	66.500	216.600	6.435E-06	1.931E-02	5.162E-03	E. E. 7E - 03	9.3342-09	1,162É-61	2.9355-05	1.3C7E-C2	
0	16.00	75.650	216.600	4.778E-06	1.468E-02	5,541E~03	6.31£E-03	6. 749E- 85	5° 41 8c - 02	2,5196-05	1.4966-62	
	19.01	64 670	216.65	4.196E-06	1.1156-02	5.5926-03	4.617E-03	5.796E-09	E.051E-C2	2.145E-05	1.6755-62	
51	20.00	55.290	216.670	3.565E-06	5+4796-03	5. 204E-83	3,3755-03	4.3616-09	6.863E-CZ	1.6302-05	1.735-02	
22	21.00	47.290	217.615	3.3725-66	5,4092-03	5.4486-83	2.452E-D3	4.6866-09	5. B605-02	1.5595-05	1.7735-02	
53	22.00	60.470	216.670	3.41695-66	4. 850E-03	5.2485-03	1.7836-42	4.387E-49	4.9925-02	1.3296-05	1.8205-02	
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25	24.00	29,720	220.500	2.4045-06	2.7906-03	4.274E-03	9.48CE-04	3.876E-89	3.6335-62	9.0/3c-ne	1 • 55 CC - C	
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<pre>125 9.367697697672007 1.000 1.0000 1.0000 1.000264.159 1.0003 1273 9.2073697677 1.000 1.0000 1.0000 1.0000 0.507 0.009 1235 9.2073667677 1.0000 1.0000 1.0000 0.507 92.657 1.0001 1235 9.2073667677 1.0000 1.0000 1.0000 0.507 92.657 1.0001 1235 9.2073667 0.998997677 1.0000 1.0000 0.507 0.003 95.455 1.0001 1235 9.2073666 0.997677 1.0000 1.0000 1.0000 0.565 0.003 95.455 1.0001 1235 9.2073666 0.997677 1.0000 1.0000 0.0000 0.0000 95.657 1.0001 1235 9.2073666 0.997677 1.0000 1.0000 1.0000 0.565 0.012 97.5 1.0001 1235 9.2073666 0.997677 1.0000 1.0000 1.0000 0.0100 0.957 0.012 97.5 1.0001 1215 9.2073668 9996677 1.0000 1.0000 1.0000 0.0100 0.957 0.012 97.5 1.0001 1215 9.2073668 9996677 1.0000 1.0000 1.0000 0.0100 0.012 97.5 0.012 97.5 1.0001 1215 9.2073668 9996677 1.0000 1.0000 1.0000 0.012 0.000 1.0000 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000 0.0000 0.0000 1.0000 0.0000 1.0000 0.000</pre>	1 3 5 0	5464 4	0110.	156s *	.9770	.0744	1.0000	1.0000	1,0500	6356 -	- G - 3C	75 63LB	1. iu 2
1773 9.74576977 .97316679 1.0000 1.0000 1.0000 1.0000 25040094 0.0357 9.2467 1.0011 1773 9.7677757793397317661 1.0000 1.0000 1.0000 55020035 95.455 1.0001 9.7235 9.72474450993997577520 1.0000 1.0000 1.000099670035 95.455 1.0001 1.017 9.72797456993997516727 1.0000 1.0000 1.000099670034 95.455 1.0001 1.017 9.72797456993997516727 1.0000 1.0000 1.000099670034 95.455 1.0001 1.019 9.72797456993999416727 1.0000 1.0000 1.0000 1.0000 95.455 1.0001 1.019 9.4270666999416721 1.0000 1.0000 1.0000 1.0000 9.0019 95.455 1.0001 1.019 9.4270666999416727 1.0000 1.0000 1.0000 9.0019 95.10000 1.010 9.4264647299616771 1.0000 1.0000 1.0000 9.00120101 95.455 1.0000 1.010 1.0000 1.0000 1.0000 1.0000 9.00120101 1.0000 9.2677 1.0019 1.018 9.2666647299616771 1.0000 1.0000 1.0000 9.6670117 1.0.6495 1.0.0001 1.018 9.2666647299636771 1.0000 1.0000 1.0000 9.6770127 101.4596 1.0000 1.010 1.0000 9.677901260117 1.0000 9.0011 0.0000 9.0010100 9.6770127 101.4595 10101 1.11 8.2756793 9.997599930000 1.0000 1.0000 9.6770127 111.471 1.0000 1.0000 9.677 9.9173 9.9270000 1.0000 1.0000 9.6751 10100 1.0000 9.675 10117 1.0000 9.0770127 101.4595 10111 1.11 8.776703 9.9174 9.99757553 10000 1.0000 1.0000 9.6760127 101.4595 10111 1.11 8.776703 9.9174 9.9972 7.716 10000 1.0000 1.0000 9.6760127 101.4595 10111 1.11.6 8.775703 9.9174 9.912 7.7159 10000 1.0000 9.675 10101 1.0000 9.675 10111 1.11.750703 9.9174 9.9972 7.716 10000 10000 9.675 10112 10100 9.675 10112 10100 10000 10100 10100 9.675 10112 10100 9.675 10112 10100 9.675 10112 10100 10100 10100 9.675 10112 10100 9.675 10000 10100 10100 9.675 10112 10100 10100 10100 9.0754 10000 10100 10100 10100 10100 9.675 1	5907	463ž *6	190U-	166°.	975e	.0976	1.0000	1.0000	1.0330	1056.	.0092	64.1590	10000.1
<pre>1375 9_2027 (*754 9997 9727 5229 1.0001 (1000 1.0000 1.0000 9562 1.0000 1.0000 1375 9_2144 (-1093 9728 5567 1.0000 1.0000 1.0000 9565 1.0001 1375 9_2144 (-1093 9942 5567 1.0000 1.0000 1.0000 9565 1.0001 1375 9_21244 (-1093 9942 5577 1.0000 1.0000 1.0000 9589 0109 95.475 1.0001 1375 9_2097 9994 6577 1.0000 1.0000 1.0000 9589 0109 95.475 1.0001 1315 9_2097 9994 6577 1.0000 1.0000 1.0000 9589 0109 95.475 1.0001 1315 9_2097 9994 6577 1.0000 1.0000 1.0000 9589 0109 95.475 1.0001 1315 9_2097 9994 6577 1.0000 1.0000 1.0000 9589 0109 95.475 1.0001 1315 9_2097 9995 9995 6577 1.0000 1.0000 1.0000 9589 0117 10.055 92.774 9997 9995 6571 1.0000 1.0000 1.0000 9589 0117 10.055 1215 9_2099 (-1729 9999 6559 1.0000 1.0000 1.0000 9589 0117 10.055 1215 9_2099 (-1729 9999 6559 1.0000 1.0000 1.0000 9589 1215 9_2099 (-1729 9995 6559 1.0000 1.0000 1.0000 9589 1215 9_2099 (-1729 9995 6559 1.0000 1.0000 1.0000 9589 1215 9_2099 (-1728 9995 6559 1.0000 1.0000 1.0000 9589 1215 9_2099 (-1729 9995 6559 1.0000 1.0000 1.0000 9589 1000 1.0000 9586 1000 1.0000 1.0000 9586 1000 1.0000 9586 1000 1.0000 9586 1000 1.0000 9586 1000 1.0000 9586 1000 1.0000 9586 1000 1.0000 9586 1000 1000 9586 1012 111.999 111.791 111.793 111.791 111.793 111.701 100 1000 9581 1000 10000 9586 1013 111.701 111 11.993 111.701 100 1000 1000 1000 1000 1000 10</pre>	C 1 3 7	9°3"28		1660°	.9731	.1658	1.000	1.0360	1616.1	+ - 5 5 4	*0°0*	60.3556	1.5422.44
<pre>133 9.4674 4630 993 9754 6509 1.0000 1.0003 9569 0101 95450 1.0003 133 9.478 4651 9939 9972 6573 1.0003 1.0000 1.0003 9569 0101 95476 1.0003 1337 9.4734 9511 9943 9941 6677 1.0003 1.0000 1.0003 9569 0101 95476 1.0003 1339 9.4594 9595 9994 6577 1.0003 1.0000 1.0003 9693 0104 97475 1.0003 113 9.4594 9945 9993 6577 1.0003 1.0000 1.0003 9693 0112 97477 1.0003 113 9.4594 9945 9993 6577 1.0003 1.0000 1.0003 9693 0117 1554 1.0003 113 9.4594 1.4793 9993 6577 1.0003 1.0000 1.0003 9673 0117 116 4855 1.0003 113 8.2564 1.4472 9993 6577 1.0003 1.0000 1.0000 9677 0112 116.4855 1.0003 113 8.2564 1.4472 9993 6579 1.0000 1.0000 1.0000 9677 0117 1.6 4855 1.0003 115 8.2964 9.997 9993 6579 1.0000 1.0000 9677 0117 1.6 4855 1.0003 115 8.2964 9.997 9993 6579 1.0000 1.0000 9677 0117 1.6 4855 1.0003 115 8.2964 9.997 9993 1.4000 1.0000 1.0000 9677 0117 1.6 4855 1.0003 115 8.2964 9.997 9993 1.4000 1.0000 1.0000 9677 0117 1.6 4855 1.0003 115 8.2964 9.997 9993 1.4000 1.0000 1.0000 9675 0117 1.6 4855 1.0001 116 8.775 7.999 9972 7.5991 1.0000 1.0000 1.0000 9664 0117 1.6 4855 1.0001 116 8.775 7.999 9972 7.559 1.0000 1.0000 1.0000 9665 0.0137 111.571 1.0000 1.0000 9656 0.0137 1.0000 9665 9013 7.0000 1.0000 1.0000 9656 0.0137 111.0372 100.001 1.0000 9656 1.0000 1.0000 1.0000 1.0000 9656 0.0137 1.0000 1.0000 9656 0.0137 111.0372 100.000 1.0000 1.0000 9656 0.013 9000 1.0000 1.0000 9656 0.0137 1.0000 9555 1.0000 1.0000 1.0000 1.0000 9655 0.0130 9655 1.0000 1.0000 1.0000 9656 0.0137 1.0000 9555 1.00001 1.0000 1.0000 1.0000 1.0000 1.0000 9555 1.0000 1.0000 1.0000 1.0000 9555 1.00001 1.0000 1.0000 1.0000 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.0000 1.0000 1.0000 9555 1.0000 1.0000 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.00000 1.0000 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.00000 1.0000 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.00001 1.0000 9555 1.00000 1.0000 1.0000 9555 1.00</pre>	1375	5.302 - 5	1135	- 9997	.512.	• 52 29	1900	1.0900	1.0000	2055*	1900.	50.0386	1 0 0 0 1
1335 9.2 Zick 64.4 To 9922 66.7 L0000 1.0000 24.4 To 1001 1001 24.4 To 1001 24.4 To 1001 1001 24.4 To 1001 1001 24.4 To 1001 1001 24.4 To 1001 <td< td=""><td>1 0 1</td><td>10-12-6</td><td>1901 L .</td><td>\$66c*</td><td>*316*</td><td>6503</td><td>1.0000</td><td>1+3369</td><td>1.0053</td><td>1956.</td><td>5620*</td><td>92.6955</td><td>1. Lu. J</td></td<>	1 0 1	10-12-6	1901 L .	\$66c*	*316*	6503	1.0000	1+3369	1.0053	1956.	562 0*	92.6955	1. Lu. J
<pre>133 9.1749 +551 +597 9947 -6727 1.0030 1.0000 1.0000 -5695 .0100 95.457 1.0001 139 9.2599 .6460 -997 9941 .6777 1.0000 1.0000 1.0000 .5699 .0159 97.775 1.0000 1115 9.2599 .6460 -9959 .9973 .6771 1.0000 1.0000 1.0000 .9899 .0116 101.214 1.0001 1115 9.2599 .6460 -9956 .9998 .6571 1.0000 1.0000 1.0000 .9891 .0112 112.9357 1.0001 1.113 9.2599 .6472 .9966 .9996 .6571 1.0000 1.0000 1.0000 .9877 .0112 112.9357 1.0001 1.113 8.2566 .6472 .9966 .9995 .6591 1.0000 1.0000 1.0000 .977 .0112 112.9357 1.0001 1.113 8.2566 .6472 .9996 .6591 1.0000 1.0000 1.0000 .977 .0112 112.64959 1.0001 1.113 8.2666 .6473 .9995 .6591 1.0000 1.0000 1.0000 .977 .0112 112.64959 1.0001 1.113 8.2466 .6473 .9995 .5599 .6501 1.0000 1.0000 .977 .0112 112.6495 1.0001 1.115 8.3469 .6779 .9995 .9946 .5519 1.0000 1.0000 0.967 .0112 112.6495 1.0001 1.115 8.3469 .6779 .9995 .5519 1.0000 1.0000 1.0000 .977 .0112 112.912 112.000 1.115 8.3469 .6779 .9956 .9956 .5100 1.0000 1.0000 0.9666 .0112 111.7671 1.0000 1.0000 1.0000 .9775 .0112 111.7671 1.0000 1.0000 1.0000 1.0000 .9666 .0112 1.0000 1.0000 0.9666 .0112 111.371 1.0000 1.0000 1.0000 9.665 .0000 1.0000 1.0000 9.666 .0113 111.2720 1.0000 1.0000 9.666 .0113 1.0000 1.0000 9.666 .0112 1.0000 1.0000 9.666 .0113 111.3721 1.0000 1.0000 9.666 .0113 1.0000 1.0000 9.666 .0112 1.0000 1.0000 9.666 .0113 111.3720 1.0000 9.655 .7000 9.9750 .7000 9.9956 .9995 .5150 1.0000 1.0000 9.666 .0113 1.11.372 1.0000 9.655 .7000 9.0000 1.0000 1.0000 9.666 .0113 1.0000 9.666 .0112 1.0000 1.0000 9.666 .0112 1.0000 1.0000 9.666 .0112 1.0000 1.0000 9.656 .0000 1.0000 9.656 .0000 1.0000 1.0000 9.655 .0000 1.0000 1.0000 9.655 .0000 1.0000 9.655 .0012 9.0012 9.0000 1.0000 1.0000 9.656 .0000 1.0000 1.0000 9.655 .0012 9.0000 1.0000 9.655 .0012 9.0000 1.0000 1.0000 9.655 .0012 9.0000 1.0000 1.0000 9.655 .0012 9.0000 1.0000 1.0000 9.655 .0012 9.0000 1.0000 1.0000 9.655 .0012 9.0000 1.0000 9.655 .0012 9.0000 1.0000 1.0000 9.655 .0012 9.0000 1.0000 1.0000 9.655 .0012 9.0000 1.0000 9.655 .0012 9.00000 1.0000 1.0000 9.655 .0012 9.0000 1.0000</pre>	5807	9.2155	.4450	96to .	. 5822	.5637	1.0000	1.0000	1.3000	9625	.010.	61.4.45	1,0003
1)35 9.1372 4.655 -995 9941 6672 1.0070 1.0010 1.0020 5.675 0.0174 95.375 1.0201 110 9.2679 4.646 9959 9973 5677 1.0020 1.0010 1.0005 9953 101621 1.0101 111 9.267 4.647 9993 6671 1.0001 1.0010 1.0010 9651 0017 112.9495 1.0101 111 9.266 4.477 9996 6671 1.0000 1.0010 1.0010 9651 0017 112.9495 1.0101 111 9.276 4.477 9995 6671 1.0000 1.0010 1.0010 9671 0017 112.9495 1.0101 111 8.275 4.477 9995 6671 1.0000 1.0010 1.0010 9671 0017 112.8495 1.0101 111 8.275 4.477 9995 6671 1.0000 1.0000 1.0000 9665 0017 111.716 4.0010 1.11 8.475 4.477 9961 6571 1.0000 1.0000 1.0000 9676 0017 111.6495 1.0000 1.11 8.475 4.477 9961 6571 1.0000 1.0000 1.0000 9676 0017 111.6495 1.0000 1.11 8.475 4.470 9973 9961 5772 1.0000 1.0000 9666 0017 111.671 1.0000 1.0000 9666 0013 111.671 1.0000	CECT	9.1743	1556.	2060.	51.6	.67 27	1.0000	1.5400	1.4035	9595 *	- 0703	96.1053	
<pre>113 9.4559 6640 7956 9973 6677 1.0001 1.0001 9893 0016 19.454 1.0001 115 9.4569 6647 9944 9992 6657 1.0001 1.0001 9893 0016 11.244 1.0001 1113 9.4569 647 9944 9992 6657 1.0001 1.0000 1.0001 9693 0012 112.945 1113 9.4564 9944 9995 6659 1.0001 1.0001 1.0001 1.0012 112.9455 1.0011 1113 8.455 6479 9959 6659 1.0001 1.0001 1.0001 1.0012 112.9455 1.0011 1115 8.4699 6417 1.0001 1.0001 1.0010 9677 0112 110.6951 1.0011 1115 8.4699 6411 9959 6599 1.0001 1.0010 1.977 0112 110.6951 1.0011 1116 8.775 6411 9956 9959 6599 1.0000 1.0010 1.0000 9566 0112 111.571 1.0001 1146 8.775 6411 9958 9958 5714 0000 1.0010 1.0000 9566 0112 111.571 1.0000 1.000 1.0001 9661 9922 7746 1.0000 1.0000 9566 0112 111.571 1.0000 1.0001 1.0001 9655 9958 9958 9923 1.0000 1.0000 1.0000 9566 0113 111.571 1.0001 1.445 8.775 774 919 9978 9978 9978 5714 0000 1.0000 1.0000 9566 0012 111.571 1.0001 1.0001 1.0000 1.0000 1.0000 9566 0112 1.0000 1.0000 1.0000 9566 0012 111.571 1.0000 1.0001 1.0000 0</pre>	195	9.1324		-660.	1 4 6 6 *	+6727	1.0020	1.0000	1.0003	• 5632	•0124	9748779	1.0201
1115 9.5.46 H. 4646 9948 667 1.0000 1.0000 1.0000 1.000 1.000 1.0000 0.000 1.00	1011	9.00.0	19 F 8 3	566c°	2465.	.6773	1-000	1.0700	1.000	. 9854	20101	111111111111111111111111111111111111111	1.0000
<pre>11: 3 9.2059 .6548 .9944 .9946 .657 1.0200 1.0000 1.0207 .9651 .0127 112.94591 1.01001 11: 3 9.564 .6472 .9994 .5998 .6571 1.0000 1.0000 1.0000 .9677 .0117 1.6 4859 1.01001 11: 3 8.4549 .6471 .9967 .9989 .6599 1.0000 1.0000 1.0000 .9977 .0117 1.6 4859 1.0101 11: 3 8.4959 .6411 .9957 .9989 .6599 1.0000 1.0010 1.0100 .9977 .0127 110.9917 1.0.000 11: 8.1756 .4713 .9957 .9981 .6577 1.0000 1.0100 1.0100 .9676 .0127 111.91917 1.0.000 11: 8.7756 .7793 .9958 .9950 .5727 1.0000 1.0100 1.0100 .9666 .0127 111.5671 1.0000 1.010 8.7756 .7793 .9958 .9958 .5728 1.0000 1.0100 1.0100 .9666 .0127 111.5671 1.0000 1.010 8.7756 .7793 .9958 .9958 .5728 1.0000 1.0100 1.0100 .9656 .0127 111.5671 1.0000 1.0100 .9661 .0127 111.5671 1.0000 1.0100 .9656 .0127 111.5671 1.0000 1.0000 1.00001 .00001 .0000 1.0100 .9658 .0127 111.3003 1.00001 1.0100 .9655 .0127 113.303 1.00001 1.0000 1.00001 .00001 .0000 1.01001 .0000 .0000 1.01000 .9655 .0148 113.5629 1.00001 1.0100 .9655 .0148 113.569 1.00001 1.0000 1.00001 .00000 .00001 .00001 .00001 .00001 .00001 .00000</pre>	1105	9.0498	.1645	556o°	2666-	.6727	1.000	1.0000	1.0000	2 696°	-010-	101.2.144	1.5051
111 0.9.5.4.4.79.9.49.9.46.5.1. 1.0000 1.0000 1.0000 1.0.012 0.01.2. 1.00.455 1.0.001 1110 0.9.5.44.4.59.9.49.9.46.0.1.0000 1.0000 1.0000 1.0.020 1.0.6.455 1.0.001 1115 0.4.9.44.9.49.9.49.9.56.4.7 1.0000 1.0000 1.0000 -9.77 0.122 1.0.6.456 1.0000 1115 0.4.9.44.6.19.9.59.9.16.5.0.1.1.0000 1.0000 -9.77 0.122 1.0.0.9.5 1114 0.4.7.64.6.29.9.57.75 1.0000 1.0000 1.0000 -9.6.5 0.01.7 1.0000 1.4.000 1.0000 9.6.5 0.01.7 111.7.71 1.0000 1.4.0000 1.0000 9.6.5 0.0000 1.0000 9.6.5 0.01.7 111.7.7 1.0000 1.5.000 1.0000 9.6.5 0.01.7 111.7.7 1.0000 1.5.000 1.0000 9.6.5 0.0000 1.0000 9.6.5 0.01.7 11.0000 9.6.5 0.01.7 11.0000 1.5.000 1.0000 1.0000 9.6.5 0.0000 1.0000 1.0000 0.0000 1.0000 0.0000 1.5.000 1.0000 1.0000 1.0000 1.0000 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000 0.0000 1.5.000 1.0000 1.0000 1.0000 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000 0.0000 1.0000 0.0000 0.0000 0.0000 1.0000 0.0000 1.0000 0.0	5113	9.0051	. 6558	* 38ct	• 9996	. 66 <i>3</i> 7	1.0000	1.4009	1.0000	.9891	.610.	1.2.9352	
1:10 8.9526 .4436 .4436 .9995 .6509 1.0000 1.0000 1.0000 9577 .0127 16.4436 .14440 .15 8.9599 .7779 .9919 .6579 1.0000 1.0000 .977 .0122 106.7966 1.0000 .1710 1.0100 .977 .0127 106.7966 1.0000 1.010 1.0100 .977 .0127 111.7671 1.4441 .1710 1.1710 1.4611 .1710 .111.7671 .1410 .1710 .1710 .1710 .1710 .1710 .1710 .1710 .1710 .111.7671 .1410 .1710 .1710 .1710 .1710 .1710 .1710 .111.7671 .1410 .1700 .1710	5112	8, 5F.Ar	51 13	566֥	9665.	• 65 51	1.6000	1.0000	1.0033	.9567	•0112	104-695	1.0001
<pre>Lif 8.4549TY</pre>	1110	8.9254	•F-425	9665-	\$666°	.65 09	1.0000	1.0003	1 C .	2985 -	.0117	1.6 4855	1.0.43
113 0.4945 0.6411 0.952 0.998 0.553 1.4000 1.010 1.010 0.4072 0.427 111.0421 1.0000 1.010 1.010 1.0100 0.656 0.112 0.012 111.7871 1.0000 1.010 1.010 1.0100 0.656 0.112 1.01000 1.010 1.010 1.0100 0.656 0.112 0.112 0.112 0.1000 1.010 1.010 1.0100 0.656 0.112 0.112 0.112 0.1000 1.010 1.010 1.0100 0.656 0.013 111.2871 1.0000 1.010 1.0100 0.656 0.013 111.2871 1.0000 1.0100 1.0100 0.056 0.013 111.010 1.0100 1.0100 1.0100 0.055 0.012 1.0100 1.0100 0.656 0.013 111.2871 1.0000 1.0100 1.0100 0.055 0.0142 1.01000 1.0100 1.0100 0.055 0.0142 1.01000 1.0100 1.0100 0.055 0.0142 111.0100 1.0000 1.0100 1.0100 0.055 0.0142 1.0100 1.0000 1.0100 1.0100 0.055 0.0142 1.01000 1.0000 1.0100 1.0100 1.0100 0.055 0.0142 111.0100 1.0000 1.0100 1.0100 1.0000 1.0100 1.0100 1.0100 1.0100 1.0100 1.01000 1.0100 1.0100 1.0100 1.0100 1.0000 1.0100 1.0000 1.0000 1.0100 1.0000 1.0	ur	8.8539	6124.	1565.	5865.	. 64 67	1.0000	1.000	1.0000	.9877	•0122	.06.2966	1.0000
ITT 6.6104 .4408 .4996 .5727 1.4000 1.010 1.000 9966 .012 11.1871 1.4009 144 8.770 .7003 .9968 .9922 .7166 1.0000 1.0000 1.0000 .9661 .0137 113 2029 1.447 144 8.735 .741 .9999 .9872 .7156 1.0000 1.0000 .9661 .0137 113.2029 1.447 2.7154916 .7302071204 F07M 907 0 1146 CM-1 = 113.93AVERAGE FRANSMITIANCE = 5555	1130	36435 8	1140.	1962.	5966 *	. 6509	1.0000	1.40300	1,900,1	5796 .	1220	110.0912	1 1
I:40 8.7710 .7023 .9958 .9928 .7166 1.0000 1.0000 .9561 .0137 113.2029 I.0000 116 8.735 .7413 .9959 .9872 .7593 1.0000 1.0000 .9655 .0142 113.9303 1.0000 Interation form 901 of 1146 GM-1 = 115.93AVERAGE TRANSMITIANCE = 5553	51:2	6.610f	90.25	9660°	.996.	. 57 27	1.0000	1.5303	1,0000	•9366	.0132	111.7871	1.00001
1145 8,7235 ."413 ,9956 ,9672 .7519 1.0000 1.0000 .9555 .0140 1.0002 .2555 .0142 Tattigtet assorbtion form 907 for 1145 CM-1 = 113.938423465 TRANSMITTANCE = 5553	3 4 7 1	8.77°0	6004*	9666.	-9922	.7156	1.0000	1.0003	1.9600	.9661	.013	113 2029	
INTERPARTED ASSORPTION FORM 913 TO 1145 CM+1 = 113,938VERAGE TRANSHITTANCE = \$5353	1145	8,7235		966e°	.9872	.7519	1.0000	1.0000	1.0003	.9855	. 0142	113.9303	1.0003
	INTERPATED APSO	RPTICH FORM	0, 006	1145 CM-1	= 11.	5.93AVERA	SE TRANSP	TTANCE =	• 5353				

Following the heading HORIZONTAL PROFILES are two pages of output, each of 12 columns. On the first page, the first four columns list a running integer associated with each level (level indicator), the level altitude in km, the level pressure (mb), and the level temperature (O K). The next six columns give the equivalent absorber amounts per km for the following absorbing species: water vapor, uniformly mixed gases, ozone, nitrogen continuum, water vapor continuum (10 μ m), and molecular scattering. The last two columns give the mean refractive index modulus (n - 1) from that level to the level above, and the equivalent absorber amount per km for the UV ozone.

On the second page, the first four columns, listing the level indicator, altitude, pressure, and temperature are repeated. The next two columns give the equivalent absorber amount per km for the water vapor continuum (4 μ m) and for nitric acid. The next four columns give the aerosol amounts per km for the four altitude regions provided for in the program. The last two columns list the product of the aerosol density times the percent relative humidity and the percent relative humidity for the boundary-layer region.

Following the horizontal profiles, level information at H1 calculated in subroutine POINT is printed.

A heading VERTICAL PROFILES is then printed followed by two lines of output per atmospheric layer. The first column is an integer level indicator. The second column gives the altitudes of the levels traversed by the atmospheric slant path. The next eight columns give the integrated equivalent absorber amounts from the initial altitude to the level above (with the species identified as in the header). The next four columns are labelled PSI, PHI, BETA, and THETA, and correspond to the angles ψ , ϕ , β , and θ described in Section 4. Columns PSI and BETA give the accumulated values of ψ and β to the level above. Columns THETA and PHI give the local zenith angle corresponding to that level and the angle of arrival at the level above, respectively. In the last column, the accumulated slant range, RANGE, is printed, and below it the differential slant range of the levels traversed.

The total equivalent absorber amounts along the atmospheric path are then summarized in their appropriate units.

Control parameters for the altitude-dependent aerosol extinction and absorption coefficients are then printed from Subroutine EXABIN.

A transmittance table, containing 13 columns, now follows. The first three columns give the frequency (cm⁻¹) wavelength (μ m), and total transmittance. The next seven columns show the individual transmittance due to water vapor, uniformly mixed gases, ozone, nitrogen (4 μ m) continuum, total water vapor continuum, molecular scattering, and total aerosol extinction. The next two columns give absorption due to aerosols and the cumulative integrated absorption. The latter

quantity can be used to determine the average transmittance over any given spectral interval within the spectral range covered by the calculation. The last column gives the transmittance of nitric acid. Finally, the total integrated absorption from V1 to V2 is printed out (units are cm⁻¹) together with the average transmittance over the band.

<u>Case 2</u>. Calculate the radiance at H1 for the same conditions as in Case 1. The output of the program, shown in Table 7, is identical to that of Case 1 up to and including the printing of the aerosol control parameters.

Two parameters, J1 and J2, are then printed out. These parameters control the loading of the cumulative absorber amounts into the matrix, WPATH.

A heading CUMULATIVE ABSORBER AMOUNTS FOR THE ATMOSPHERIC PATH is then printed followed by 16 columns. The first column gives an integer associated with the layer traversal by the atmospheric slant path. The following 10 columns give the cumulative absorber amounts for the following species: water vapor, uniformly mixed gases, ozone, nitrogen continuum, water vapor continuum (10 μ m), molecular scattering, aerosol extinction (boundary layer), UV ozone, water vapor continuum (4 μ m) and nitric acid. The next column is the average temperature of the layer.

Below this output, the layer ID is repeated and the other three altitude-dependent, cumulative acrosol absorber amounts are printed.

A radiance table, containing six columns, now follows. The first two columns give the frequency (cm^{-1}) and the wavelength (μm) . The next two columns give the radiance in units of W/cm²-ster-cm⁻¹ and W/cm²-ster-un. The next column gives the cumulative integrated radiance (W/cm²-ster). The last column is the total transmittance.

Finally, the maximum and minimum radiances and their frequencies, the integrated absorption, the average transmittance, and the total integrated radiance are printed.

Case 3. Calculate the transmittance from 900 to 1145 cm^{-1} in steps of 5 cm⁻¹ for a 1-km horizontal path at sea level, using the U.S. Standard atmosphere and the rural, 23-km meteorological range, aerosol model.

The output for Case 3, shown in Table 8, with the exception of the omission of the vertical profiles, is similar to that described for Case 1.

<u>Case 4.</u> Calculate the transmittance from 900 to 1145 cm⁻¹ in steps of 5 cm⁻¹. for a slant path from 12 km to ground (0 km) at a zenith angle of 180° , using the midlatitude summer model atmosphere and a maritime, 23 km meteorological range acrosol model.

The output for this case, shown in Table 9, is similar to that described for Case 1.

Table 7. Program Output for Case 2

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HAZE MODEL = 23.0 KM VISUAL RANGE AT SEA LEVEL

DOMELAT*OSPHEDE 6 = 1362 US STANDAPE

HAZE MCCCL 1 = RUPAL VIS= 23,0KM

SEASON = SPAIS CUMM

VERTICAL PROFILE AEROSOL MODEL = STRAT BKGR

FPEINENCY RAVEE V1= AGA.D MA+1 TO V2= 1145.D CM−1 FOR DV = 5.D CM−1 (8.73 + 11.11 MICRONS)

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P1	1.440	833.503	0.9.19.2	3.719E-C1	7.7765-91	2.3076-03	6.014E-D1	3.632E-03	8.604E-01	2.3535-04	2.52LE-L3
м	2.5	20. 267	275.100	2.3245-01	5.48 DE -01	2.2845-93	4.6756-01	2.127E-03	7.7926-01	2.129E-04	2.520E-07
đ	1.00	701.230	244.703	1.302E-01	5.2735-01	2.021E-03	3.3256-81	9.847E-04	7.0375-01	1.9216-04	2.333E-D?
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đ	00 ° 0	240.53	254, 736	20-3942-23	3.6435-01	1.592E-03	2.515E-01	1.327E-C4	5.70JE-11	1.5526-44	2.147E-C.
Þ.	6.00	472.293	302°642	1.907E-02	2.9535-01	1.576E-33	1,995E-01	8.679E-05	5.1056-01	1.3906-04	2.100E-03
a 1	7.05	411.100	242.710	0-335 F.D	2.4285-31	1.632E-03	1.F73E-01	3.5596-05	4.5675-51	1.2416-34	2.267E-C2
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•	9.00	303.605	229.700	1.77"E-02	1.58vE-01	2.131E-D3	3.5905-02	4.0795-06	3.616E-01	9.7922-05	3.313E-02
:	16.00	255.000	223.200	5-397E-04	1.2435-01	2.548E-03	7.412E-02	1.1815-06	3.201E-01	8.6542-35	4.200E-03
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	3 0215-010 3 0215-010				16-32348/	10-3561-3	9.79:5-04	2 0 2 0 2 0 2			20-3230*2	1.0176-13	1.0175-33			2.0-3/11.5		1543	3.	;	J.		• 17		•	ц.					•
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		œ	ADIANCE (HATTS	/CH2-STEP-XXX	-	
	EF (CH-1)	WAL (MICRON)	PER CH-1	FEF HICRON	INTEGRAL	TRANS
	0005	11.11111	.15164E-06	.130936-04	•4 341 GE-GE	ee1126°
	3-5-6	11.049724	.12192E-06	•55852E-95	.1013?E-05	947745
	910.0	110696.01	.13297E-U6	.85266E-05	.15285E-O5	.955162
	915.0	10.928962	.85637E-07	.72534E-25	.19617€-D5	\$61666
	0.026	10.069565	.60854E-07	. 51507E-05	2 2 6 6 4 E - 0 5	.972621
	925.0	10.510211	.265775-07	.22740E-05	+ 2 358 8E - 05	.987833
	630.9	10.752685	.31905E-07	.27594E-05	•25584E-05	.945119
	3 S S S	16.695187	.33754E-07	 34754E+05 	*27571E-05	.981171
	C • 1 + 6	1. 638298	-47C81E-07	.43601E-45	* 2 3 5 2 5 5 - 0 5	.977301
	0 4 4 5 9 4 9 4	110264.01		**************************************		
	0.010	10.526316	.15285E-06	•13795E-04	**036E*05	E22626
	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1001140NT	* 2 2 2 3 2E - 10	* N= 271027 -	60-306576.	TT4510.
	0.000	100014101	90-301226*	**************************************		576457
	1.070	10.2020C • CT			-118205-03	276579
	975.0	13.256410	• 57475E-06		.151946-04	634653
	0.040	11.204082	. 83156F-56		196015-01	-511063
	995	10.157786	10724E-D5	-10405E-03	-249646-04	393142
	0.00	10-10:010	12275F-15	150316-03	314010-04	-277756
	995.0	10.050251	.12792E-05	.126655-03	.37497E-04	.227030
	10001	10.00000	13341E-05	.133415-03	.44168E-34	.174697
	1005.0	9,950249	-13591E-05	.137285-03	•50564E-04	.140230
	1513.	966096 *6	.13670E-U5	20-36521.	+57833E-04	.116348
	1015.8	3.852217	.137196-05	.14134E-03	•64662E-D4	.095201
	10 20 .0	3.803922	.13F14E-05	.141646-03	.71469E-D4	.083967
	1025.5	9.756098	*1.540 BE-05	.140075-03	.78173E-04	. 634534
	1010.0	9°24802 * 6	.137006-05	.14004E-B3	-94773E-04	277442
	1035.9	3.651836	.1322DE-05	.14161E-03	• 31383E-04	055971
		9.615385	-12896E-05	.13948E-33	.57231E-04	.063006
		9,56578	.120106-05	27-352721 2	.1 C364 E - D2	
	10-0-0	9.523410	.123596-05	•1?€26E-33	•11002E-03	.0500.51
	10 45.9	9.478673	.12228E-05	.126105-03	•1116136-07 • 37815 83	672650.
	1,0401	306204 40 2002		50-31262T.	• • • • • • • • • • • •	7557777
	1.275.31			00-310611 *		50205
	10 61 - 0	9.259259	.46800E-06	54597E-04	.13649E-03	.628418
	1765.0	9.216590	•44050E-05	.51856E-04	.14059E-03	- 645 C 48
	1992.0	3.174312	.41827E-CF	40-346954.	5C-38274T.	.65707E
	1095.3	9.132421	• 4 3 F3 4E - 0 6	. 4 8 E C 1 E - 0 4	• 1 4431 E - 0 Z	661553
	1190.0	606060 6	.39F39E-06	472385-04	.146766-03	.667575
	0.4011		• 565564E=U6 26544E=06	. 4/2055-U+		01010100 9700100
		011110 T	10.28E-16		- 1 5 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	
	1:20.7	8.92 2571	-38734E-06	- 48588E-04	15453E-02	542639
	11 25 . 0	6.58889	. 3452E-65	• 4 6 6 6 5 E - 0 4	•15645E-ū3	,637£66
	1131.0	3.849555	• 37 11 3E - 06	.477725-04	•15632E-C3	642652
	1135.0	8.810573	.348085-36	+C-375857.	.16006E+03	.660839
	1140.0	3,771930	, 331.24E-06	.391496-04	.16157E-D3	.700852
	1145.6	3 . 733624	.255156-06	• 35421-04	162215-03	*10142°
INTEGRATED ABSORPTION FROM	90 IO 114	5 CH-1 = T:	13.934VERAGE	"PAN SHIT TANCE	≠ . 535C	
I.J.ESRATED PADIANCE = +162 Pashiji pare par sing singt	215-0;48TT 07	CH -? SR				
101/101 001/000 101/101 101/101 001/01	5 C F 1					
2						

Table 8. Program Output for Case 3

FR3CR1M MILL BE EXECUTED IN THE TRAJENISSION MODE 6 1 1 3 0 20 0 3 7 3 0 4900 0.000 0 0.000 903.003 1145.303 5.000 HORIZCHTAL PATH, ALTITUR = 0.010 KM,RANGE = 1.000 KM

HAZE MCOFL = 73.0 KM VISUAL RANGE AT 55.4 LEVEL

HOJEL & 140544545 6 = 1962 US STANDARD

HA75 MCDEL 1 = RJRAL VIS= 23.0KH

HHNS VIEDS = HUSE BS

VERTICAL PROFILE AFROSOL MODEL = STRAT EKGP

FREQUENCY RANGE VI= 90140 CM-1 TO V2= 1145.0 CM-1 FOR DV = 5.0 CM-1 1 8.73 - 11.11 MICRONS)

	(AD)	20E-03	20E-03	20-302	133E-03	47E-63	47E-13	0.0E-03	87E-G3	27E-03	136-03	101E-03	67E-C3	672-13	133E-JJ	167E-03	G 0E - 03	1205-02	0.12-02	936-32	532E-42	735-02	736-02	1205-02	736-05	50 DE - 0 2	50-318:	23-36 E S	E0-3EE1	20-3202	13.3E - 14	167E-04		10/1-02	
	ö	N	~	~		2	2.	2	2	N	-	4			-	5	å	-	-	4	-	-1	-		-	1	4		5	~	-	-			:
	(N-T)	2.595E-04	2.3535-04	2.1295-04	1.921E-D4	1.7295+64	1.5522-04	1.350E-04	1.2416-04	1.1.245-34	9.7 526 - 05	8.654E-05	7.5255-05	6.4346-05	5.4996-05	4 .699E-D5	4-016E-05	3.4336-0	2.9 355 - 35	2 • 5C 9E -0 5	2.145E-0	1.6306-0	1.5595-6	1.3296-0	1.1236-05	9.6736-06	6.502E-06	5.9885-16	1.330E-0	6.574E+07	3-328-01	1.239E-D7	9.78/E-U-	11-3846.C	;
	NCLS	9.4815-01	8.604E-01	1-1926-01	7.037E-01	6.3415-61	5.7.36-61	5.1096-01	4.567E-01	4.070E-01	Z. 6165-01	3.201E-01	2.823£-01	2.415E-01	E. 06 4E-01	1.764F01	1. 50 8E-01	1.288E-C1	1.102E-D1	5.41 8E-02	C.G51E-C2	6.883E-C2	5. 6602-02	4.992E-02	4.257É-C2	3.633E-92	3.102E-02	1.4256-02	6.551E-03	3, 055E- 02	1.5226-63	7-9505-04	6. 775E-05	3.862E+U7	•
	H20(10H)	6.5746-03	3.8326-03	2.1276-03	9.8476-04	4.5346-84	1.9276-84	6.6792-05	3.5595-05	1.567E-05	4.079E-06	1.18186	4.288E-07	1.5436-87	6.169E-08	2.415E-08	1.7695-08	1.281E-00	9.334E- 8 9	50-36+2.9	5°,796E-89	4,981[-09	4.686E-09	4.387E-09	4.171E-09	3.875E-09	3.560E-85	9.9446-10	1.9436-10	3.942E-11	9.676E-12	1.9226-12	1.653E-15	6.154E-2G	
	¥ 2	7.385E-D1	6. 514E-01	4.8856-81	3,9296-01	3.152E-01	2. 515E-01	1.9952~81	1.573E-01	1.232E-01	9.595E+82	7.412E-02	5. EÅ1E-02	4.1556-12	3.1356-02	2.217E-02	1.619E-02	1.183E-02	A. 647E-03	E. 310E-03	4. 617E-82	3.375E-03	2" 452E - 03	1.783E-03	1. JODE-03	9-4886-04	6.932E-04	1.479E+84	3.195E-05	7.192E-05	1.822E-G6	5.032E-07	3• 523E - 0 -3	1.0465-13	•
	03	2.4936+13	2,367E-13	2" 29HE-113	2.021E-13	1.7756-03	1.6926-33	1.576E-'3	1,6326-53	1. 6456-03	2.131E-03	2.558E-03	3.493E-03	4.034E-03	4.029E-03	4,229E-C3	5 3895-03	4.7116-03	5.152E-03	5.541E-CJ	5.692E-13	5. 8 046 -03	5.448E-C3	5. 248E-03	4.883E-83	4.2746-03	3.7936-03	1,642E-83	6.574E-84	2. 222E -04	5.882E-05	1. 07 2E - 15	8.259E-88	5.161E-12	
	C02+	3.294E-01	7.776E~01	10-3084.5	5.373E-01	4.4376-01	3,6485-01	2.943E-01	2.4286-01	1.964E-01	1.580E-81	1.263E-01	1.0325-01	7.627E-02	5.7945-02	4.452E- 07	3.344E-02	2.0-30-5-5	1.9312-82	1.4686-08	1.115E-02	20-362540	5.4495-03	4 + 85 DE- 0 3	3. 67 EE-03	2.790E-13	2.1195-03	5.4795-24	10-362401	3,660E-85	1.150E-C5	3.751E-BE	4.6625-08	5.422E-12	
	HPC	5,763E-01	3.7196-01	2.3246-01	1.3025-91	7.167E-02	3.7468-92	1.39976-02	9.434E-03	5.156-63	1.7236-03	5.8978-04	2.76 E-04	50-3612.6	30-3616'1	1.5695-05	1.1.2E-05	3.591E-J6	6.435E-06	4 .7 23 E-06	4.1066-06	3.°°55E-06	3,3725-06	3.1.69E-C6	3.0165-05	2.2046-06	2.6376-06	7.614E-07	1.624E-07	3.531£-0.6	9.178E-05	1.939E-09	2.405E-12	1.50? 8-16	
らこしてらい	-	236.100	2010650	275.10	961.790	252,226	255.750	202*544	242 - 00	235.200	234 *622	223.230	215.890	216.603	216.600	216.500	216.653	216.850	715-515	216.600	216.650	216.EP	717.650	218-650	219.620	220+600	221.600	226+500	2 36.5 00	253.400	254.250	275.500	214.708	210.012	210.000
ILTONTAL P	a	1013.000	009*860	260*662	7 31. 206	516+570	543.530	472.200	411-100	356.500	308.005	265.030	227.000	194.060	165.300	141.700	101.121	102-501	88.560	75+650	64.573	55.290	41.290	43.470	34.570	29+720	25**52	11.970	5.7.6	2-071	1.491	367.	.055	.000	0.000
10H	41.7	5.00	1.00	2+00	1. OC	4.00	5. 33	6.00	7.00	8.00	9. 00	10.00	11.00	12-30	13.00	14.03	15.00	16.00	17.00	1 8. 00	15.00	20-00	21.00	22.00	23.00	24.00	25.00	30.00	35.00	40.04	45.00	50.60	73.40	100.00	00.69996
	C	+1	N		3	¥	ç	~	c >	o,	Ĥ	H	27	÷	4	ۍ ۱	4	5	6 7	ст. т	2	21	22	2	4	5 2	2£	27	5	53	n M	1	ŝ	in M	,

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	LONH									070E-55	616E-96	0566-05	2596-05	898E-05	690E-05	8226-05	7146-05	4486-85	2036-05	97.85-05	852E-15	065E-05	1696-05	0976-05	50-3412	1805-05	1796-05	7056-06	10-3144	0556-57						, XEF, I.
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	H20(44)	0-3614.6	5.8976-0	3-359E-C	2.432E-0	1.469E-0	0-3404° i	5.039E-0	2.796E-D	1.612E-0	5.266E-0	2.502E-0	1.1675-0	4.525E-D	1.5#1E-1	7.502E-D	5.4955-0	3-3736-0	2.901E-01	2-3960-2	10-3461.1	1.53"6-0	1.390F-0	1.2535-01	1.1445-01	1.021E-C	9.714E-D	2-1646-0	3 *4 47 E- 0	4.305E-C	9.787E-1	1.7435-1	1-3644.4	2.706E-1	.0	N-2 - 2 - N - 2 - N - 2 - N
HILES	1	201.103	231,640	275.100	256.700	262.200	255.730	249.200	242.700	236.270	229.720	223.200	216.500	216.600	215.609	216.500	216.600	214,67C	216.600	215.610	215.600	216.500	217.690	219.626	219.619	220-602	221.600	226.530	235.500	253.400	264.200	276.673	219.700	210.700	210-000	0.0C00 4H
ZONTAL PS	a	1013-000	634.600	795.000	701.255	616.603	540.500	002*225	411+100	256.503	308.334	265,300	227.000	200**63	165.800	141.730	121.100	103.536	88.500	75.650	64.570	55.290	47.290	40.470	34.570	29.720	25.430	11.973	5.745	2.571	104-1	796	• 055	•000	0.000	EIGHT≃ JIV. A9S09
1504	ALT	1 00 1	1.60	2.00	3 • 00	4.00	5.00	6.00	7.00	8.06	9.00	10.00	1:.00	12.00	13,66	14.00	15.00	1 6. 20	:7.00	18.00	19.00	29.00	CD * T Z	22.00	2 3. 00	24,00	25,00	34.90	35.00	40.00	45.00	50.00	CO " O 4	130.93	10 00000	POINTN HE
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.158E+00 .2520-02

... 5 Tx(12-14) = 0. EJUIVALENT SEA LEVEL ABSDRAEP ANJUNTS

	MATER VAPOUR 64 CM-2	502 ETC. Km	OZ ONE ATH CH	NITFOSEN (COHT) KM	H2C (CONT) GM CH-2	нсі SC AT Ки	4 E R 1	DZGNE(U-V) ATP CP NITRIC ACID:
= [9-])4	+5765+00	•9296+00	a 249€-02	* 7 3 5 E + 0 0	.657E-02 .848E-01	,948E+CO	.156E+00	. 252E-02
=(12-12) =	0. AER2	A ER 3 0.	AER4 0.	R. 4. MEAN 4. 5756+01				

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ICH 1 6 10 15 Extinction and assorption Coefficients

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F 2 E 1	HAVEL ENGTH	TOTAL	H2C TO AUC	C02 +	020NE	NZ CONT	H20 CONT TRAVE	HOL SCAT	AEROSOL	AERCSOL	INTEGRATEE Approprise	NITRIC ACLE TRANS
	21111111111111111111111111111111111111	2112	777.0		0000-1			1-0000	. 9885	0042	2202	1.0000
9.05	11.045	00.6	15201	7666	1-0010		9446	1.0005	4366	54084	.6704	1.0000
		0010	3140	0000	1.0000	0000	9656	1-0000		2460-	1.1244	1.00004
4 F	10.976	1015	1478	9985	1.0000	1-0000	946	1.9505	9662	0.44	1.57.3	1.04.1.1.1
0.00	10.755	9110.	7 5 6	4466	0000	1.0000	9677	1.0020	9661	-0045	2.0125	1.40001
1.0	10.6105	1065	9956	1965	1-0000	1-0105	9646	1.0602	9879	.00.6	(°.	1.64451
220	10 7527	5025	94.69	9945	1.0009	1.0000	96 66	1.0003	9.976	1004	 	1.0001
52.5	10.6952	.9234	1006	9323	1.0000	1.000	-9502		.9877	5478.	3.2.75	2
0 7 6	10.6363	.9175	.9859	.9906	1.6000	1.0006	.9513	1.0000	.9675	.0050	3.6197	1.0001
5 7 5	10.5820	-9125	.9814	1696.	1,0000	1.0(00	• 9521	1.0000	.9874	.0.51	4.0571	2.44.694
156	10.5263	1606.	+9783	1895.	6666.	1.0100	.9529	1.000	.9872	5200°	4.5101	10001
625	10.4717	*9075	.9753	- 906 -	9555 *	1.3003	4256*	1.4666	.9871	•6053	4.9728	11
96 0	13.4157	.9066	1419.	1996.	<i>1</i> 666°	1.0000	.9544	1.000	•9669	.0.54	5.4356	1.00001
96	10.3627	.9364	.9737	.9481	9666.	1.0000	• 9551	1-996-2	. 5 66 8	.0055	5.3.75	1.C.ū. I
573	13.3093	.°345	.9733	5996.	2566"	1.0000	.9556	1.0000	.9256	1001	6.3347	1.00001
516	10.2554	.9758	- 97 45	• 9862	6965.	1,0105	.9565	1.000	.5065	.0.55	6.0558	2.10,01
1986	10.2041	.9115	7370.	.986 -	0965	1.0000	.9571	1.0500	, 9862	-0055	7.257c	1.0001
386	10.1521	. 91 63	0296 .	1266 *	.9956	1.0070	2256"	1.0060	5962°	.8.67	7. 7. 6.	
066	10.1019	6229.	.9865	6563'	0166.	1.0000	°9583	1.0030	.5560	0161	8.3317	1.00001
555	13.050	19.6.	6096"	• 265 •	.9916	1.0000	. 9558	1.003.	÷ 535 •	.6.52	č.5.13	11
1090	10.0000	.9083	. 9745	2566.	.985	1.6030	• 5 2 5 4	1.0000	*585 1	10001	e.4581	1.6000
1005	9.532	.9023	1176.	.999€	. 5824	1.90)0	• 9539	1.0¢Cv	*38°*	•8587	5.4465	1 1 1 1 1 1 1
1010	013616	. 4 9 3 1	.9658	• 9995	. 97 80	1.0090	.9694	1.0000	.9856	1200.	5046 5	1.0001
1015	3.6522	. 5613	6×5E.	0666.	6246.	1.0034	,9639	1.0000	- 136 -	.0.75	24-5729	2+2-45
1320	9.8039	. 1125	1490.	.998.	6699.	1.0()0	.9613	1.7000	5436.	• 1 0 1 9	11.1594	1.00001
1025	9.7561	.8787	.9633	.996	.96.74	1.0505	9618	1.0200	.9646	5508.	11.7657	1.54.52
1030	9.7057		. 9647	.3953	• 545	1.0000	.9522	1.3000	9295°	•00×6	12.3776	1.03031
1035	9.6618	• 8 E 75	96 96 °	7266 .	.95 22	1.0000	\$29 6 *	1.0000	.9833	.0.0.	13 357	2 - 4 - 1 2
0401	9.6154	.8.24	61,6.	2066.	.9577	1.0000	292J	1.0000	,9630	1600.	13 6777	1.00001
5407	9.5694	.8585	.9726	986.	-9785	1.0000	.9634	1.370	.9626	-0-0-	14 2352	11
1050	9.5238	£6¥8*	9696 *	.9851	.9612	3 300 * 1	.9638	1.0000	£235 *	.0101	14.8667	1.00001
1 05 5	9.4787	. 6604	• 3 6 6 4	.9538	.9559	1.00CD	.9641	1.0000	1286.	48125	15.5665	2-154.1
1050	6-4343	.8610	.3595	.9636	- 9£ 35	1.0000	°9644	1.1000	.9e17	.010 C	15.2818	1.0000
1065	9.3657	• 8 F F 2	.3563	.98.29	•623*	1.0026	.9648	1.396.1	.9613	5116.	16.95~8	2
1973	9.3454	5673°	•9502	.9012	.9858	1.6000	•9651	1.0500	. 5 2 1 0	.0115	17.5543	1-66461
1075	9, 302 ⁴	.8910	.9613	5 6 36.	0.980	1.000	• 3654	1-300	26	.0119	2660*21	
1.05 C	- 652 ° 6	105.	2596.	9226	6365 ·	0 0 0 0 1	1446	1.000	12251	2220*	10	
1.365	4972.6		5.17		nf 55 .		940F.	10000				
	4-11-6			. 155.	1666.		2005					• • • • • • •
656T	1001°5		70 C F C				COCK *				201 E 2 1 E 2 1 E 2	
				1000			0006	300.1			51.5486	
SOTT		00200					• • • •				21. 7267	100011
7 1 1 1	1.500.5			0000	0666		1796		0.00		1262 22	
	0.000			000	0000		9676	1.0060		. 0112	22.0162	1.04031
1171		0127		1999.	0000	000011	. 9678	10.001	1.50	1111	23.3.29	1.26.63 1
1111	5 - 9 - 9 - 5	DEAD.	0110	1999		1.060.0	9680	1.0000	5805	.0110	23, 7529	1.00001
	6.3105	1.100	. 9517	1 1 90 .	9999	1.020-1	- 3662	1.0000	9366.	01.5	24.2613	1
1140	6.7719	146	9473	8166.	2666	5 . 0 E B 3	.9684	1.0000	5606	.010e	24.7493	1.00001
1145	6.7335	1533.	2116*	-166.	1666	1.000.1	.9686	1-6400	5136*	.0107	25. u665	
INTESPATED ABSOR	PTION FROM	900 TO	1145 CH-1	4	. G 7 AVERA	GE TRANSM	111ANCE =	. 8977				
2												

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Table 9. Program Output for Case 4

SLANT PATH BETHEEN ALTITUDES H1 AND H2 MHERE H1 = 12.000 KH H2 = 0.030 Km, Zenith Argle =100.030 decrees

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HAZE HODEL = 23.0 KM VISUAL RANGE AT SEA LEVEL

HODEL DIFCSPHERE 2 = 410LAIITUCE SUMMER

HAPE MODEL 3 - MARITIME VIS+ 23.EKM

SEASON = SPRIS SUMM

STRAT EKGR VERTICAL PROFILE AERCSOL MCDEL =

FPEQUENCY RANGE VI= 900.0 FM-1 TO V2= 1145.0 CM-1 FOR DV = 5.0 CM-1 (6.73 - 11.11 MICRONS)

	Ϋ́Υ	LIZONIAL P	SETIES									
5	AL T	a	۲	H20	C02+	03	K2	H20 (10M)	HOLS	(H-T)	03 (NN)	
- 4	0.53	1013.000	234.000	1.7546+32	3.038E-01	2.759E-03	7.164E-01	3.0136-02	9.291E-C1	2.5336-04	2.E00E-02	
ę.	1.00	002.200	296.029	8.155E-01	7,45176-01	2. 041E-03	5. 798E-01	1.460E-02	6.387E-01	Z 290E-04	2.800£-03	
٣,	2.01	832.500	295.000	4.6915-01	5.2686-01	2,529E-03	4.°705E-01	6+6465-03	7. 5886-31	2.6735-04	2.8306-03	
t	2° 00	710.000	279, 310	2.74E-01	5.215E-D1	2,499E-33	3.8075-01	2.4672-03	6.862E-01	1.675E-04	2.833E-13	
u	4.60	629.333	277.000	1.734 8-01	4.3356-01	2.467E-33	3.077E-01	9.8475-04	6.2035+31	1.6545-04	2.967E-03	
Ð	5, 30	554,000	267.000	5.863E-02	3.5696-01	2.430E-03	E.476E-01	3.4486-04	5.55E-GJ	1.5266-94	3.381E-D3	
۲	5.00	487,000	251.008	3.221E-02	2.955E-31	2.424E-03	1.980E-01	1.5856-84	5.u31E-01	1.37uē-34	3. 22CE-03	
10	7.66	426.040	5:5-0-0	1.75CE-07	2.414E-01	2.5055-03	1.568E-51	7.3405-05	4.505E-01	1.2285-04	3.5002-02	
σ	8.00	372,000	248.900	3.203E-03	1.978E-D1	2.510E-03	1.247E-01	3.159E-05	4.0455-01	1.6 995-34	3.667E-03	
C F	3.00	324.000	242.50	4.5425-C3	1.607E-01	2.6066-63	9°814E-12	1.4364E-D5	2.610E-C1	5-5175-05	4. 61 3E - C 3	
. 4 17	10.00	281.000	235, 050	2.14ft.03	1.2846-91	2. 592E+03	7. 7146-02	5 .677 E- C 6	3.224 E- C1	8.741E-05	4.200E-03	
12	11.00	243-000	600°620	6.5505-04	1.348E-01	3.904E-03	5.957E-02	1.355E-D6	2.861E-01	7.7562-05	5.1336-02	
بد ۲۱	12.00	209,000	722.000	1. 591 F - 04	8.400E-02	3.105E-03	4.F4eE-02	2.752E-07	2.539E-01	E.E56E-G5	5.6036-53	
4	13.00	179-020	216.300	4.2045-05	6.650E-02	3. 668E-03	3.552E-82	6.665E-C8	2.235E-01	5°-323E-02	7.400E-02	
15	14.00	153,300	215.00r	2.02AE-05	5.053E-02	4,133E-03	2.595E-02	3.1146-08	1.9106-01	5.075E-05	€°*400E-C3	
16	15.00	130.300	216.000	1.731E-05	3. CO 9E-02	4,088E-03	1.874E-02	2+005E-08	1.623E-C1	4.3526+05	8.867E-63	
17	16.00	111.856	216.000	9.7236-06	2.882E-02	4.241E-03	1.356E-02	1.441E-08	1.3665-01	3.694E-05	9. COCE-22	
	17.00	95,000	215.0.6	7.335E-06	2.195E-02	4.555E-83	1.001E-02	1.080E-08	1.186E-01	3.160E-05	1.120E-02	
5	16.00	21.200	216,900	5.733F-06	1.568E-02	4.9906-03	7.310E-03	8.250E-09	1. 014E-01	2.697E-05	1.307E-02	
22	15.00	69,500	217.000	4.574E-06	1.2675-02	5.354E-03	5.2165-03	5.941c-09	8.6365-02	2.250E-05	1.4935-02	
21	20.05	59,510	214.059	3.5542-06	3.556E-02	5.341E-03	3. 871E- 9 3	5.464£-89	7.360E-02	1.9536-05	1.5076-52	
14	21.00	51,000	219.030	3.74F-06	7.251E-03	5.312E-03	2.825E-03	5.3556-09	€.279E-02	1.6715-05	1.680E-02	
23	22.00	43.700	220, 000	3.321E-06	£0-366*°£	4.959E-03	2.060E-03	4.613E-09	5.3566-62	1.425E-05	1.6836-02	
57	23,69	37.600	222,500	3.0596-06	4.1746-03	4.429E-03	1+564E-03	4.2335-09	4.567E-02	1.215E-05	1.587E-02	
25	2 4c 0G	32.200	223 303	Z.352E-06	3.163E-03	3.914E-0J	1. 896E - 83	4.0825-09	3.894E-02	1.038E-05	1.493E-02	
55	25.00	27.700	224.005	2.871F-05	2.415E-03	3.452E-03	8.055E-84	3.9886-09	3.334E-02	6.9752-06	1.400E-02	
27	30.00	13.200	234.010	7.7676-07	6.21.7E-04	1.596E-03	1. 713E - 04	1.007E-09	1.521E-G2	3.2162-96	9.3355-63	
5.5	35.00	6.520	245.300	1.231E-07	1.6985-04	5.830E-04	3, 9016-45	1.4645-10	7.1765-63	1.5316-66	4.293E-63	
6.V	44.00	3.330	255.000	2.55595+08	+ • 881E-05	1.966E-04	9.417E-86	2.880E-11	3.480E-03	7.5246-07	1.913E-03	
Ē	45.00	1.760	270.003	61-2565.19	1.502E-05	4.785E-05	2.457E-86	6+682E-12	1.758E-03	3.854E+01	6.0575-64	
31	50.03	.951	276,000	1.187E-09	4.964E-06	1.232E-05	6.942E-07	1.1915-12	9.291E-04	1.454E-07	2.007E-94	
22	70, 90	• 6 5 7	216.500	2.5675-12	5.632F-08	8.9446-08	4.923E-09	1.8726-15	6.300E-05	1.158E-08	4.0136-06	
£E	100-001	.00.	210.700	1.4995-16	5.397E-12	5.175E-12	1.041E-13	6.038E-20	3.852E-07	5.5235-11	2,007E-05	
т Ф	00.95566	00000	216.905			،	•		•	•		
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ياما هنگ ميند کرد. . . ش

بالتقاط ستقار مطرب مستراد بلاعات

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	H	7.665E+01	6.43eE+21	5.548E+01	0 .	. .			d.	.		ب .	.	g.	e.	o.	ð.	q.	;		<i>u</i> .	••		٩.	•0		0.	C.	
	CAER1"RH)	1.211E+D1	6.383E+00	3.4452460	.0	ŀ.	0 .		.			.0		••	. .				••		•	.0		:	;	в.	0 .	- 2	6 .	•0	• 5	<i>د</i> .	о.	0 .	
	A E R4																												640E-05	99 <i>16-C</i> E	C10E-C6	10.5-36	6005-07	3106-10	
		5	ů	å	•	:		5	5	រំ	5	: E	: *	- 1	1	å *	15 1	1 1 1	• • •		2 1	• 0.	-0 -1	1	•	- - -	ڻ ج	5 8.	4	ř.	J			'n	5
	AE RJ	•0		.	••			. .		•0	•	1.140E-C	7.9906-1	6.410E-6	5.1705-0	4.420E-0	3-9506-6	3.8205-1	4.2505-0	5.2006-4	5.810 E-0	5.890E-0	5.0205-1	4.262E-0	3-3005-0	1-3006-1	1.310E-0	3.3205-0	:	• •	:	.0			
	ME 32				4605-02	250E-02	3106-03	7105-03	230E-03	29-3016	2.5-13																								
		- 5 - 1	12 0.	to 21	ń	-	•		÷	•	4	5	ð		•	3		å	3	0	6	5	;		ð	5	6	å	5	•	ċ	3	j	6	•
	AER1	1. 580E-0	9.910E-4	6.210E-0	.	.	.0	. .	.0		.,	. .	•0		5			.,	.	o.	.9		<u>с</u> .	Э.	•		ŋ.			.0		.	d .	a.	
	1001									3456+55	6106-06	00 4E - D 5	28-3692	3465-05	L28E-05	056E-05	321E-05	6335-05	37 2E-05	1296-05	3866-05	2055-05	3236-05	20-3052	37 5E- DS	736E-05	2676-05	355E-16	29-3625	1905-57					
		1 0.1	.0.5	•0 2	: 0 0	2 O.	-0 2	 10	- D E	3 6.0	3.5	4 1.1	1 2	3.0	5 3.1		N	5	20		5 1.	~	11	5.5	5.43		7 1.		:		0 0		.0.0	• 0 -	
	H20 (44)	1.9716-0	1.203E-3	7.159E-0	0-336P*E	2-1345-0	1.0 946-0	6.558E-0	3.9156-0	2.247E-9	1.2735-0.	6.971E-D	2.4365-0	6.797E-D	2.1555-0	9.9124-0	5.335E-0	4.5565-01	3.412F-J	2.5545-01	2.1725-0	1.5215-0	1.5315-04	1.2765-0	1.1.00 E-01	1.3115-01	9-3-25-0	1.9855-0	2.195E-31	3.721E-0	5-3445-3	9.977E-1	5. c 89E-1	2-300 - 2	
10FILFS	۲	294.000	296.000	295,930	279.000	273,000	267,100	261.305	255.003	249.700	242.000	235.000	224.300	222, 128	216.250	216.000	216.255	216.000	21F.000	216.000	217.000	218.0.0	219.530	220.050	222.900	273.000	224.900	234 .510	111 111	255.700	273.000	274.905	218.000	000*012	222.055
ZONTAL PR	۵	013.309	000.206	802-000	710.000	620.020	554.030	487.600	426.000	372.000	324.030	261.000	243,000	209.000	179.010	153.000	130.000	111.000	95.000	81.200	69,500	59.530	51.000	43.700	37.600	32.209	50±°±2	13.200	6.520	3.330	1.763	:46.	.067	000*	0.000
IPOH	417	1.00.1		2.19	0.0	4 CL	2.00	6.00	- 00	6. CJ	6.00	10.00	11.00	12.00	13. 35	14.00	15.00	16.03	17.03	16.03	19.00	23.00	21.03	22.50	23.00	24.00	35.30	30.00	35. 60	43.30	45.00	53.30	7 6 . 5 0	100.001	00.0046
	Ц	1	- IV		4	IJ	ъ	2	e	e	0.1	11	12	14	t.	и •П	51	11	£1	ç	23	21	27	22	4	ð 5	2 F.	27	20	62	51	11	22	ŗ	б Т,

5 3 aid ilN∩D+ 1011V. 4850454

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T×(12-14)= 0. • 5415-03 1.4

5824 POINTV HEIGHT= 0.3030 KM,NE 1,MF= 1,MEF, IMDEX & BEVYE & EELOA X= 25336402 0. 41P= 1 Equiv, Absorge Apounts of KM &I X= 1156401 49046400 .2766402 .7166400 .2016401 .4236400 .156400 .2006402

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19 N N

TX(12-14)= 0. 6. F.1

4×11 = -5371.230

	RANGE	1.00 1.00	2.0 1.00	3.0 1.30	4.0 1.00	5.0 1.60	6.0 1.00	1.00	3,0 1.00	9.0 1 ((13.0	11.UU 1.03	12.0 1.6			\$	
	THETA	0000-091	163.0000	169 0000	180.6000	183.0000	Leg 0000	180-020C	183-6406	20.010	1.00.000	lt. iiii	Lod.CJ.J			DZDNE(U- ATP SP TRIC ACJD:	.4252-01 .490č-04
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	03(UV)	5. 363E-03	1. 0 01E-D2	1.4126-02	1.7976-02	2.156E-02	2.492E-02	2.607E-02	3.1105-82	3.404E-02	3,6892-02	2 14 965E ·C2	1 4.249E-C2			20 (CONT) 14 CM-2	384 6-01 367E+00
	AERL		<u>.</u>	:	•		•	•	<u>.</u>		•	1-3916".				ONT) H	••
	HOL 5	2.697E-01 0 0.	5.736E-11 0 0.	9.149E-01 0 d.	1,297E+86 u U,	1.724£+80 0 0.	2.201£+00 0 0.	2.731£+80 0 0.	3.3216+00 0 0.	3.973E+00 0 0.	4. 655E +03 0. 0.	5.433E+00 7 3.	6.377E+30 2 0.			NITROGEN (C KM	+307E+01
	H20(10M) AER3	6.773 E-8 7 7.171E-04	3.694E-86 1.677E-83	1.286E-85 1.677E-83	Z. 437E-65 1.677E-93	8.396E-05 1.677E-03	1.946E-04 1.677E-83	4.344E-04 1.677E-03	1.846E-03 1.677E-03	2,558 E- 13 1,677 <u>E-0</u> 3	6, 874E-83 1, 677E-83	1.698E-12 1.677 E- 03	3+8+25-02 1+6775-03			OZQNE Ath ch	1 112-01
	N2 NER2	5.294E-32 0.	1.211E-01 J.	2.084E-01].	3. 192E- 61 2.516E-03	4.594E-01 7.170E-03	6.360E-01 1.411E-02	8.5795-01 2.260E-02	1.134E+D0 3.598E-B2	1.477E+93 6.170E+02	1.901E+00 5.170E-02	2.425E+01 6.170E-02	3.070E+00 5.170E-02		SINCO	≞TC.	• • •
	5 CM1	3.0545-03 2.650E-03	5.547E+03 4.249E-05	8.1455-03 4.699E-05	1.101E-02 4.902E-05	1.352E-02 4.90?E-05	1.599E-02	1.541F-02 4.302E-45	2.365E-02 4.362E-05	2+335E-02 4-902E-05	2.586E-02	2,045E-02 4,972E-02	3.1145-02 4.302E-05		8 SJRGE0 AN	20 20 20 20 20 20 20 20 20 20 20 20 20 2	
ROFILES	CO2+ CO2+	9.400E-02 1. 365E-04	2.111E-01 5.657E- 04	3. 561E -01 1. 524E-03	5,347E-01 3,741E-03	7.5365-01 6.2466-03	1.]21E+00 1.137E-12	1.3476+87 1.9946-02	2, 742E +0J 3, 55CE +0J	2,218E+00 6.448E-02	2.7915.00 1.1775-01	3.4785+00 2.115E-71	4, 7945 / 80 3.6715 - 61		EA LEVEL A	AT5R VAPCU 64 64- 2	.23€2+D1
VERTICAL P	420	3. 518E-94	1.616E-03	4.821E-03	1.1305-02	2.4025-02	4.8135-32	9. 225E-02	1. 794E-61	3,538F-01	6.939E-01	1. 320E+00	2.Z63E+00		UIVALENT S	×	1-8)=
	ュレア	12.003 11.000	11.000 13.030	10.000	9 • 0 0 6 8 • 3 0 6	000°4	7.000	6.000 5.000	5, 300 4, 010	000.4	3.000	2.000 1.360	1+000 0.000	1.230	ĒŪ		ž
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F.H. HEAN 6.671E+01

3ER4

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652 4683 M(12-15)= 5.17.2-02 1.677.E-03 ICH 3 6 10 15 Extinction AND Absorption Cefficients

FRECH	H D NE LE NG TH	10101	420	C 02 +	0 ZONE	N2 00N7	420 CONT	PCL SCAT	AER CSCL	AFRCSCL	INTEGRATED	WITRIC ACID
1-1-0	MICROMS	TPLNS	TRANS	TRANS	TPANS	TRANS	TRANS	TRANS	TRANS	A 9 S	ABSORPTION	TRANS
005	111111	. 4576	6272"	1.0000	1.0000	1.0030	.7114	1.400	.5E.E	0608.	. 8560	• 5365 •
9.15	11.0497	.6575	.9379	.996.	1.0300	1.000	.7164	1.0000	6095	.0088	2,5686	19565 *
91.0	13.9893	.6598	.9360	9 966*	1.0000	1.0050	.7212	1.0600	. 9 86 8		4.2697	: 25.65 .
915	10.9290	6184°	.9351	1466*	1.0960	1.0000	+ 7258	1.0000	.9006	.0045	5,9504	19666 *
920	10.8696	.6568	.9356	•9921	1.0030	1.000	5 CE .	1.0001	.585.	.0083	7.6263	16555.*
925	10.0105	2789.	. 9526	.9870	1.0000	1.0000	.7347	1.0000	- 98.2	.0082	5,2051	1.0003.1
310	10.7527	0999's *	. 96.6D	.9620	1.0000	1 + 0 0 0 0	.7389	1.3000	195.1	.6.8.	10.7704	1
635	10. 5952	.6235	.9589	.9763	1.0000	1.000	5242*	1.0000	6615*	e 2 0 0 .	12.3276	1.00001
546	19.6383	.505.	.9636	.5721	1.0000	1.000	.7468	1.0560	.9797	.0077	13.9.04	1 - e e u J 1
19 1 5	10.5827	.6778	.9519	.9685	6999.	1.000	.7506	1.6000	•9795	.0076	15.5116	1.00001
950	10.5263	*673×	.044C	• 9662	0565 .	1.0000	. 7543	1-0000	1 679 1	.0476	17,1450	1. jugu t
955	10.4712	. 5714	62 26 *	.9673	1.66.	1.0000	.7578	1.0000	- 5 7 8 7	.0076	18.7880	1.0000
090	10.4167	.6719	1359.	.9668	.9963	1.000	.7613	1.0020	.9784	.0.76	2. 4341	2.0
255	1027	7974.	-9341	-966	.9930	1.9003	.7646	1,0000	0416*	.0076	22°0°05	1.00001
970	13.3693	.6449	2226"	-9617	0066*	1000.11	.7678	1.0060	.9776	.4076	23.7461	3-101-5
526	10.2564	6674	.9360	.9617	5486	1.0000	. 7708	1.9000	î 1 7 6°	.0076	25,4092	1.00001
0.92	10.2041	. 6713	. 9453	.9673	. 97 36	1.0001	.7738	1.0000	• 5 7 6 9	. 037E	27.2444	1 1
365	10.1523	1019.	• 9565	.916.	•9599	1.0300	.7767	1.0000	.9766	.0076	28 6437	1.0000
066	10.1019	• 9765	.9655	.5858	1426.	1.000	1611.	1.0043	.9762	.0.76	34.2612	1.6440
566	10.0503	.6571	• a506	19941	.9111	1.0000	.7821	1.0000	• 5759	.0076	31.9756	1.00001
1000	13.000	6265	.2360	• 9971	8798	1.0000	.7847	1+0000	•9755	.007E	22, 8331	1.668
1001	9.9502	5050	92.86	.000	. 6515	1.0000	.7872	1.0000	5115	.0078	35. 8037	1.0000
	9.3010	5820	9167	1965	.0252	1.0000	.7896	1.0000	• 9742	.0.81	37.8537	1
1115	9.8522		1906	9963	. 7965	1.0000	. 7919	1.0000	.9736	.8054	40.1246	100001
0201	9.8030	5444	-9152	563J	8 1 2 Z	1.0000	1967.	1.000.	.9730	.0.87	42.4425	1.6060
	9.756	212.5	. 130	. 296.	. 76.83	1.0000	. 7962	1.0000	.9723	€800*	44.7178	1.0000
	9.7087	5233	916	9842	.7618	1.000	.7983	1.0004	1115.	. 2092	47.1529	1.444
1035	9.6618		•a251	.9767	.6993	1.0000	.9003	1.0000	.9711	.0095	43.5374	1,0000
	9.6154	1913.	• 9295	6016.	• 7 2 4 6	1.0003	.6022	1.0000	• 976 5	260 0 .	52. 1519	******
	9.5494	5 . 5 1	£110*	.9617	. 82 77	1.0000	+8041	1.0000	6635"	.010	54.1613	1.0002
1050	9.5238	• 5136	1926.	.956.	66 £ 4 °	1.4000	.0059	1.0000	° 6 6 6 °	.010 <i>.</i>	56° 5984	1. 66 L0 1
1055	7.874-9	4354	• 91.98	• 555 *	. 7165	1.0009	.3076	1.0000	.9 Ec 8	•0105	55, 1353	1.0001
1060	3.4340	15051	* 9065	.9547	1251.	1.0000	.8352	1.000.	.9582	.0107	61 59 v ü	1.0ucv1
1065	164.5.4	*2 ± 0 f	-9006-	.9528	1991.	1.0003	. 3108	1.0000	.9676	.0113	61.8982	1.0001
1010	9.3458	.5331	£20c"	.5478	. 673.	1.800	.3124	1.0000	.9672	.6112	65+947E	1.0001
1075	9.3023	.6597	• 90 95	1146.	. 9736	1.0000	e139	1.0000	•9665	.0115	67.6495	1.00001
0901	9.2593	.6621	272E •	.9521	24 85 *	1.0003	.8153	1.0000	.9659	.0117	69. 2392	1.0001
1085	9.2155	. 6328	.9242	.9651	.9853	1.6003	.8167	1,0000	• 3 6 5 4	.0119	19.7750	1.0000
1090	9.1743	6943	.9152	1416.	6385	1.0000	. 6180	1.000	. 9656	.0119	72 3.37	1.0000
1095	9.1324	.6931	.9017	. 3865	• 9:59	1.0000	.5192	1.0000	9646	.0117	73.0361	1.60 00 1
1100	6°0°5	•6921	• 8795	.9939	3363	1-0000	.8205	1.0000	5 1 3 5	9119	6154 61	1.0000 ·
1105	3670 6	.5711	.3609	.9982	.9359	1.0000	.5217	10000*1	9640	.110.	1710121	10000
1110	36 00 * 6	. 6573	.8555	•9991	.9853	1.8000	.8228	1.000	• 9636	.0112	78.7331	1.0000
1115	8.56.85	.5775	•3671	•666•	. 95 46	1.0000	6 2 3 3 6	1.0000	.9636	.0112	80.3458	1.0000
1120	8,9286	.5874	• 8795	0666*	2486.	1.000	5426	1-0010	.9637		1014-10	10000
1125	8.88CG	• 5363	1468-	5465.	- 98.39	1.000	.3260					• • • • • • •
1130	8.8495	-7364	- d0 51	• 9951	24 26	1.0004	6979*				2400 100	
1135	8.8106	6569"	. : 315	6066*	- 36 53	0.000 * 1	6/29*	10000	9639	1110*		• nn nn • T
1140	8.7719	•5364	. A 8 35	01185*	.9895	1.000			7974 1	1118.	51.4111	1.00.00
1145	8.7236	62.93	6778	1416.	0265		9620	7-0000	4724.	1119.		
INTEGRATEC ACOUN.	PTION FRUM	n 006	1.47 (41)	8 11	S+ / OAVERT			0.00				

<u>Case 5.</u> Calculate the transmittance from 900 to 1145 cm⁻¹ in steps of 5 cm⁻¹, using the MODEL = 0 option to define a 10-km horizontal path at 0-km altitude, at a pressure of 1000 mb, an ambient temperature of 10° C, and a relative humidity of 40 percent. Use the midlatitude winter ozone profile, and a 23-km meteorological range, rural aerosol model.

The output, shown in Table 10, is similar to the horizontal path case, Case 3, given in Table 4.

<u>Case 6.</u> Calculate, using the MODEL = 7 option, for a given set of radiosonde data the transmittance from 900 to 1145 cm^{-1} in steps of 5 cm⁻¹ for a slant path from 0.21 km to 8.55 km at a zenith angle of 35.5[°]. Use a 23-km sea-level meteorological range for the maritime aerosol model and the ozone distribution of the midlatitude summer atmospheric model.

In this example, the radiosonde data consists of 21 levels with the following parameters given: altitude (km), pressure (mb), ambient temperature ($^{\circ}C$) and dew-point temperature ($^{\circ}C$).

The output for Case 6 is given in Table 11. The only change in the output from a standard run occurs of the first page of the output. Each MODEL = 7 input card is printed followed by the internal model profile parameters derived from this card. Also, detailed information on the aerosol profile and type of extinction is printed for each level. The rest of the output is the same as that described for the previous standard transmittance cases.

<u>Case 7.</u> Calculate the transmittance from 900 to 1145 cm^{-1} in steps of 5 cm⁻¹ for a vertical path from ground to 10 km (zenith angle = 0°). Using the MODEL = 7 option, provide for a radiation fog (0.5 km meteorological range) from ground to 200 meters altitude and a rural aerosol model (23-km meteorological range) from 200 meters to 2-km altitude. Use the U.S. Standard model atmosphere profile for the molecular absorber amounts and for the pressure and temperature profile.

In this example, only the altitudes of the levels and the aerosol control parameters need to be specified on the MODEL = 7 cards. The program output for this case is given in Table 12 and is similar to that of Case 6.

ເດ Table 10. Program Output for Case

RURAL FROM POINTN HEIGHT= 0.0000 KM,M= 1.NF= 1.REF. INDEX ABOVE I BELCM X= 0. 0. 1. , IP= 1 Equiv. Absopace, Apounts per KM at X= .356f+00 .976f+00 .2776-02 .739f+00 .316f+02 .952f+01 .156f+00 .2316f-02 GM M-3 0 (UV) 2.600E-32 (AER1*RH) RHI 6.323E+30 4.0.46+01 FREDUENCY RANGE V1= 900.0 M-1 TO V2= 1145.6 M-1 FCR DV = 5.0 CM-1 (0.73 - 11.11 MICRONS) ALT P I T H20 CO24 OJ N2 H20 KCO24 CO3 AZ H20(10P) HCLS (N-1) 0.60 1600.030 283.150 3.6018-01 3.3056-01 2.7666-03 7.2876-01 3.1816-03 5.5236-01 3. AER4 0. JEFZ AER3 0. HAZE MODEL = 23.0 KM VISUAL RANGE AT SEA LEVEL STRAT BIGR HORIZONTAL PATH, ALTITUDE = 0.000 KM,RANGE = 10.800 KM AER1 1.5-3E-01 0. VIS= 23.0KH VERTICAL PROFILE AFROSOL MODEL = ALT P T H20(44) HNO3 6.00 1000.000 287.150 5.7145-32 0. HAZE MCDEL 1 = RJRAL SEASON = SPETS SUMM MORIZUNTAL PROFILES

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5 TX (12-14)= 0. EQUIVALENT SEA LEVEL ABSJORER ANJUNTS

OZCNE (U~V) ATH CH NITEIC ACIDI .284E-01 C -1526+41 1 53 t **SCA1** .<u>5</u>52E+01 ų P NITROGEN (CONT) H2C (CONT) KH 5H CM-2 .318E-01 .571E+00 R. X. MEAN 4. DIDE+DI ∗739E+01 .277E-01 OZ ONE Atm CM CO2 ETC. Km •930E+01 4876P V4PCU3 54 CM-2 . 752E+01 ÷(1-8) =

: • ICH 1 6 10 15 Extinction and Assorption Ccefficients ċ #(15-12)=

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M. P. M. L.

AER 4

AER3

AERZ

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ED NITRIC ACIO Ca trans	5e 1í	57 1.00001	16 1.Liuut	57 D C C C C C C C C C C C C C C C C C C	15 1. 64001	36 1.00001	10707'T ES	100001 1.00001	52 1.660°	34 1.00004	100-01-1 69	29 1.00001	25 I. G. G.C.	45 1.00004	15 I.Cuurt	10 1.00001	10	15 1.60001	10:03-2 62	12 1.0100	17 2.LL2U1	14 1.0001	15 1.1.401	26 1.00CO?	12 1.60.01	1.00001	28 1.54 Wil	100001	r2 1.444638	5E .0001	1 n n n n n n n n n n n n n n n n n n n	1000 60	1 1.0000	1004 3. 29	59 I 100 I	20 77.36001	12.000	1.0201	10001 1 20	22 1- 30 00 1	1. 1. 00 00 1	10200-** 75	10 2.11.44	45 1.0000	50 1.000.1	·5 1.00001	1i.s. 52	12 1.00001	107771 50	10 1. 00001	
INTEGRATI A BSOAPTI	÷.	2.844	172 5	6.65	8° 551	10.300	12.17	12,991	15.851	17.77	12.72	21.69	23 67	- 25 . 65	27. 661	29.681	33.65.	33.578	35.48	37.47	39.591	41.025	44.24	46.67	49.213	51, 751	54.415	57.23	[+ F * 5 5	62.42	65.18	68.034	73.944	73+5+0	26.45	76.30	80.44	82.53	9.4.9.7	66.68	88° 8°	90.98	93.171	62° 30	51° 38	65	161.30	103 13	155.55	106.51	
A EROSCL A 85	.0428	.0410		-042E	. 8438	. 8 4 50	2943.	-147	+ 0 ~ 0 ·	.c496	. 1 5 6 7	.0518	.0529	0750.	.0551	.0562	. 151 3	.0563	*850*	.0504	.1614	.0651	.0688	.0725	.0760	.0796	1284.	.0365	6 690 °	.0932	.0967		.1032	.1364	.1095	.1126	.1157	.1147	.1165	+1161	.1136	.1115	.1092	.1075	.1064	.1058	.1048	.1036	.1628	•1013	
AERCSOL TRANS	91.0	. 5901	1529.	6238*	.8866		5439.	. 4 2 3 0		.8607	.6792	.8779	• 8765	.0751	.8738	• 8 7 2 5	. 6712	. 6699	.8665	•8 E7 3	.8561	. 6 6 2 9	. 8598	1926-	225 8*	.050.	8 4 7 8 °	.8449	6548.	5 95 9°	, 8364	.8336	. 8 3C 9	.8282	• • 256	• 8 2 2 9	. 8204	.5178	. 6170	525 9 *	.0176	.6179	. 8182	1619r	•0199	.8 2 0 3	. 8216	. 8225	1000 B	2 5 2 8*	
MOL SCAT TRANS	1.4000	1.0000	1.0000	1.0000	1.000	1.0000	1.000.	1.0500	1.000.1	1.6030	1.0366	1.9000	1.0000	1.000	1.0306	1,0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1-0000	1.0000	1.0000	1.0000	1.0000	1.2640	1,0000	1.0000	1.0070	1.000.	1.0900	1.0000	1.000	1.0000	1.0000	1.0300	1.0000	1.0000	1.0000	1.0000	1.0100	1.0600	1.0000	1.9.00	1.0000	1.9000	1.0000	- 56 H
H20 CONT TRANS	47574	.7567	• 7629	•7670	6 D 4 4 *	1747	* 2 7 8 4	.7019	.7853	.7466	916/°	6762*	6/6/ *	. 698.	.8035	5062	2 0 0 2	.0112	- 2136	.4159	.0151	.8203	. 8223		. 5252	4251	. 3299	. 5316	. 0 3 3 2	.8348	.6364	6373	. 6 3 9 3	.8406	.8420	a432		.8456	9469	5149*	.8489	* 5 4 9 9	505 0 -	.8518	.8527	.8536	• 8544	• 8552	. 8560	. 6553	ITTANCE ≈
NZ CONT TRANS	1.0019	1.0030	1.0010	1-6030	1.2000	1.0000	1.0002	1.0000	1.9000	1.0010	1.0000	1.0300	1.0000	1.000	1.0000	1.0000	1.000 5	1 + 0000	1.9005	1.000 0	1.000	1.0000	1.103	1.0002	1.000	1.0230	1.0000	1.0004	1-5000	1.000(1.0001	1.000	1.4000	1+0000	1.000	1.0000	1.0000	1.0000	1-9600	1-0000	1.0000	1.0000	1.9550	1.0090	1.8000	1.4000	1.4004	1.6060	1.0000	1.6006	GE TRUNSNI
0 20ME TRANS	1.0000	1.0530	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	6666 .	1666.	0865.	.9966	**65*	. 9911	.9860	.9762	• 96 39	.9485	. 91.64	. 88 92	.8631	61 29	.0119	6062 .	7.640	.7785	.7213	2442 -	1010.	. 75 90	1367.	• 7686	.8149	. 8837	.9762	• 98 64	04 06 *	44.96	. 98 77	.9869	285.	.9870	• 9863	* 58 60	1505.	.986.	1296*	1066.	6266 *	6.61 AV ER 3
CO 2+ TRANS	1-0003	1966.	2 \$ 66 *	1066.	.98.52	18 16 ·	.978.	.9603	.9531	- 94.75	5115		.9451	.9443	.9377	.9377	.3459	9096.	-976-	.9891	94945	0166.	F965	2599.	36.61	1006.	97 36	.9608	49511	.9377	-9331	.9285	• 3275	.9250	- 618-	£1.9	1426.	.9428	.9577	.9775	. 9886	1966"	1926	2666*	1966 .	.9952	.9910	.9833	.9719	.9577	1 = 10
H 20 TRANS	1926*	.9208	.9188	-91.76	1225	4507	.9545	9579	.9520	13371	. 9278	.9208	.9176	.9165	43724	- 91 Cu	-9287	.9430	.9539	-9352	9189	1001	1969		.929	8 903	54942	-9052	.9105	.9131	. 9052	5898°.	.8824	.8750	37	• 8863	1906*	.9041	• 1 9 2 9	.9766	. 94.67	.8259	.3200	.9336	. 34.87	. 35 73	.3810	542	.8541	6949.	11 45 01-1
TOTAL	.6225	.6194	•61 if	.6133	• 6 2 0 7	. 53 80	.6375	.6351	.6284	.5166	. 60.95	.6055	.6045	.6031	F752.	54 55 .	-6042	6163	.6191	.6011	-5757	.5543	579	5916		121.4	1774	.4405	. 523	.5041	49.44.	1623.	.4389	1592	4985	- 220 -	.5707	5613	2041	.585°	. 5753	.5651	+5625	.5731	.5639	• 5950	.6343	1065	.5796	•5¢86	C1 006
HAVELENGTH HICRONS	11.1111	11.0497	10.9890	10.9290	19.8696	10.5105	10.7527	10.5952	10.6383	10.5820	10.5263	13.4712	10.4157	19-342	10.3093	10.2554	10.2041	10.1523	10.1010	10.0503	10.2000	9.9502	9.411	9.8522	0.63.9	9.7561	9.70.77	9.6616	9. 61 54	9.044	9.5236	9.47.67	84348	9-3897	9.7450	9.3023	9.2×93	5.2155	9.1743	9-1324	6060°6	9.0498	6-0093	8.9685	6.9286	8.889	8.34.96	8.5195	6777B	8.7335	PTION FROM
FRED CH-1	006	985	910	915	920	926	025	935	940	945	956	955	960	965	015	975	685	195	066	16E	1220	1005	1010	5101	1020	1025	1030	1035	0405	1040	1050	1055	1060	1055	1.970	1075	1083	1085	0607	1095	1 2 6 9	1105	1110	1115	1123	1125	1130	1135	1140	1145	INTEGRATED ABSOR

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Table 11. Program Output for Case 5

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1 1	10 T T T T T T T T T T T T T T T T T T T	4 H20(6M.H-3	1. 03.06M.M-7									
C, JOC 1015,000 24,407 0.02 1015,000 227,500 116 1200,000 237,550 117 1200,000 232,000 117,002 350,000 291,557 0.010 952,000 291,557 1.010 832,000 291,557 1.010 842,000 291,557 1.0100 842,0000 291,557 1.010 842,000 842,0	5			IN NO . DEN.				AER	CSCL PRO	3113	ENTINCI	NOI
116 1000,000 Z2:00 Z2:00 10 10 10 10 10 10 10 10 10 10 10 10 1	5.4	-9 C. -9 C. -9 -136E+92	0. .603E+04	.158E+06	23,600			1 RITIME			ήÀ	ZTIME
5553 556.296 17.400 .5568 959.000 29.4957 1.088 892.000 14.696 1.1080 892.000	19 19 19 19	.7 C. .0 .155E+02	0- 0E-04	.148E+00	23.000	9 4 9 4 9 **	ы м	BWITIWE			4 4 X	34111
1.080 892.000 14.600 14.600 1.1.180 892.000	16.1 2.	0 0. 	9. . FORF-D4	. 12 26 4 M 1	0.000	0+ 0+	R N N	LRT TIME			0 4 4	LTIME
139.742 000.548 041.1	11.9	.0 0.	D		0.002	• • •						
		• 3 • • 1 3 FE + 4 2	.611E-04	.955E-01	23.000	-1- -1-	£ ~	INT THE			U P H	JIIHE
1.4345 8554853 7454950 1.4356 8554853 2454950		.1 .0 .599E+01	.600E-04	• 77 5E-01	23.000		2 m	ARTIME			5 9 M	I TIME
1-550 832-900 12-70	1 2 3-	- 2 3	0.		0.000							117 MC
1.650 832.910 295.955 2 232 735 610 14.800-		292E+01	• >00E-04	• /31E-01	23.300		2 7	SUTITAL				
2.270 775.000 284.350-		• 0 • 111E+01	. 635E-84	530E-C.	23.003	, 	ц,	s	PRIG SUM	×	1 40.6	4 Эні dS Ov
3+1+0 703+059 7+20C-	-20.8 0.	.0 1.	0			0 ' 0 '	-	·	0020	2	1 600	C C D H F D
5.1443 710.160 770.400 5.820 500.100 -101.100-	0 4 02-	• • • • • • • • • • • • • • • • • • •	. 5/35-94 1.	• • • • • • • • • • • • • • • • • • •		- 0 - 0	. =	n				
	29.1.9	0 501E+03		-148E-12	23.010	 . <i>P</i>)	÷	s	CDI 20145	ĩ	1609	SPHE 2
5.930 488.600 -11.60°-	-57.5	• C 0•	5		0.010	0 0	~					
5.330 43A.000 261.655-	-27,5 0.	• 0 • 5 3 3 E + C 0	469 .E-B.	• 77 2E- 32	23.060	•••• •••	م	ŝ	LTC SLA	I	12051	13MdSD
		.0 C. . 3775.FA	J. 7775-01.		0.000			v	Parc Sur	I	1505	Bakasco
-100-100 -100-100 -24-200-100-100-100-100-100-100-100-100-100		.0 0.		31-300r.	0.000	4 00 4 00 7 00	, .=	0				
4.720 338.000 244.650-	1 5 0	.1 .1435+00	.8495-04	.216E-J2	23.06.	1	ب ت	SI	ans Diad	X.	16.37	SSP465
3.130 318.330 -32.701-	5.7	t.			0.000		_	Ľ		a recto a		LOTO V
9.130 310.000 240.450-		176E+00	.767E-94	.1676-02	23,000			~			142 254	110 4
9,590 300,000 -005,500 -220 300,000 337,500		.0 0. .1 .1225400	. 6837 -04	.1386-02	000-12	 	7	и	DS DIG	IN STRAT 9	KGR EAC	CK STR2
-002.91- 000.96. 02.45	-42.7	• 0 0•	3.		2.004		-	1				
9.720 294.000 239.450-	-42.7 0.	.D .129E+30	• 986E-0+	.130£-02	23,000	E E	10	s	PRIG SUP	IN STRAT BI	KGR EAC	K STRA
10-120 201+000 -39-700-	-45-7 3.		1. 		0.000		. :	ç	410 J 100	M CTSAT D	770 07V	A CTOA
13.320 281.000 234.451-	- F 2	•C •351E-G1	.904E-C4	• 11 3E-U 2			2.	n	100 0TH1			
13,945 250,000 278,456- 13,945 250,000 278,456-		-9 U. -0 -502E-61		• 84 5E- 12	23. Dr0	2 m 2 m	57	S	FRIG SUP	W STRAT B	XGR EAC	K STRA
12.290 200.000 -57.100-	-50.9 0.	•0 0•	.0		0.00.0	0 0	=					
12.734 200.000 216.650-		.0 .535E+01	.1225-03	. 60 2E-93	23.000	 	1	s	HOS DIAD	IN STRAT C	KSK END	K SIRE
13.675 161.000 -63.500-	-53.0 0	J.			0.00.0				2	9 11010 10		ADTO V.
13.638 151.000 203.65C-		• 0 • 675E• 31	.1575-03	. 47 1E-C3	23.000		2	n	יור וו איז			
14.050 150.000 -71.10C-		• 3 4. • • • • • • • • • •	9 1AuF-03	. 440 F- 23	000.00	3 * 3 * 5 #	10	5	FRIC SU	IN STRAT 6	KGR EAC	X STPA
10111111111111111111111111111111111111			0.		0.000	 	-					
16.450 100.000 202.250-	20.07	.0 .55CE-01	• 22 3E - 0 3	.401E-03	23.070		93	s	PRIG SUP	H STRAT O	KCR BAC	K STRB
.210 8.550	35.51	00 0.000	0.00.0									
H1= .210rM .H2= 6.	550K4, 41	NGLE= 35.580C	BEDN. RANGE	. = 10.24KH	,8£73≊ .	05341						
903.616 1145.909 5.000												

FREQUENCY AMME VI= 91040 FM-1 TC V2= 114540 CM-1 FCR DY = 54D CM-1 E 8473 - 11411 MICROWS)

STRAT BKGR

VERTICAL PROFILE AT RUSOL MODEL =

447E MODEL = 23.0 KM VISUAL RANGE AT SEA LEVEL

VIS= 23.0KH

HAZE MODEL 3 = MARITIME Season = Spris Summ

...

•• : TX(12-14)= 0.

FRCM POINTN HEIGHTE A.5500 KM,N= 11,NF= 0,REF. INGEX ABOWE & EALOW X= .1000F-03 .1154E-03,17× 1 Eqjiv. Absorger Amounts PFR XM at X= .654e-02 .476E+46 «257E+02 .4194E+00 .217E-04 .384E+00 0.

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TX(12-14)= .240E-02 8.

.347E-32

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	ΥĒ	RTICAL F	ROF 1LES											
11	ALT	, ЮСН	CD2+ H20144)	E CNT	NZ AER2	HZO(10H) AER3	N JL S PE 34	A E R 1	(10)20	ISd	[Kd	8ET #	THETA	PANGE DPANGE
~	.210 5. .560	9266+01	3.6275-01 6.852F-02	1.167E-03 2 9. 0	:• 8465-01	1. 462 E-8 2 0.	3. 847E-81 5 0.	;•682E- 8 2	1, 204E-C3	C. 000 J	144.5222	. 0022	35-5644	13
٣	.560 L.	2785+00	8.617E 01 1.939E-01	2 .9 48 E-03 6	. 716E-01	2. 993E-82 č.	5,32:E-01 1 0.	.,258E+ 0 1	2.992E-03	-000-	244.5052	.0056	29, 450Z	1.1
4	1.480 1. 1.526	00+3169	1,2555400 2,5485-01	4.298 6-0 3 9 2.	.724E-01	3. 726E-02 C.	1. 380E+00 1 0.	L.730E-81	4.5266-03	5000*	144.5076	. 406 .	35° 4° 55	1.6 .55
ŝ	1.526 1. 1.650	740E+00	1. 7585+80 2.6365-01	4.699E-03 1 0.	• 051E+03	3, 7956-02 C.	1.501E+00 1 0.	1.8456-81	4.9526-03	- 0012	144.5081	. 3092	35.4927	1.5 .15
чС	2.27C	854E+00	1.8355+00 2.8315-01	5+625E-031	• 40 9E +0 0	3.855E-02 D.	2,079E+00 1 0,	******	7.094E-03	. Cult	144.5117	2270.	35 4 35 3	2.5
•	2.279 1. 3.149	933£+00	2,4205+01 2,9196-01	9.3016-03 1 3.	. 639E+00	3.899E-02 0.	2.850E+83 1 D.	1• 845E - 81	1.016E-02	2210+	144.5166	0 P T Q .	3684°SE	3.6 1.67
a)	2,140 2, 5,820	0755+00	3.729E+D3 3.1695-01	1.740F-02 2 0. 1	.758E-00	₹.959£-82 0.	4.769E+00 1 0.	1.845E-01	2+ 019E- 02	.0035	144.5324	0359	35.4847	6 * 5 3 • 2 3
ø	5.820 2. 5.990	00 DE+ 00	3, 790E +01 1, 171E -01	1.790E-02 2 0.	. 26 0E+ 0 0 . 025E- 0 1	3. 962E-02 U.	4. 875E +06 1 0.	1*242E-\$1	2.4866-12	5464.	144.5325	. 1370	25 4EBE	7.1
2	5.990 2. 7.510	1226+00	4.2565+05 3.2595-01	2.?51F-62 3 3. [11356+00 .1376-01	3.960E-02 0.	€,739°+00 1 0.		2.721E-02	.0050	144.5418	• C + 5 B	35.468	9.0 1.87
11	7.510 ?. 8.550	135E+ÅÅ	4 - 516E + 01 3= 29 15 - 01	2.576E-32 3 3.	. 2706+00 . 1806-51	3,9856-62 D,	6.2525+00 1 0.	L.845E-01	2+197E-02	.0057	144.5477	1231	35°+596	10.2 1.23
	EQUI	VOLENT S	IEN LEVEL A	CMT a JENCSO	UNTS									
		Ŧ	18TER VIPCU 64 Em-2	ы CO2 5 КМ	тс .	02 DNE ATH CH	MITRDGEN (C Ky	CON TJ M20	(CONT) CM-2	10F 10F 10F	CAT	AER1. Ni	DZENEC	X
	HC1-	8) =	*214 c +01	, 452E+		250E-01	. 32 7E+01	5 ° ° °	9£ - 01 5E + 00	, 625E+01	•13	4 E + O G	.3236-0	

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AER? AER? AER3 H(12+15)= 1+10%-01 0. ICH 3 6 10 15 Extinction and Absorption Coefficients

R.W. MEAN 8.019E+01

a. A€R4

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900		TRANS	TRANS	TPANS	T C A M	TPAKS	TRANS	TRANS	TPANS		AFSORPT TO	TRANS
910												
510	1111111			1.0070			7075		1975		* 100°	
076												
	10.7290		.									
126	4692 nt	1666.					1767		3 3 4 5	COTN4	2122.1	
020	10.7577	6742		51851	1.40.04		7306	1-0000	. 9766		11.1636	1 2 7 2 2 - 1
910	10.6952	. 7 . 5	1124-		1.000		7 7 7 7		0.00		15.7461	
070	10.6333	57.50	34.45	0.4.2					10.01	1910.	1 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	
	10.500 PT		1550	1.1.10	0000		7627		7 .		16. 227	
5	10.6263			0.940	1000		1.64		0.70		17.723	10000
	4 P P 7 4 9						7 60 -		9990		10 1705	
5	10.6167	SEAL.			0000				1040	157	1111	
	15.15.27	6607	01.66		99.63		757	1.0000			22.07.16	
	10 2002		4410	1040			1.0.1				DE EAF?	
			1010	1005.	124		2007				555 15 15	
									- 20/		10. CONCE	
100	1603 404		0696				1001					

105			1130	- 101 -			7760		0000	*****	1010.10	
90.01		1023	1010	0707					1990		34 4166	
				4600			7.4.2				76.7671	
1010	0.00.0	76	100	1000			7 7 7 6	1.0000	1.1.1.0.	1152	12.4.285	1000-1
1015	9.8577	12 4 2 4	10.0	. 006.7			7.45					
1920	9.6039	5546	5026	100	10201	1.4.100	7973	1-0000		1156	1012.24	1.50 00.1
1025	9.7561	5 T T T	- 1 B -	- 986 -	F162 -	1.0000	7895	1.0000	.9621	6156	45.5.17	1.0.10
1035	9.7087	.5435	.9214	.9837	.7841	1.8000	.7916	1.000	.9614	.0161	47.7835	1.0000
1035	9.6615	.5170	1929.	.9759	22.6.4	1.0000	1267.	1.0000	.9617	.0163	56.2487	3
1040	9.6154	•5224	6113.	.9701	. 7556	1.0000	- 7957	1.0000	•9€CD	.0165	52.6341	1.0001
1945	9.5694	.5826	9326	•9615	51.5	1.4000	.7976	1.0660	1656.	.0167	54.7260	1
1050	9.5238	.5243	£626°	.9573	.7691	1.4000	* 1994	1.0000	.5567	•0163	2 2 0 d d 2	1.00001
1355	9.4787	5062	0126.	.9540	29.42	1.9000		1.8250	.950.	.0171	1,35*65	1.5501
1360	9.4340	-52 62	.9115.	• 9>34		1.8000	. 5029	1.0000	4256°	.0173	61.9660	1.0300
1005	9.3697	29.95	6525	+ 156 +	6233	1.0000		1-0000	1356	175	E4 2791	
	9.3453	-16 - .	121 -	2976.	1682.		1909	1.5000	.9561	1111	3672.00	
	5202 6	1249	1416.		1/26-			1.00¢J		F/13.	101111111	
	5667.6 0											
	11111	1964	0205								72.7960	
	0.1724	1964	0208-		1005		0110	1.000	2520.	10101	74.3676	
	9.000	6759		1100	000		- 8164	1-6280		1177	75.946	10000
1105	5.0494	.6561		- 99.6	9868	1.4000	.0157	1.0190		.0175	77.6575	1.4.00
1110	0.000.0	.6634		. 999.	. 5881	1.8000	.6168	1.0000	9524	-0172	19.3+0+	1 0 0 0 0 1
1115	8.9586	.6724	5720	9666 *	12 86 .	1 6030	.6160	1.6080	.9526	1716.	80.9782	11
1120	8.92 <i>8</i> 6	.6813	.8859	6966 .	0206.	0000-1	.0190	1.0000	,9524	1716.	82,5716	1,00001
1125	8.889 8.889	.5913	.9003	£166°	.9867	1.0030	.8201	1.0000	.95.26	. 217.	84.1.23	3.6446
1130	8.8496	.6963	• 6 T D f	6766*	. 36 7	1.1000	.8211	1.0000	.9520	.4169	65.6162	1.00.001
1175	8.8105	.6680	- 6977	· 3395	.9885	1.8000	•8221	1.0040	.9519	.0169	87.1782	1
114)	8.7719	-6787	. 6698	.9625	-9913	1	• • • 5 3 0	1.0000	1136*	.0168	EE. 7646	1.0000
1145	8.7336	.5708	• 9 9 4 5	es 19.	£E 66 *	1.6090	.8239	1.0000	• 951 J		89 6-74	1.0.0

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Table 12. Program Output for Case 7

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	VIIVIICN		FCS2 (PAC)		FCG2 (AAC		4007 L		אמניםר		RUFAL		1 FOPOSUME		12000SPHE		P EACK STH		SPE BACK STRE		F EACK STOL		SP EACY STFA		IR EACK STPI		
	CFILG												ī		1		IN STRAT EKO		IN STRAT EK		W STPAT BKO		STRAT EK		STRAT EKS		
	CL FF(10 S UF		16 50		10 50		10 SUP		IC SUP						
	SC a Be		€C02 (S02)		FC62 (P4C)		F,2AL		5084L		RURAL		SPD		3.9.6		SPE		Spp		Ca S						
		:0	ייט ריו	10	41 07	:0			+1 +1	:5	1	10	1 2	10	1 4	10	110	:	1 10	16	с; т	 	1 10		1 10		
		0	÷٩	0	4	Ģ	H	•	ч	0	-1	5	ч	0	ч	0	÷	c	٦	cJ	-	•	•1		11	36.0	
		0	ო	U	¢,	+ 4	*1		*1	-4	41	c	ጥ	0	U'	0	0 1	•	m	0	σ	Ģ	U,	G	თ	σ. σ.	
		6.920	.503	3.003	.530	23,000	23.500	23.900	23,000	23.000	23.003	0* 3 0 0	.506	000.0	+ 500	000.0	-500	0.000	+50C	3.033	.500	0.00.0	.03.	000*0	.500	f,8∈T≜=	
0.00.	3) NG. DEN.		• 749E+C1	0.	· 745E+01	.	.1446+00	0.	, 991 6- 31		. 62 16 - 71		.617E-01	3.	•931E-12	• •	.114E-72	0.	. 79 SE-C 3	• 10	.332E-C4	.9	.1545-04	0.	.153E-16	E = 1004	
1 0 0) 63 (GH. M-		•545E-04		.5406-04		.548E-04	. .	• 2 4 0 E - D 4	g.	10-30151		+ 2+ 5 E - 3 +	3.	.460 <u>5</u> -04	. .	9036-34		.1316-43	د .	.201E-03	.	.1105-03	•	.86°E-07	3.00 . 3fch. FANG	
SSION HODE	H2) (GH. H- 3	:	.590E+01	0.	.551E+C1		.551E+01		•42 0E +01	o.	.29CE+U1	 	* 2 8 95 + 01	o.	.540€+33	.;	.18 CE - 31	¢.	•32CE-C2	:	•3¢0E-33	ç.	16CE-07		.15(E-06	0.000 E= C.Ū000	
1.0	r a	6 - 6	6.0	3	5	0.1	0°9	e••0	.	0.0	:	c · o	0° i	÷•••	0°0	0.5	5	; . .	J•0	0.0	0°0	C•C	5.5	5		O C C C G N G L	
1 5	5 - 5	0-0	C• 0	6 •0	. ·	0.3	00	0.0	0.9	0 0 0	ຍ ປີ	0. 0	0 • 0	0.0	G. J	0.0	ر ت	9.3	0.0	5.0		0.0	0.0	د • ا	ن. ن	-0 - 1	
СТЕО IN ТН 6 6 5.22 7	T (C) SEM	100 * 6	242,190	1111	265.738	3.0.0	567.52.	11111	231.602	3.030	5-5°110	0.000	275.035	ا*فار	255.703	0000-0	22 * 201	3.033	216.830	30."4	506°20C	300.00	234.500		2:3.70	13.33° H,H?= 16.0	с 0 , и
af ExeC 3 1 5 5 4525 ND.	(27) 0	050-0	101 7.000	000-0	399.ŭlu	0.0.0	946.992	010.0	83d.f33	C • 3 8 C	795. U25	0.000	201 * 7 62	C00°-	54 0. 500	0-11-0	255.000	020 •	2274303	010-0	11.970	0.000	5.746	0.050	.055	11= 0.000 ×	1145-058
PP00524 111	(14) -	3.330	9.735	365.	202.	.271	102+	1.130	1.730	2.000	2 * č 3 £	2.010	2 - 113	5,230	5.030	11.210	10, 101	266-127	11-563	77.295	20.0.65	15.000	*5.JJG	74.546	360.67	I	900.000

SLANT PITH PETWEIN ALTITUCES MI IND H2 WHERE H1 = 0.300 KM H2 = 10.990 KM J2ENITH ANGLE = 0.310 DEGREES

44.25 4005L = 45 KM VISUAL PANGE 47 SEA LEVEL

• 5 KM

=5 £A

HATE MODEL 3 = \$062 (RAD)

SEASON = SPOIG SUMM

VERTICAL PROFILE AEROSOL MODEL = STRAT BKGR

8 8.73 - 11.11 MICFCNS) 5.3 54-1 FPEQUENCY RANGE VI= 900." " "-1 TO V2= 1145.0 CM-1 FOR DV =

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HORIZONIAL PROFILES

03(UV) 2-5266-03 2-5266-03 2-5266-03 2-5206-03 2-5206-03 2-5206-03 2-5206-03 2-5206-03 2-5206-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 6-3576-03 7-577777777777777777777777777777777777
(K+1) 2.6947-704 2.6947-704 2.359967-704 2.359967-704 2.239597-704 2.239587-704 1.123957-704 1.1
4015 9.2965-01 9.2965-01 9.2965-01 9.2965-01 7.795-01 7.795-01 7.795-01 7.2675-01 7.2675-01 2.2015-01 2.2015-01 2.2015-01 6.555-03 6.755-03 6.755-03 6.755-03
H20(10) 5,5745-03 5,5745-03 5,5946-03 5,8966-03 7,8356-03 7,8356-03 7,8356-03 7,8356-03 7,1575-03 1,1575-04 1,1575-04 1,1575-04 1,5545-07 1,94456-07 1,9456-
A2 33655-01 7.0865-01 7.0865-01 6.0145-01 4.80555-01 4.80555-01 4.80555-01 4.905-01 5.5555-01 7.4125-02 3.5555-01 3.1955-02 3.19555-02 3.19555-02 3.19555-02 3.1
<pre>(, 4938-43 2, 4938-43 2, 4728-40 2, 4728-40 2, 4728-40 2, 4728-40 2, 4728-40 3, 4538-40 1, 6928-40 1, 6928-4004-4004-4004-4004-4004-4004-4004-40</pre>
C024 3.2946-01 3.2946-01 3.55666-01 3.45666-01 3.4566-01 3.4566-01 3.4566-01 3.4566-01 1.2536-01 1.2536-01 1.2536-01 1.2536-01 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4, 1.4
H2C 5.78576-01 5.278576-01 5.278576-01 3.21956-01 2.32956-01 3.24556-01 3.24556-01 5.24556-01 5.24556-01 7.52685-02 7.52685-02 7.52685-02 7.52685-02 7.52685-02
2000 2010 2010 2010 2010 2010 2010 2010
1111 989.600 989.6010 998.992 998.6010 998.6010 898.5010 795.1010 265.5010 265.7510 267.7510 26017 794.6017 264.75000 264.75000 264.75000 264.75000 264.75000000000000000000000000000000000000
400000404040 400000404040 40000000000
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	545	5755401				2-45411							
	8F 21 * 2 4 1	-											
	1029								1405-03 0	0 90 - 30 56.	3225-05 5	640F-05 0	600E-17 C
	A583						.1746-02 0	.310E-03 0					
	A5P2			434F-01 0.	0105-02 0.	-210F-02 0.) . .					
	26P1	7.495E+00 3.	7.495E+0ú ĉ			а.							
	HNCE	•							.0565-05 0	. 25 96-35 0	. 705E-06	.4416-07 1	
	(20 C C A)	C 20-361% *	787E-C2 1	7.8725-62)	5.897E-C2 0	3.2916-02 3	3.973F-02 3	A.194E-03 0	2.5025-34 1	1.1675-04 2	2.194E-C7 3	3.4715-08 1	4.777E-13 J.
POFILES	* -	201.955	295.748	235.762	291.696	275.100	275.035	255,716	223.200	216.810	226 525	276.500	219.700
CZCNTAL PI	٩	1013-000	989.010	986.892	898.600	795.03r	200.467	540.506	2-5.010	227.000	11.970	5.746	355
1204	¢ר⊺	0.10 1	. 20	• 20	1.00	2. 33	2.01	5. 50	10.60	11.50	30.00	35.00	70.03
	A	••	N	۲	t.	ſ	ъ	~	æ	σ	с і •••	:	21

PJININ MEIGHT= 0.9990 KM,W= 1,NP= 1,REF. INDEX ÅBOVE K KELOM ∴= .2694E-03 C. Equiv. Abscrafe Amgunts pik km åt X= .5746+00 .3296+00 .2496-02 .5396+00 .6576-02 .5486+00 .7496+01 .2558-ú2

TX(12+14)= 3. 0. C.T

.4206-02 ¢60H POINTN MEIGHT= 10.0℃C°C K4,N= 8,NP= 1,R€5, INDEX AGCVE & B€LOA X= .48654£-04 .1278E-03,IP= 1 Eouiv Absomest apounts per ka at X= .593E-03 .126€405 .255E-02 .4741E-01 .118€-∪5 .320€400 0. ş.+

¢.

TX112-14"= 0. 0. 4114E-02

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10. EXAMPLES OF TRANSMITTANCE AND RADIANCE SPECTRA

Some examples of transmittance and radiance spectra obtained from LOWTRAN 5 are presented in Figures 28 through 41. Figures 28 to 30 show the variations in transmittance and radiance with the six model atmospheres for three atmospheric paths. The rural aerosol model, with a 23-km VIS, was used for the boundary layer, and the default aerosol models for the rest of the atmosphere. The spectral regions shown are between 400 and 2000 cm⁻¹ and between 2000 and 3600 cm^{-1} .

Figures 31 to 38 show the variation in transmittance and radiance with atmospheric slant path for the U.S. Standard model atmosphere and the rural, 23-km VIS, aerosol model for the spectral region between 400 and 4000 cm⁻¹. These figures show the range of observer altitudes, zenith angles, and atmospheric slant paths to which the code can be applied to model transmittance and radiance for specific atmospheric problems.

Figure 39 shows the transmittance from ground to space from 0.25 to $4 \mu m$. This calculation used the U.S. Standard model atmosphere and the rural aerosol model with a 23-km VIS.

Figure 40 shows the variation in transmittance in the spectral region between 400 and 4000 cm^{-1} for the rural, maritime, urban, and tropospheric aerosol models. The calculation is for a 10-km horizontal sea-level path using the U.S Standard model atmosphere and a 23-km VIS.

Figure 41 shows the transmittance of the two fog models in LOWTRAN for a 0.2-km horizontal sea-level path and a 1-km VIS in the spectral regions from 400 to 4000 cm⁻¹.



a. transmittance, from 400 to 2000 $\rm cm^{-1}$







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c. transmittance, from 2000 to 3600 $\rm cm^{-1}$



d. radiance, from 2000 to 3600 $\rm cm^{-1}$

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a. transmittance, from 400 to 2000 $\rm cm^{-1}$



b. radiance, from 400 to 2000 $\rm cm^{-1}$





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Figure 31. Transmittance and Radiance Spectra for a Vertical Path Looking to Space From H1 (H1 = 0, 20 km, 40 km, H2 \geq 100 km, ANGLE = 0°) the Rural Aerosol Model (iHAZE = 1, VIS = 23 km) and the U.S. Standard Atmosphere (MODEL = 6), From 400 to 4000 cm⁻¹; a. transmittance, b. radiance



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Figure 32. Transmittance and Radiance Spectra for a Slant Path at 45° Looking to Space From H1 (H1 = 0, 20 km, 40 km, ANGLE = 45°) With the Rural Aerosol Model (IHAZE = 1, VIS = 23 km) and the U.S. Standard Atmosphere (MODEL = 6) From 400 to 4000 cm⁻¹: a. transmittance, b. radiance



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Figure 33. Transmittance and Radiance Spectra for a Slant Path Looking From Space to Space Through a Tangent Height of HMIN (ITYPE = 3, H1 \geq 100 km, HMIN = 0.5 km, 20 km, 40 km) With the Rural Aerosol Model (IHAZE = 1, VIS = 23 km) and the U.S. Standard Atmosphere, From 400 to 4000 cm⁻¹: a. transmittance (for HMIN = 0.5 km, the transmittance is ~ zero between 400 and 4000 cm⁻¹), b. radiance







Figure 35. Transmittance and Radiance Spectra for a Slant Path Looking to the Ground From H1 (H1 = 10, 20, 30 km, H2 = 0 km, ANGLE = 135°) With the Rural Aerosol Model (IHAZE = 1, VIS = 23 km) and the U.S. Standard Atmosphere (MODEL = 6), From 400 to 4000 cm⁻¹: a. transmittance, b. radiance



Figure 36. Transmittance and Radiance Spectra for a Vertical Path Looking at the Ground From H1 (H1 = 10, 20, 30 km, ANGLE = 180°) With the Rural Aerosol Model (HHAZE = 1, VIS = 23 km) and the U.S. Standard Atmosphere (M)DEL = 6) From 400 to 4000 cm⁻¹; a. transmittance, b. radiance

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Figure 39. Transmittance Spectra for a Vertical Path From Ground to Space From 0.25 to 4 μ , Using the Rural Aerosol Model, 23-km VIS and the U.S. Standard Model Atmosphere

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Figure 41. Transmittance Spectra for the Advection Fog (Fog 1) and the Radiation Fog (Fog 2) Models, for a 0.2-km Horizontal Path at Sea Level, With the U.S. Standard Model Atmosphere and a 1-km VIS, From 400 to 4000 cm⁻¹

11. AEROSOL MODEL COMPARISON WITH MEASUREMENTS

Between January and September 1970, EMI Ltd. made a series of measurements of infrared transmittance at various wavelengths over the sea. ^{80, 81} Under the conditions of the setup, the experiment was largely a measurement of aerosol extinction and it provides a data set against which the LOWTRAN maritime aerosol model can be tested. This section will review these measurements briefly and compare them with LOWTRAN calculations.

11.1 Measurements

The EMI measurements were made over a 20-km path across Mounts Bay at the southwestern tip of England. Most of the path was several kilometers offshore. The source for the transmittance measurements was a 3800-K carbon are blackbody while the receiver was a Golay cell mounted at the focus of a 76-cm diameter

^{80.} Arnold, D.H., Lake, D.B., and Sanders, R. (1970) <u>Comparative Measure-</u> <u>ments of Infrared Transmission Over a Long Overseas Path</u>, EMI Report DMP 3736.

^{81.} Arnold, D.H. and Sanders, R. (1971) <u>Comparative Measurements of Infrared</u> Transmission Over A Long <u>Overseas Path</u>, EMI Report DMP 3858.

mirror. Various filters could be placed in front of the detector. In this report, data will be presented on three filters: their filter response functions are shown in Figure 42.



Figure 42. System Response Functions for Three of the Filters From the EMI Measurements: 1. 0.57 to 0.97 μ ; 2. 3.5 to 4.2 μ ; 3. 7.9 to 11.3 μ

In addition to the transmittance, other physical parameters were measured at one end of the path, including: air temperature, relative humidity (from a wet and dry bulb thermometer), wind speed (estimated according to the Beaufort scale), wind direction, and visibility (estimated by an observer viewing six landmarks around Mounts Bay). A block of data consisted of the measurement of these physical parameters plus the detector response for each of the filters consecutively.

11.2 Calibration

The measurements were calibrated by selecting one particular data block with the highest (relative) measured transmittance for the 7.9- to 11.3- μ filter: for this case the absolute transmittance was calculated using the data from Altshuler.⁸² Comparing the absolute calculated value of the transmittance with the relative measured value allowed the baseline for this filter to be set. The system response for the other filters relative to the 7.9- to 11.3- μ filter was also measured over a short path with negligible attenuation. From the absolute transmittance for the 7.9- to 11.3- μ filter and the relative responses of the other filters, the baselines for the other filters could be set.

82. Altshuler, T.L. (1961) <u>Infrared Transmission and Background Radiation by</u> <u>Clear Atmospheres</u>, GE Report 61SD 199, AD401923. The data are actually presented as "effective atmospheric extinction coefficients" σ which are related to the filter-averaged transmittance \overline{T} by

$$\sigma = -(\ln \overline{T})/L \tag{32}$$

where L is the path length; in this case 20 km. (Note that σ is merely the log of the transmittance and is not comparable to a band model extinction coefficient. Since the transmittances span four orders of magnitude, it is necessary to present the data on a log scale.) As will be seen later, the quality of the calibration appears to be good.

11.3 LOWTRAN Calculations

To compare with the measured transmittances, the equivalent filter-weighted transmittance for each data block was calculated using LOWTRAN 5. The required inputs to LOWTRAN were given by the path length (20.0 km) the pressure (assumed to be 1013.25 mb), and the measured temperature and relative humidity. The inputs relating to the aerosol extinction are the aerosol model and the meteorological range. For most calculations the maritime aerosol model was used. However, the observer-estimated value of visual range reported in the data was found to be inaccurate and unrepresentative of the conditions along the path.

To circumvent this problem with the observer estimated visibility, it was decided to use the measured value of the extinction for filter 1 (0.57-0.97 μ) to derive a value for the meteorological range. The meteorological range, VIS, is defined as the path length over which the transmittance at 0.55 μ is 0.02. From this definition and from Beer's law

$$VIS = \frac{3.912}{\sigma(0.55)}$$
(33)

where σ (0.55) is the total extinction coefficient at 0.55 μ and 3.912 = ln (0.02), (See footnote on page 22, Section 3.2.)

In the spectral region from 0.57 μ to 0.97 μ , the extinction coefficient is dominated by the aerosol extinction coefficient which in LOWTRAN depends only upon the wavelength, VIS, and to a lesser extent, the relative humidity. Neglecting the relative humidity dependence for now, if σ_1^* is the calculated mean filter-weighted aerosol extinction coefficient for filter 1, then $\sigma_1^* = \sigma$ (0.55) B, where B is a constant. One can then write

$$VIS = \frac{3.912 \times B}{\sigma_1^*}$$
(34)

Now between 0.57 and 0.97 μ , the aerosol extinction coefficient varies slowly with wavelength, especially for the maritime aerosol model (see Figure 10a). For this reason we can approximate σ_1^* by the measured effective atmospheric extinction coefficient σ_1 (Eq. (32)) even though the spectral weighting is different for the two quantities. Therefore, to the degree of approximation noted above, one can write

VIS = $3.912 \times B/\sigma_1$

In practice, the constant B was determined empirically by assuming an initial value of B and calculating the "effective extinction coefficient" (that is, $-L^{-1}$ ln \overline{T}_1 , where \overline{T}_1 is mean transmittance for filter 1 calculated by LOWTRAN) for each case in the data set. B was then adjusted until the mean of this value averaged over the sample equalled the mean of the measured values σ_1 .

11.4 Results of the Comparison

This section will present the results of the comparison of the measured and calculated extinctions for various subsets of the measured data. In the figures to be presented, the axes will represent the "effective extinction coefficient", that is, $(-\ln \overline{T})/L$, where \overline{T} is the filter-weighted mean transmittance over the path length L = 20 km. The solid line in each figure is a 45° line through the origin while the dashed line is a least-squares fit of the calculated extinctions to the measured ones. Note that since both the measured and the calculated extinctions contain errors, simple least-squares theory is not strictly applicable in this case.

Figure 43 shows the calculated vs the measured effective extinction coefficient for the 7.9- to 11.3- μ filter for the 50 cases of highest meteorological range (that is, the lowest extinction in filter 1). The maritime aerosol model was used in the calculations; however, due to the combination of the spectral region and the high visibility, the maximum calculated aerosol extinction in these cases is less than 0.02 km⁻¹. This graph then is primarily a demonstration of molecular extinction.

The regression line gives an indication of the quality of fit. The fact that the y-intercept is nearly zero indicates that the calibration of the measurements is good while the slope of the line of 1.09 indicates that the average fit is within 10 percent. The standard deviation about the regression line is 0.016 km^{-1} ; the random uncertainty between the measured and the calculated extinctions can be taken as plus or minus two standard deviations or $\pm 0.032 \text{ km}^{-1}$. The mean transmittance for this set of points is about 0.09. For the level of transmittance, the uncertainty in the "effective extinction coefficient" of $\pm 0.032 \text{ km}^{-1}$ translates to an uncertainty in the transmittance of about ± 0.06 .



Figure 43. Comparison of the Calculated vs the Measured "Effective Extinction Coefficients" for the 7.9- to $11.3 - \mu$ Filter for the 50 Cases of Highest VIS, Using the Maritime Acrosol Model. The dashed line is a simple least-squares fit of the calculated to the measured data: the slope, the intercept and the standard deviation about the regression line are given

Since the calibration error appears to be negligible, all further regression lines will be constrained to pass through the origin.

The maritime aerosol model is designed to be representative of moderate wind speed conditions over the open ocean. To test the validity of this model, those cases for which the wind was off the ocean and between 6 and 17 m/sec (Beaufort scale 4 to 7) were selected. The results for this subset of the data for the 3.4 to 4.2μ and for the 7.9- to $11.3 - \mu$ filters are shown in Figures 44a and b. In both cases, slope of the regression line is not significantly different from 1, indicating a good average fit between the calculated and the measured extinctions. Also, the standard deviations about the regression lines are not significantly greater than that in Figure 43, indicating the same level of random error.

To demonstrate the results when an inappropriate aerosol model is used, the subset of the cases for which the wind was offshore was chosen and the LOWTRAN transmittances were calculated, again using the maritime aerosol model. The results for the 3.4- to 4.2- μ and the 7.9- to 11.3- μ filters are shown in Figures 45a and b. In Figure 45a the calculated extinctions in the 4- μ region are clearly









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too large, by almost a factor of 2 for the high extinction cases. For the $10-\mu$ filter shown in Figure 45b, the slope of the regression line is only slightly greater than that in Figure 44b, where the proper aerosol model is used, and is the same as in Figure 43, where aerosol extinction is relatively unimportant. The scatter of points in both Figures 45a and b is double that in Figures 44a and b respectively.

Since the maritime aerosol model is inappropriate for these cases for which the wind blows off the land (at least for the shorter wavelengths), these cases were rerun using the rural aerosol model (and adjusting B in Eq. (34) so that LOWTRAN returns the same calculated extinction for filter 1 as was measured). These results are shown in Figures 46a and b. In Figure 46a, the calculated extinction in the 4- μ region are now too low, again by a factor of almost 2 in the high extinction cases. In Figure 46b, the slope of the regression line has been reduced to slightly less than 1.0, but it is still not significantly different from 1.0. The scatter of these points using the rural model is less than those using the maritime model in about the same proportions as the reduction of the slopes of the regression lines.

The conclusions that can be drawn from these data are as follows: in the $4-\mu$ region, the maritime aerosol model provides a reasonably accurate description of open ocean, moderate wind-speed conditions. For air masses originating over land, the maritime model gives far too much extinction. The rural model is not appropriate for the offshore wind cases either, probably because as the wind blows over the short stretch of water it generates sea spray and picks up some marine-type aerosols. For the cases of offshore winds the most appropriate model is some average of the maritime and the rural models.

In the 10- μ region, aerosol extinction is less important than in the 4- μ region, so that the choice of the aerosol model is less critical. Again the maritime model gives an accurate description of an open ocean, moderate wind-speed condition. However, even in situations where an inappropriate aerosol model is used, the results may not be greatly in error.

12. SENSITIVITY TO METEOROLOGICAL INPUT PARAMETERS

In this section, an example of variations in transmittance, calculated from the LOWTRAN model, due to uncertainties in meteorological input parameters is presented. It is given to illustrate one method of determining the sensitivity of the program to meteorological conditions, which could be applied by LOWTRAN users to a specific atmospheric problem. A more definitive study in this area, using a

similar approach for electro-optical systems application, has been carried out by Snyder⁸³ of the Naval Oceans Systems Center.

In general, the transmittance, $\overline{\tau}_k$, calculated from LOWTRAN for an atmospheric path at a given wavenumber, ν_k , depends on an array of meteorological input parameters, x_i .

$$\overline{\tau}_{\mathbf{k}} = \overline{\tau}(\mathbf{x}_{1}, \ldots, \mathbf{x}_{i}, \ldots, \mathbf{x}_{N^{n-1}\mathbf{k}})$$
(35)

The N-parameters, x_i , correspond to temperature, pressure, molecular absorber amounts, aerosol type and amounts, meteorological range, path length, etc.

Assuming that the variations in the input parameters, Δx_i , are completely independent, the variation in the total transmittance can be written as

$$\Delta \overline{\tau}_{k} = \pm \left[\sum_{i=1}^{N} \left(\frac{\partial \overline{\tau}_{k}}{\partial x_{i}} \right)^{2} \left(\Delta x_{i} \right)^{2} \right]^{1/2} .$$
(36)

Equation (36) defines the rms variation in total transmittance at the wavenumber, $\nu_{\mathbf{k}}$, for independent variations in the meteorological input parameters. It does not include LOWTRAN model uncertainties such as the band model approximation for molecular absorption or the assumption of homogeneous layering of the atmosphere, with thermal equilibrium in each layer.

Since the transmittance is usually a highly non-linear function of the input parameters, the partial derivatives, $(\partial \overline{\tau}_k/\partial x_i)$, of the transmittance in Eq. (36) must be calculated numerically, starting from a given set of input conditions and a specific atmospheric path. The atmospheric case chosen for this example is a horizontal path of 2 km at sca level, with a meteorological range of 4 km for the rural aerosol model, and the 1962 U.S. Standard atmospheric model. The transmittance for this case from 500 to 3000 cm⁻¹ is shown in Figure 47.

The partial derivatives of the transmittance were calculated from this set of starting conditions by successive runs of LOWTRAN in which the various meteorological parameters were varied one at a time between 500 and 3000 cm⁻¹. The partial derivatives of the transmittance were stored in an (NxM) matrix, where N is the number of meteorological parameters varied and M the number of wavenumber points. Figure 48 shows the partial derivative of the transmittance with respect to the water vapor density for this path and Figure 49 the derivative in transmittance with respect to meteorological range.

^{83.} Snyder, F. P. (1978) The Effects of Meteorological Uncertainties on Electro-Optical Transmittance Calculations, Naval Oceans Systems Center, San Diego, California, NOSC-TN-440,











Figure 49. Partial Derivative of the Total Transmittance for the Case in Figure 47 With Respect to VIS

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The variation in the total transmittance is shown in Figure 50. Uncertainties in five input parameters (pressure, temperature, meteorolegical range, water-vapor density, and path length) were assumed for this atmospheric path. For the values used, transmittances varied by approximately ± 5 percent in the window regions (1000 and 2500 cm⁻¹).

13. COMMENTS

It should be remembered that the transmittance and radiance values obtained f. om LOWTRAN are at a spectral resolution of 20 cm⁻¹, although the output can be obtained at 5-cm^{-1} intervals.

The program will round off input frequencies to the nearest frequency at which spectral data are given.

The overall accuracy in transmittance, which this technique provides, is better than 10 percent. The largest errors may occur in the distant wings of strongly absorbing bands in regions which such bands overlap appreciably.

The reason for this error is twofold. First, the spectral curves in Figures 19 to 21, Section 5 are based on a single absorber parameter and cannot be defined for a wide range of atmospheric paths without some loss in accuracy.

Secondly, the transmittance in the window regions between strong bands generally lies in the weak-line approximation region, where the transmittance is a function of the quantity of absorber present and not of the product of absorber amount and pressure. The one-dimensional prediction scheme presented in this report is less accurate for such conditions. The digitized data were obtained for conditions representative of moderate atmospheric paths and will tend to overestimate the transmittance for very long paths and underestumate the transmittance for very short paths, in the spectral regions described above.

As the transmittance approaches 1.0, the percentage error in transmittance decreases toward zero but the uncertainty in the absorption (or radiance) increases.

Additional constraints on both the validity of the model as well as the range of applicability are introduced for atmospheric radiance calculations. As mentioned above the atmospheric radiance becomes less accurate for very short paths. In addition, the radiance calculations assume local thermodynamic equilibrium exists in each layer of the model atmospheres. This assumption will break down for radiance calculations in the upper atmosphere. Therefore, because of the limitations in the LOWTRAN model for short paths (or small absorber amounts) and deviations from thermal equilibrium (both conditions which occur in the upper atmosphere) it is recommended that the LOWTRAN radiance calculations be restricted to altitudes below 40 km. For the shorter wavelengths (<5 μ m), scattered solar radiation becomes an important source of background radiation. Since this is not included in the LOWTRAN model at the present time, radiance calculations at the shorter wavelengths with a sunlit atmosphere should be made with caution. A single scattering solar-radiance code (SPOT) for plane-parallel geometry has been developed by Lampley and Blattner.⁸⁴ This code uses LOWTRAN 4 for the atmospheric attenuation of the solar flux.

Because of the nature of the program — which uses a layered atmosphere errors can be introduced into the refraction calculation, since we assume each layer to have a mean refractive index associated with it. This is particularly true for a long path in one layer near ground level where one would expect refraction to be a maximum; but in fact, for such a condition the program may indicate no refraction at all. If problems like these are encountered, the number of levels must be increased in the altitude region of interest.

An additional note should be made here on the calculation of transmittance. Although the code will calculate total transmittance for a given atmospheric path in either mode of program execution, the time is increased by a factor of N in the radiance mode, where N is the number of atmospheric layers along a given path.

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Appendix A

Listing of Program

A listing of the Fortran program LOWTRAN 5 (PROGRAM LOWEM) is given in Table A1 together with the 19 subroutines, as described in Section 7 and summarized in Table A2. A definition of symbols used in the main program is given in Appendix B. A segmented loader map of the LOWTRAN 5 code, from the AFGL CDC 6600, is listed in Appendix C. An additional subroutine (DRYSTR), used to generate "dry" stratospheric water vapor profiles is described in Appendix E.

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PROG PAM LONEM(INPUT=128, OUTFUT=128, TAPE6=OUTPUT, TAPE7=64) LOW 10 ¢ *LOW 20 LOWTRAN 1 NOV 79 С С Ф LOW 30 LON 40 AUTHORS LOW 50 F.X. KNEI7YS LOW €0 5. P. SHETTLE LOW 70 L. H. APREU LON 80 J. H. CHETHYND JR. LOW 90 J.E.A. SELPY LOW 100 H. C. GALLERY R. H. F.NN R. A. MCGLATCHEY LOW 110 LOW 120 LOW 130 LOH 140 PROGRAM LONTRAN DALCULATES THE TRANSMITTANCE OF THE ATMOSPHERE AND/OR RADIANCE 1.0 M 150 LON 160 FROM 35" CM-1 TO 40000 CM-1 (0.25 TO 28.57 HIGRONS) AT 20 CM-1 LOW 170 SPECTRAL RESOLUTION ON A _INEAR HAVENUMBER SCALE. LOW REFRACTION AND FARTH CURVITURE EFFECTS ARE INCLUDED. ATMOSPHERELOW IS LAYERED IN ONE KM. INTERVALS BETWEEN D AND 25 KM., 5 KM. INTER-LOW VALS TO 5° KM., A THENTY KM. INTERVAL TO 70 KM., AND A THIRTY KM. LOW i80 190 200 210 INTERVAL TO 100 KM. LOW 220 ************ ¥I N M 230 240 LON THE FOLLOWING CARDS SHOULD PE KEYPUNCHED BY THE USER LOW 250 AND HAILSP TO: F.X.KNEIZYS, AFGL/OFI, HANSCCH AFB, MASS 01731 THE CARDS WILL OF USED TO UFDATE THE AFGL MALING LIST LOW 260 270 LOW AND FOR NOTIFICATION TO THE USER OF ERRORS IN THE CODE LOW 2**8**0 LOW 290 LOW 3úC (USE COLUMNS 21 TO 72) LOW 310 LOWIS NA ME 108 320 LOWTS COMPANY LOW 3 30 LOWTE ADDRESS LOW 340 350 LCM 360 LOW #E O Li 370 PROGRAM ACTIVATED BY SUBMISSION OF FOUR CARD SEGUENCE AS FOLLOWS LOW 380 LOW 390 CARD 1 MOCEL, IHA7", ITYPE, LEN, JP, IM, H2, H3, HL, IEMISS, RO, TBOUND, LOW 460 1ISEASN, IVULCN, VIS 410 LON FORMAT (1113,2F10.3,213, F10.3) LOK 420 CARD 2 H1, H2, ANGLE, RANGE, BETA FORMAT(7F10.3) LOW 430 CARD 3 V1, V2, DV CARD 4 IXY FORMAT(7F10.3) LOW 440 FCRMAT(I3) LOW 450 108 460 MODEL=1,2,3,4,5 02 6 SELECTS ONE OF THE FOLLOWING MODEL ATMOSPHERELOW TROPICAL,MIDLATITUDE SUMMER,HIDLATITUDE HINTER,SUPARCTIC SUMMER, LOW SUBARCTIC WINTER,OR THE 1962 U.S. STANDARD RESPECTIVELY LOW 47⊾ 480 490 MODEL=0 FCR HCRI7, PATH WHEN METEOROL. CATA USECNINSTEAD OF CARE 2LON 500 PEAD H1, P(HD) AT TOES () PEAF HAEN METEUROL. LATA OBELLIY, H2C DENSITION (GM, H-X), 03 DENSITY(GM, H-3), RANGE(KH) WITH FORMAT 429. LON MODEL=7 WH5N NEW MODEL ATMOSPHERE(S.G. RACIOSONCE DATA) USED. LON DATA CAPYS APS REAP IN BEINEEN CARES 1 AND 2, AND SHOULD CONTAINN LOW ALTITUPS(KM,), FRESSURE, TEMP, DEM PT.TEMP, REL. FUMICITY, H2C DENSITY, LOW 03 DENSITY, AFFOSOL NO DENSITY , VIS1, IHA1, ISEA1, IVUL1 FORMATLOM 510 520 520 540 6.60 03 DENSITY, AFFOSOL NO DENS 435 SEE NSMDL FOR DETAILS. 560 570 LOM NOTE THAT EITHER DEW PT. TEMP.OR REL. HUMIDITY CAN BE USED. LOW 580 LOH 590 M1, M2, M3, BRE USED TO CHANGE TEMP, H20, AND 03 ALTITUDE PROFILES. LON 600

Table A1. Listing of Fortran Code LOWTRAN 5

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С	IEMISS=0=TPANS4ISSION MODE / IEMISS=1=EMISSICN FCCE	LON	€10
С	TBOUND=TEMPERATUPE OF EARTH IN DEGREES KELVIN	LON	620
С	IF THOUND = 7FRO, ASSULES AIR TEMPERATURE OF HODEL ATMOS.	LOW	630
С	•	LOW	640
C	IF IHAZE=0 NO AEROSOL EXTINCTION IS COMPUTED	LON	650
CCC	VIS PARAMETER ON CARD 1 OVERRIDES DEFAULT IHAZE VALUE	LOW	660
000	NOTE EXPANSION OF THATE PARAMETER	LOW	E 70
^	IHA7E=1 RURAL+23KH	LON	E 8 G
С	THAZE=2 RURAL- 5KH	LOW	690
Ċ	IHAZE≠3 MARITIME-23KH	LOW	700
Ċ	IHA7E=4 MARITIME-5KM	LOW	710
č	IHA7E=5 UPPAN-5KM	LOW	720
č	IHAZE≠6 TPOFOSPHERIC~50KH	LOW	730
ć	IHAZE≠7 USER DEFINED	LOW	740
ŕ	THAZE #8 FOG1 - DEFAULT VISIPILITY =0.2KM	LOW	250
č	THAZE=9 F052 - DEFAULT VISIATLITY =0.5KM	เอิด	760
č	VISTATITY FROFTLES (NEW PARAMETER-ISEASN)	108	770
ř	TSEASNEN DEFAULTS TO SEASON OF MODEL	108	7.8
č	TSEASNET SPETNG-SIMMER	LOW	790
č		1.04	8.06
č	NEW DARAMETER - TVIICN	100	#10
č	ALACKH AFRASAL TYDE AVE PROFILE	104	8 2 0
r		101	830
č		LOP	81.0
č	TVUELN-1 STRPTUS-DERIG GACKGROUND TVUELN-2 ACC VOLTANTC TVDEVMORECATE VOLCANTE ERCETES	108	850
r r	TWO CON-2 ROOS WELFANTE TYPE/HOUSENTE TO CANTE ROOFILE		0 6 0
č	TWOLEN- A CONTRACT OF EVERY VOLCANTE PROFILE	100	0.00
č	TVUEN-4 AMEE VOLVANTO TIFEVANDEDATE VOLVANTO EDDETLE		070
ι c	IVULLN-3 FRESH VJELANIG FREFILDERATE VULGANIG FRUFILE	LOW	000
C C	TTYDER 2 OD 7 THOTOSTER THE TYDE OF ATMENDURGED DATH	1.04	0.00
ĉ	TYPE-1,7 OR S THULLIES FE THE OF STREAMERIN PALK	1.0 #	900
Č.	TITES, VENTER, JN SLANI PATH DESUER AN ALTITES	LON	210
l.	ITTEES, VENTICAL OF SLANT PATH BEINFEN ING ALTITUDES	LUR	220
C C	TITPE=1, CORRESPONDS TO A HURIZON AL COUNSTANT PRESSURE) PATH	101	230
ć		LUN	940
C C	HI-CONDOC ALTINCE (KM)	LUW	550
č	HZ=SUURGE ALIIIUHE (KH) ANGLG- ZENATU ANGLG AT HA (PEGDEGE)	LON	560
U C	ANGLES ZENIN ANGLE P' HI (LEGREES)	LUN	970
ι Γ	RANGESPAIN LENGIN (RH)	LUN	980
C n	BELAEDAN IM LENIKE ANGLE NTO - NTOUAL CAUCE IT CEA LENEL (VH)	LOW	5 20
(VIS = VISUAL MANGE AF SEA CEVEL (MM)	LOW	1000
U A	(IF IITPET READ AL AND RANGES IF ITTES READ AL ANGLES	LON	1010
с 0	IF LIYPE=2 SEAS HI AND IND DIHER PARAMETERS C.G. HZ AND ANGLEP	LUP	1020
L A		LUN	10.50
C C	VIEINIIIAL FRENDENCE (MAVENUMERCONTI / INTEGER VALLE	LUN	1140
L	VERTINAL FREDURNUT (NAVENUT XER UTTI) INTEGER VALUE	LUW	1050
C C	VE FREUDENUT INTERVALS AT MAINT RANSHITTANCE IS PRINTED	LUN	1050
U	NOTE UV MOST BE A MULTIFLE OF 5 CM-1	LUN	1070
C .		LUW	1380
ι Γ	137=0 10 EV, DATE ,=1 FOR NEW VIV2, DV ONLY , =2 10 CONTINUE DAT	ALOW	1000
C	IXYES FOR NEW CADD 2 ONLY, 14 FOR NEW CARD 1 ONLY.	LOW	1100
C		TLON	1111
	COMMENT ACTIVE MODEL, THACS, II THE, LEN, JH, IP, MI, MC, MA, ML, IEMISS, RO	LUW	1120
	1, BUUNN, ISAAN, IVU, CN, VIS	LON	1150
	COMMON // ASY2/ H1, H2, ANGL: JRANGE, PETA, HATN, RE	LUN	1140
	LUMMUN /LAPUS/ V1, V2, JV, AVN, GU, UN, W(157, E 157, GA, -/]	LUN	1150
	COMMON /LNIME/ LANSI, KMAX, M, 13, 31, 32, 3 MIN, 32 XIRA, 11, IKMAX, NLL, NFI	LON	1160
	1, FIND, NL, KLU	LOW	1170
	UUMMUN /*******/ /(4),***/,54),***/*********************************	LUN	1180
	- , SEASN(2), VULUN(5), VSB(9), H7(15), HMIX(34)	LOK	1190
	COMMEN RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),TX(15)	LOW	1200

COMMON HLAY	((74,15),WPATH(58,15),TORY(68)	LOW	1210
COMMON APSC	'(4,40), FX TC (4,40), VX2(40)	LON	1220
IXY=0		LOW	1 Z 30
CALL MOTA		LOW	1240
KH A X = 15		LOW	1250
PI=2.0*45IN	1(1.0)	LOH	1260
CA= PI/180.		LOW	1270
10 CONTINUE		LOW	1280
RE=6771.23		LON	1290
IFIND=0		LOH	1300
JP NE 9 SU	JE C SC PPINT	LOW	1310
REAC 105, M	OCEL, THAZE, ITYPE, LEN, JP, IM, M1, M2, M3, ML, IEMISS, R0,	, THCUNCLOW	1320
1, ISEASN, IVL	JLON, VIS	LOM	1330
IEMISS= 1= TR	RANSMISSION MODE / IEMISS=1=EMISSION MODE	LUW	1340
IF (IEMISS.	ED.1) PRINT 11J	LOW	1350
IF (IENISS.	FQ.0) PRINT 115	LOW	1360
LENST=LEN		LOW	1370
PRINT 175.	PCCEL.IHAZE, ITYPE, LEN, JP, IM, M1, N2, H3, PL, IEMISS, RG),TBOUNLOW	1360
10, ISEASN, IV	JUL CN, VTS	LOW	1390
15 HEMODEL		LOW	1400
IF((M.50.7.	CF. H. FD. 5) . AND. I SEA SN . EQ. 0) I SLA SN=2	LOW	1410
IF (VIS.LF.	n. 0. AND. THAZE. ST. 0) VIS-VSB (IHAZE)	LOW	1420
ICH(1) = THA7	7F	LOW	1430
ICH(2)=6		LOW	1440
ICH(3)=9+1V	VULON	LOM	1450
ICH(4)=15		LOW	1460
IF (ICH(1),	LE.0) TOH(1)=1	LOW	1476
IF (ICH(3).	LE.9) [CH(3)=10	LOW	1480
IF (MODEL,	EQ.1) RE#6 178.33	LOW	1,4 90
IF (HODFL.E	(r. 4) PF=6356.91	LOW	1500
IF (HODEL .	EC.F) 9E=6356.91	LOW	1510
IF (THATE.)	NE.7) SO TO 20	LOW	1520
REAP 200.	(NUMBY,EXTC(1,I), ABSC(1,I), I=1,40)	LOW	1530
20 IF (R0.51.1	C.C) PF=R0	LOW	1540
IF (MODEL.	EC.7.AND.IM.NE.0) GO TO 35	LOW	1550
IF (IXY.GT.	· 7) 60 TO 65	LON	1960
IF (MODEL.)	50.0) GO TO 35	LOW	1570
25 READ 120, 1	H1, H2, ANGLE, RANSE, BETA	LOW	1580
PRINT 195	H1, H2, ANGLE, RANGE, BETA	LOW	1590
X1=RE+Hi		LOW	1600
IF (ITYPE.S	EQ. 7) GO TO 40	LOW	1610
IF (ITYPE,	EG.1) FO TO 65	LOW	1620
X2=RE+H2		LOW	1630
IF (PANGE.	EG.(.) 50 TO 50	LOW	1640
FRINT 135.	H1.H2.ANGLE.KANGE. BETA	LOR	1650
IF (H2.E0.	C.C.AND.ANGLE.NF. C. D) GO TO 30	LOW	1660
ANGLE=ACOS	(1.5*((H7+H1)*(1.+X2/X1)/RANGE-RANGE/X1))/CA	LOW	1670
GO TO 61		LOW	1680
30 X2=SCRT((X	1/RANG#+RANGE/X1+2.0*COS(ANGLE*CA))*X1*RANGE)	LOW	1690
H2=X2-RF		LOW	1700
CO TO F1		LOW	1710
35 CONTINUE		LOW	172
IF (ML.IF.	C) ML=1	LOW	173
CALL NS MP1		LOW	174
IM=0		LOW	175
IF (MODEL -	FC+() GD TO 65	LOW	176
NL= MI	· · · · · · · · · · · ·	LOW	2771
NOTE THAT	7 (I) MAY NOT CORRESPOND TO THE VALUES GIVEN FOR S	TANDARELON	178
MODEL ATMO	SFHERES	LOW	179
IF LTXY.GT	.72 60 70 65	LOW	1800
· · · · · · · · · · · · · · · · · ·	1 V V V V		

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	60 T 0	26		1810
	40 TE (8	ANGE. 67. 0.0) 60 TO 45	LOW.	1820
	IF (H	12.GT.0.0.AND.H2.LT.H1) IFIND=1	LOW	18 30
	GO TO	65	LOW	1840
	45 ITYPE	= 2	LOW	1850
	BET A=	ACOS(0.5*(PANGE*RANGE/(X1*X2)-X2/X1-X1/X2))/CA	LOW	18 80
	50 IF (8	ETA.EQ.C.) GO TO 55	LQW	1870
	IFINC	2=1	LOH	1880
	19E T ≃ C	A* PETA	LOH	1890
	X2=RE	+H 2	LOH	1960
	ANGLE	=ATAN(X2*SIN(BET)/(X2*COS(BET)-X1))/CA	LOW	1910
	RANGE	=X2+SIN(HEI)/SIN(ANG_E+UA)	.0M	1920
			LON	1930
		- 03 	100	1000
	55 KANUC	ANGE, CE. A.A.) RENCESXI≢ (NORT (RANGE) → ARS (COS (ANG) E€CA)))	104	1040
	50 TE (A	NGLE.NE. 0. 08. ANGLE.VE.1AD.) 9ET=ASTA(RANGE*STA (ANGLE*CA)/X2	มัดพ	1970
	TECAN	IGL . I T. O.) ANGL F = ANGL F + 180.	LON	1980
	IF (F	ANGE.LT.C.D) PANGE=-RANGE	LOH	1990
	8ET=8	ET/CA	LGW	2000
	PRINT	195, H1,H2,ANGLF,RANGE,BET	LO ₩	2010
	55 CONTI	INUE	LON	2020
	IF (]	(XY.LE.2) READ 120, V1,V2,DV	LON	2 û 3 û
	IF (1	XY.LE.2) PRINT 120, V1,V2,DV	LOW	2040
	1F (1	(TYPE.EG.1) PPINT 125, P1,RANGE	LOW	2050
	IF (1	T(PE, FQ, 2) PRIVI 130, H1, H2, ANGLE	LCW	2860
		(1746,50,3) PRINT 137, MI;ANGLE		2070
	1 1	100 CL + CM + U/ F	104	2000
	17 44	1.50.11 PRINT 14P. MODEL	108	2166
	1. 11	1.E.D. 21 FRINT 145. MODEL	LOW	2110
	TF (M	1.FQ. 3) PRINT 150. MODEL	LOH	2120
	IF (P	(.E0.4) PRINT 155, MOREL	LOH	2130
	1F (1	I.EQ.F) PRINT 165, MODEL	LOH	2140
	IF (M	4,EQ.6) PRINT 160, MODEL	LOW	2150
	IF (I	HAZE.EP.C) PRINT 190	LOW	2160
	IF (1	(HAZE.NE.J) PRINT 170, IHAZE, HZ(IHAZE), VIS	LOW	2170
	IF (1	SEASN.EC.0) PRINT 203, SEASN(1)	LOH	2180
	IF (1	ISEASN.NE.OD PRINT 205, SEASN(ISEASN)	LOH	2190
	18 (1	VULUN, EU. 9) AWINI 219, VULUN(1)	LOW	2250
		INDERVER AND FRINT FLUG VOLGALIVEGNI		2220
		:1000; / VI :1000; /V7	100	2230
	PRINT	1 HP. VI.V2.0V.ALAM.3VW	LON	2240
	CALL	HPROF	1.0 .	22.50
	CALL	GED	LOW	2260
	CÀLL	EXABIN	LON	2270
70	WRITE	(7,105)HODFL, INAZE, ITYFE, LEN, JF, IM, M1, M2, M3, ML, IEMISS, RO,	LOW	2280
	1 1800	IND, ISFASH, IVULCH, VIS	EOW	2290
	WRITE	E(7,120) H1,H2,ANGLE,RANGE,BETA	1 4	2300
	WRITE	(7,120)V1,V2, BV	LOW	2310
	11- (1	127133+80+00 00 10 73	LUW	2320
		1941 F	101	2320
	DOTN1 POTN1	τ 22Π	104	2358
	75 (11)	TRANS	108	2360
	READ	105. TXY	LOR	2378
	END F	ILE 7	LON	23.60
	JEXTE	RA = ŋ	LON	2390
	IFING	າະບໍ	LON	2400

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PRINT 179, IXY	LON 2410
IF (IXY-EQ.0) GO TO 95	LON 2420
GO TO (80.10.65.10.95). IXY	LON 2430
80 READ 123, V1.V2.DV	108 2440
$AVW = 10000 \cdot V1$	108 2450
	108 2460
PRTNT 1A0. VI.V2. V. ALAM. AVW	108 2420
	LON 2410
AS TE FEMILS, EC 43 PETNY 440	104 2400
TE TENTSS FO D DENT 115	LON 2500
	LUN 2370
97 STUP	LUN 2530
	LOW 2540
100 / ORMAN (314, ++11.4)	LON 2550
105 FORMAT (1112,2F10, 3,2I3,F11.3)	LOW 2560
1 10 FORMAT (47H1 PROGRAM WILL BE EXECUTED IN THE EMISSION MOD	E) LOW 2570
- 115 FORMAT (51H1 PROGRAM WILL BE EXECUTED IN THE TRANSMISSION	MODE) LOH 2580
12G FORMAT (7F10.3)	LON 2590
125 FORMAT (//10x,28H HORIZONFAL PATH, ALTITUDE =,F7.3,11H KM	,RANGE =,LOW 2600
1F7.3,3H KM)	LON 2610
130 FORMAT (7/10X,50H SLANT PATH BETHEEN ALTITUDES H1 AND H2	WHERE H1 LOW 2620
1=,F7.3,8H KM HZ =,F7.3,18H KM,ZENITH ANGLE =,F7.3,8H DEGR	EES) LOW 2030
135 FORHAT (//10X, 39H SLANT PATH TO SPACE FROM ALTITUDE H1 =.	F7. 3.19H LON 2640
1KM. ZENITH ANGLE = F/.3,64 (EGREES)	LOW 2650
140 FORMAT (/20X.18H MODEL ATMOSPHERE . I1.11H = TROFICAL)	LON 2660
145 FORMAT (/20X. 18H YODFL ATYOSPHERE . II. 21H = MIDIATITUDE S	UNNER) LOW 2670
150 FORMAT 1/29X.18H HODEL ATHOSPHERE .11.21H = MIDLATITUOF H	INTERS LON 2640
155 FORMAT (/2011 AN MODEL ATMOSPHERE .T1. 21H = SUB-ARCTTC SU	NHEP 3 108 2490
150 EODNAT (/2014, AN WORE) ATMOSPHERE . 11.21H - 106 - US STAND	APD 3 (08 2700
165 CODWAT (/2004) AN HOLE PITOCOUCH /11/210 - 1902 03 STAND	NTEP 3 10W 2710
100 FORMAT (2200 (CU) 470 FULL (11) 210 - 200 - REFIG H	6 4 3HKHNLOH 2720
TTU FURTHET VERVENTER AND A FE A AND THE AND	
1/5 FORMAT (725%) CONDUCT = JES. 1,29H RH VISUAL RANGE AT	SEA LEVELUM 2730
	LUW 2748
180 FURMAT (710×,214 FREQUENCY PANGE V1= ,F7, 1,134 CH-1 1C V2	= , F/.1,1LOW 2750
14H CH-1 FOR UV S,FR.1,9H CM-1 (,F6.2,3H - ,F5.2,10H MIG	RUNS JJ LOW 2760
185 FORM#1 (10(,7110,3)	LOW 2770
190 FORMAT (/20%, 39HAEROSOL SCATTERING NOT COMPUTED, IHAZE=0)	LOK 2780
195 FORMAT (10X,4H H1=,F7.3,6+KM,H2=,F7.3,9+KN,ANGLE=,F8.4,13	HGECH. FALOW 2790
1NGE =,F7.2,8HKM,9ETA=,F8,5)	LOW 2800
200 FORMAT (4(FE.2,2F7.5))	LON 2810
205 FORMAT (/201,10H SFASON = ,413)	LOW 2820
210 FORMAT (/20X, "4H VEPTICAL PROFILE A("OSOL MOCEL = , A16)	LON 2830
21% FORMAT (1H1,="X, "3HPADIANJE (WATTS/CH2-STER-XXX))	LON 2840
220 FORMAT (30X,47HER(CH-1) WVL(HICRCH) FER CH-1 PER H	ICRON 26HLON 2850
1 INTEGRAL TRANS)	LOW 2860
END	LON 2878

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	SUBROUTINE MITA	MDT 10
С		NOT 20
С	NODEL ATMOSTHERS DATA	MDT 30
С		NDT 40
	COMMON /CARC1/ MODEL, IMAZE, ITYPE, LEN, JP, IH, M1, M2, M3, ML, IEMISS, RC	HCT 50
	1 ,TBOUND,ISEASN,IVULCN,VIS	MOT 60
	COMMON /CARD2/ H1,H2,ANGL2,RANGE,BETA,HMIN,RE	NDT 70
	COMMON /CA9C3/ V1, V2, OV, AVH, CO, CH, H(15), E(15), CA, FI	HOT 80
	COMMON /CNTFL/ LENST, KMAX, M, IJ, J1, J2, JMIN, JEXTRA, IL, IKMAX, NLL, NP1	NOT 90
	1, IFIND, NL, IKLO	MOT 100
	COMMON /HDATA/ 7(34),7(7,34),T(7,34),WH(7,34),HC(7,34)	HOT 110
	1 , SEASN (2), VULCN (5), VSB (9) ;HZ (15) ,HMIX (34)	MOT 120
	COMMON RELHUM(34),HSTOR(34),EH(15,34),ICH(4),VH(15),IX(15)	MDT 130
	COMMON WLAY(34,15),WPATH(38,15),TBBY(68)	MDT 140
	COMMON APSC(4,40),EXTC(4,40),VX2(40)	NDT 150
	DATA IATH/ E/,N./ 34/	MDT 165
	EATA/ Z(I),I=1, 34)/	MOT 170
	1 0,, 1,, 2,, 3,, 4,, 5,, 6,, 7,, 8,,	MOT 180
	2 9., 10., 11., 12., 13., 14., 15., 16., 17.,	MDT 190
	3 18., 19., 20., 21., 22., 23., 24., 25., 30.,	MCT 200
	4 35., 40., 45., 50., 70., 100.,99999./	MDT 210
	DATA(P(1,1),I=1, 36)/	MOT 220
	1 1.013E+C3, 9.04FE+D2, 8.050E+02, 7.150E+02, 6.330E+02, 5.593E+02,	NOT 230
	2 4.920E+02, 4.320E+02, 3.780E+02, 3.290E+02, 2.860E+02, 2.470E+02,	MDI 240
	$3 2 \cdot 1300 + 02 \cdot 1 \cdot 02 \cdot 0 \cdot 1 \cdot 1$	MDI 250
	4 (,07) CT (1, 0,00) (1) (, 0,00) CT (1, 4,00) CT (1, 4,00) CT (1, 4,00) CT (1, 3,00) CT (1, 0,00) CT (1,	MUT 200
	2 - 3 + 0 + 0 + 0 + 1 + 2 + 2 + 0 + 0 + 1 + 1 + 2 + 0 + 1 + 1 + 3 + 0 + 0 + 0 + 1 + 3 + 0 + 0 + 0 + 1 + 3 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0	HUI 670 HDT 240
		HD7 200
	1 1.013F403.0.000F402.8.020F402.7.100F402.6.280F402.5.560F402.	
	2 4.8715+02. 4.265+02. 3.725+02. 3.7266+02. 4.265+02. 2.4105+02.	MOT 310
	3 2 0905 +02 1 1 7905 +02 1 1 5306 +02 1 1 3005 +02 1 1 105 +02 9 5005 +01	MDT 320
	4 8. 120E+C1, 6.95*E+01, E.950E+01, 5.100E+01, 4.370E+01, 3.760E+01	MDT 330
	5 3.2200 +01, 2.7705 +01, 1.320E +01, 6.520E +00, 3.330E +00, 1.760E +00,	NOT 340
	6 9.510E-01, 6.719E-02, 3.00CE-04, 0.	HDT 350
	DATA(P(3,1),1=1, 34)/	NOT 360
	1 1.018F+07, 8.973F+02, 7.897E+02, 6.938E+02, 6.081E+02, 5.313E+02,	NOT 370
	2 4.627F+02, 4.016E+02, 3.473E+02, 2.992E+02, 2.58FE+02, 2.199E+02;	HOT 380
	3 1.882F+02, 1.610E+02, 1.378E+02, 1.178E+02, 1.007E+02, 8.610E+01,	MDT 390
	4 7.350E+01, 6.280E+01, 5.370E+01, 4.580E+01, 3.910E+01, 3.340E+01,	MDT 400
	5 2+860E+01, 2+430E+01, 1+110E+01, 5+180E+00, 2+530E+00, 1+290E+00;	NDT 410
	6 6.820E-01, 4.670E-02, 3.000E-04, 0. /	HOT 420
	OATA(P(4, 1), 1=1, 34)/	MDT 430
	1 1.010E+03, 8.960E+02, 7.929E+02, 7.000E+02, 6.1E0E+02, 5.410E+02,	NOT 440
	2 4.730E+02, 4.130E+02, 3.590E+02, 3.137E+02, 2.677E+02, 2.300E+02,	MOT 450
	31.977+12, 1.700+12, 1.4600+02, 1.2500+02, 1.0800+02, 9.2800+01,	MDT 460
	4 7.9805401, 5.8602401 , 5.5902401 , 5.0702401 , 4.3602401 , 3.7502401 ,	MDI 470
	5 3.227F+01, 2.700F+J1, 1.340E+01, 5.619E+00, 3.40LE+00, 1.819E+00,	MUI 480 NOT 480
	0 300/05-019 /00/02-029 300000-049 94 //	NOT 510
	- 2 4.467F+02. 3.453F+02. 3.30FF+02. 2.829F+02. 2.418F+02. 2.067F402	NDT 510
	3 1.766F+D2. 1.51DE+D2. 1.201E+D2. 1.1D3E+D2. C.431E+D1. A.OFAF4D1.	NOT 51
	4 6+8822+01, 5+875F+01, 5+014E+01, 4+277E+01, 3+647E+01, 3+109E+01	NOT 540
	5 2.6498+01, 7.2565+01, 1.9208+01, 4.7018+00, 2.2438+00, 1.1138+00.	HUT 550
	6 5.719E-01, 4.016E-22, 3.300E-04, 0. /	HDT 560
	PATA(P(6,I),I=1, 34)/	MDT 570
	1 1.013 +C7, 8.9463+C2, 7.350E+02, 7.012E+02, 6.16EE+02, 5.405E+02	HDT SEC
	2 4.722E+92, 4.111E+22, 3.365E+62, 3.380E+92, 2.65LE+02, 2.270E+02	HDT 590
	3 1.440E+02, 1.65 FF+02, 1.417E+02, 1.211E+02, 1.035E+02, 8.850E+01.	NCT 600

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4 7.565E+01, 6.467E+01, 5.529E+01, 4.729E+01, 4.047E+01, 3.467E+01,MDT 5 2.972E+01, 2.549E+01, 1.197E+01, 5.746E+00, 2.871E+00, 1.491E+00,MDT 6 7.978E-01, 5.520F-02, 3.008E-04, 0. MDT 610 620 € 30 DATA(T(1,I),I=1, 34)/ MDT 640 3.000E+02, 2.940E+02, 2.880E+02, 2.840E+02, 2.770E+02, 2.700E+02,MDT 650 2 2.5540E+02, 2.570E+02, 2.500E+02, 2.440E+02, 2.370E+02, 2.300E+02,00T 3 2.240E+02, 2.570E+02, 2.100E+02, 2.040E+02, 1.970E+02, 1.950E+02,0HDT 4 1.990F+02, 2.030E+02, 2.370E+02, 2.110L+02, 2.156E+02, 2.170E+02,0HDT 5 2.190E+02, 2.210E+02, 2.320E+02, 2.430E+02, 2.540E+02, 2.650E+02,0HDT 5 2.190E+02, 2.210E+02, 2.320E+02, 2.430E+02, 2.540E+02, 2.650E+02,0HDT 5 2.190E+02, 2.210E+02, 2.320E+02, 2.430E+02, 2.540E+02, 2.650E+02,0HDT 5 2.190E+02, 2.210E+02, 2.40E+02, 2.430E+02, 2.540E+02, 2.650E+02,0HDT 5 2.190E+02, 2.210E+02, 2.40E+02, 2.540E+02, 2.650E+02,0HDT 5 2.190E+02, 2.210E+02, 2.40E+02, 2.540E+02, 2.650E+02,0HDT 5 2.190E+02, 2.210E+02, 2.40E+02, 2.540E+02, 2.550E+02,0HDT 5 2.190E+02, 2.40E+02, 2.40E+02, 2.540E+02, 2.550E+02,0HDT 5 2.190E+02, 2.40E+02, 2.40E+02, 2.550E+02, 2.550E+02,0HDT 5 2.190E+02, 2.40E+02, 2.40E+02, 2.550E+02, 2.550E+02,0HDT 5 2.190E+02, 2.40E+02, 2.550E+02, 2.550E+02, 2.550E+02,0HDT 5 2.190E+02, 2.40E+02, 2.550E+02, 2.550E+02, 2.550E+02,0HDT 5 2.190E+02, 2.550E+02, 2.550E+02, 2.550E+02, 2.550E+02,0HDT 5 2.550E+02, 2.550E+02, 2.550E+02, 2.550E+02, 2.550E+02, 2.550E+02,0HDT 5 2.550E+02, 2.550E+02, 2.550E+02, 2.550E+02, 2.550E+02, 2.550E+02,0HDT 5 2.550E+02, 2.550E+02, 2.550E+02, 2.550E+02, 2.550E+02,0HDT 5 2.550E+02, 2.550E+02, 2.550E+02,0HDT 5 2.550E+02, 2.550E+02,0HDT 5 2. 660 670 680 690 6 2.700F+02, 2.199E+02, 2.100E+02, 2.100E+02/ MOT 700 DATA(T(2,1),T=1, 34)/ HOT 710 1 2.940E+02, 2.900E+02, 2.850E+02, 2.790E+02, 2.730E+02, 2.670E+02,MDT 2 2.610E+02, 2.550E+02, 2.480E+02, 2.420E+02, 2.350E+02, 2.290E+02,MDT 3 2.220F+02, 2.160E+02, 2.160E+02, 2.160E+02, 2.160E+02, 2.160E+02, 2.160E+02, 2.160E+02, 2.160E+02, 2.160E+02, 720 7 30 740 4 2.160E+02, 2.170E+02, 2.186E+02, 2.190E+02, 2.20CE+02, 2.220E+02,HDT 750 5 2.2TOE+02, 2.240F+02, 2.340E+02, 2.450E+02, 2.560E+02, 2.7COE+02,MOT 760 6 2.760E+02, 2.180E+02, 2.100E+02, 2.100E+02/ NOT 770 DATA(T(3,1),T=1,34)/ 1 2.7?2E+0?, 2.687E+0?, 2.652E+02, 2.617E+0?, 2.557E+02, 2.497E+02,MDT 2 2.437E+02, 2.377E+02, 2.317E+02, 2.257E+02, 2.192E+02,MDT 2 2.437E+02, 2.377F+02, 2.317E+02, 2.257E+02, 2.197E+02, 2.192E+02,MDT 780 790 800 3 2.1875+02, 2.1825+02, 2.177E+02, 2.172E+02, 2.1E7E+02, 2.162E+02,MDT 810 2.1575+02, 2.1525+02, 2.1526+02, 2.1526+02, 2.1526+02, 2.1526+02, MDT 820 5 2.152E+02, 2.152E+02, 2.174E+02, 2.278E+02, 2.432E+02, 2.585E+02,MDT 830 6 2.657E+02, 2.307E+02, 2.102E+02, 2.100E+02/ MDT 840 850 DATA(T(4,I),I=1, 34)/ MOT 1 2.870E+02, 2.870E+02, 2.760E+02, 2.71UE+02, 2.660E+02, 2.600E+02, MOT 2 2.830E+02, 2.460E+02, 2.390E+02, 2.320E+02, 2.250E+02, 2.250E+02, 2.250E+02, 3.250E+02, 2.250E+02, 2.2 860 870 8 80 2.250E+02, 2.250E+02, 2.250E+02, 2.250E+02, 2.250E+02, 2.250E+02, MDT 890 5 2.2605+02, 2.280E+02, 2.350E+02, 2.470E+02, 2.620E+02, 2.740E+02,MDT 900 6 2.770E+02, 2.160E+02, 2.100E+02, 2.100E+02/ MOT 910 DATA(T(F, I), I=1, 34)/ NDT < 20 2 2.341F+02, 2.273E+02, 2.2559E+02, 2.477E+02, 2.477E+02, 2.409E+02,MOT 2 2.341F+02, 2.273E+02, 2.206E+02, 2.172E+02, 2.172E+02, 2.172E+02,MOT 930 940 3 2.172E+02, 2.172E+02, 2.172E+02, 2.172E+02, 2.164E+02, 2.164E+02, MDT 950 2.154E+02, 2.148E+02, 2.141E+02, 2.136E+02, 2.130E+02, 2.124E+02,MDT 960 5 2+118F+02, 2+112E+02, 2+160E+02, 2+222E+02, 2+347E+02, 2+470E+02,MDT C 7 A 580 6 2.593E+02, 2.457E+02, 2.100E+02, 2.100E+02/ MDT MDT 990 DATA(T(6,1),1=1, 34)/ 1 2.801E+02, 2.816F+02, 2.751E+02, 2.607E+02, 2.622E+02, 2.557E+02,NDT 1000 2 2.492E+02, 2.427F+02, 2.362E+02, 2.297E+02, 2.232E+02, 2.168E+02,MOT 1010 3 2.166E+02, 2.166E+02, 2.166E+02, 2.166E+02, 2.166E+02, 2.166E+02, MUT 1020 4 2.106E+02, 2.166E+02, 2.166E+02, 2.176E+02, 2.186E+02, 2.196E+02,HOT 1030 5 2.205E+02, 2.216E+02, 2.265E+02, 2.365E+02, 2.534E+02, 2.642E+02,MOT 1040 MOT 1050 6 2.706E+02, 2.197E+02, 2.100E+02, 2.100E+02/ MDT 1060 DATA(WH(1,I),I=1, 34)/ 1 1.900 +01, 1.300 +01, 9.300 +00, 4.700 E+00, 2.20 CE+00, 1.500 E+00, MCT 1070 1 1.900*+01, 1.500±+01, 9.500±+00, 4.700±+00, 2.200±+00, 1.500±+00, MCT 1070 2 8.500±-01, 4.700±-01, 2.500±-01, 1.200±-01, 5.000±-02, 1.700±-02,MDT 1080 3 6.000±-03, 1.800±-03, 1.000±-03, 7.600±-04, 6.400±-04, 5.600±-(4.HDT 1050 4 5.000±-04, 4.900±-04, 4.500±-04, 5.100±-04, 5.100±-04, 5.400±-04,MDT 1100 5 6.000±-04, 6.700±-04, 3.600±-04, 5.100±-04, 5.100±-05, 1.900±-05,NDT 1110 6 6.300±-05, 1.400±-7, 1.000±-09, 0. MDT 1120 DATA(HH(2,1),I=1, 34)/ 4 6.00±+05, 1.900±+05, 2.700±+05, 4.000±+05, 4.0 DATA(WH(2,1), I=1, 34)/ 1 1.4005+C1, 9.300E+00, 5.900E+00, 3.300E+00, 1.900E+00, 1.000E+00,MOT 1140 2 6.1005-U1, 3.705-C1, 2.100E-01, 1.200E-01, 6.400E-02, 2.200E+02,MOT 1150 3 6.000E-03, 1.0005-03, 1.000E-03, 7.600E-04, 6.400E-04, 5.600E-04,MOT 1160 4 5.000E-04, 4.900E-04, 4.500E-04, 5.100F-04, 5.100E-04, 5.400E-04,MOT 1170 5 6,000E-04, 6,700E-04, 3,600E-04, 1,100E-04, 4,39uE-05, 1.900E-05,MDT 1180 MDT 1190 6 6.300E-06, 1.440E-07, 1.000E-09, 0. DATA(HH(3,1),1=1, 34)/ MDT 1200

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1 3.500E+0C, 2.500E+0C,	1.80CE+00,	1.200E+50,	6.600E-01,	3.800E-01,MDT	1210
2 2.100E-01, 8.500E-02,	3.5000-02,	1.6008-02,	7.500E-03,	6.900E-03,MDT	1220
3 6.0005-03, 1.8005-03,	1.000E-03,	7.600E-04,	6.400E-04,	5.600E-04,HDT	1230
4 5.000E-04, 4.900E-04,	4.500E-C4,	5.100E-04,	5.10LE-04,	5.400E-04,MOT	1240
5 6.000E-04, 5.700E-04,	3.600E-04,	1.100E-04,	4.300E-05,	1.900E-05,HDY	1250
6 6.3005-06, 1.4005-07,	1.000E-09.	0. /		MOT	1260
DATA(HH(4,1),1=1, 34)/				HOT	1270
1 9.1002+00, 6.0005+00,	4,200E+00,	2.700E+00,	1.700E+00;	1.000E+00,MCT	1280
2 5.4008-01. 2.9005-01.	1.300E-01.	4.200E-02.	1.500E-02.	9.400E-03.MDT	1290
3 6.000E-03, 1.800F-03.	1.000E-03.	7.600E-04.	6.400E-04.	5.600E-04.HDT	1200
4 5.000E-C4, 4.900E-D4.	4.500E-04.	5.100E-04.	5.10CE-04.	5.400E+04.HDT	1310
5 6.000E-04. 6.700E-04.	3.600E-04.	1.1005-04.	4.300E-05,	1.900E-05.HDT	1320
6 6.300E-06. 1.400E-07.	1.000E-09.	0. /		MOT	1330
DATA (WH (5, I), I=1, 34) /	,			NDT	1340
1 1.200E+00. 1.200E+00.	9.400F-01.	6.800E-01.	4.100E-01.	2.000E-01.NCT	1350
2 9.800E-02. 5.400F-02.	1.100E-02.	8.400E-03.	5.500E-03.	3.800E-03.MDT	1360
3 2.600E-03. 1.800F-03.	1.000E-03.	7.600E-04.	6.400E-04.	5.600E-04.HDT	1370
4 5.000E-C4. 4.900E-04.	4.500E-04.	5.100F-04.	5.100E-04.	5.400E+04.MDT	1380
5 6.000F-04. 6.700F-04.	3.6005-04.	1.100E-04.	4.300F-05.	1.900E-05.NOT	1390
6 6.300E-06. 1.400E-37.	1.0005-09-	n. /		NOT	1400
DATA (WH (6. T), T=1. 34) /	100002 000	. ,		нот	1410
1 5.900E+00. 4.200E+00.	2.9006+00.	1.800E+00.	1.180F+88.	6.400F-01.HDT	14.20
2 3.800E+01. 2.100E+01.	1.2005-01-	4.60000-000	1.8005-02.	A. 2005-03.WOT	4430
3 3.7005=03. 1.8005=03.	A. 6 0 0 E - 0 L J	7-2005+04.	6.100E-04.	5.2005+04.401	1440
4 4 4 00E=04 4 400E=04	L.L. 10E=049	4.800E-04.	5.2006-04.	5.7005+04.801	1450
5 6.1005-04. 6.6005-04.	3.8005-04,	1.6005-04,	6.700E-049	3.2005-05-001	1450
6 1.200E=05. 1.500E=07.	1 0 0 0 5 - 0 4	1. UUL-U49	C4 / UUL - 459		4670
0110000-000100000000000000000000000000	100000-039			HOT	44.48
1 5 6005-05 5 6005-06	5 4 005-05	E 100E-05	4 7005-DE	6 5005-05 NOT	1400
2 6 2005-05 6 4005-05	7 3 0 0 5 - 0 5	7 0005-05	3.0005-05	4.500E-05,HDT	12430
X 4.3000-099 4.1000-099	4 200E-05	0 700E-05	3 7 8 0 C - 8 5 F	6 BUCC-DE NOT	1510
4 - 3 - 3 - 5 - 5 - 4 - 5 - 5 - 5 - 5 - 5 - 5 - 5	4.9000-009	4 4 7 0 0 E = 05 9	3 8007-06	3 2005-04 401	1010
	2 6 0 05 06	2,4000-04,	2.000-04,	1 700E-04 MOT	1250
5 6 2005-06 B 6006-04	2.4 CUE ~ 04;	9.2000-05,	4.1606-49;	1.3000-079801	1530
6 4.300E-00, 8.600E-08,	403004-119	u. /		101	1540
1 C ADDE DE C DADE OF	6 0 0 0 F - 0 F	6 2005-05	6 4.00E-0E		1220
2 6 0005-05 7 5000-05,		0.200C-07;	0 0005-05	1 1005-04 MDT	1500
2 0+910E-09; 7+900E-09; 7 1 200E-04 + 500E-04	1 8 00E - 05	4 0 0 0 5 - 05	5 5 6 0 E - 84	2 4005-04 807	12/0
5 1.200E-04, 1.500E-04,	7 6 0 0 5 04	1.9002-049	2.1000-049	2.400E-04.HD1	12 64
4 2.0000-04, 3.2000-04, E 7 2000-04, 7 2002-04	3.4002-04;	3.0005-05	5. CUVE-U4;	3 4 4 U U C - U 4 5 M U I	1290
5 3,200E=04, 3,00004, 6 4 300E-04 8 600E-04,	2 C C U U E = V4 y	9.2002-09,	4.1002-099	1:3002-07,001	1000
0 4.3002-00, 0.0002-JC,	4.5000-11,	U. /			1010
1 6 0000-05 E 400T-05	4.0005.05	4 0005-0F			1620
1 0.0000-05, 5.400-05,	4.900E-05,	4.9000-05,	4.9002-09,	2 4005-04 807	1030
2 6.400E-04, 77700-05,	9.0000 - 05,	1.200E-04,	1.0000-04,	2.1006-04,801	1640
3 2.6008-04, 3.0008-04,	3.200E-04,	3.4002-04,	2. CUUE-04,	3.900E-04,MD1	1690
4 4.1000-04, 4.300-04,	4.5002-04,	4.3001-34,	4.300E-04,	3.900E-04,MUT	1660
5 3.6002-04, 3.400-04,	1.9008-04,	9.200E-05,	4.10UE=05;	1.3002-07,801	1670
6 4.3002-06, 8.6005-08,	4.3U0E-11,	0.		101	1600
UALA(WC(4,1),1=1, 34)/					1690
1 4.9001-05, 5.4001-05,	5.6UUE-05,	D.800E-05,	C.UUUE-05,	0.400E-05,8CT	1/00
2 7.1002-05, 7.5005-05,	(.900E-05,	1.1001-04,	1.JULE-04,	1.800E-04,MDT	1710
3 2.1000 -04, 2.000 -04,	2+5 UUE + U4;	3.2UUE-U4,	3.400E-04.	3.900E-04,MU1	1720
4 4.10UE-04, 4.1005-04,	3.900E-04,	3.60UE-04,	3.2006-04,	3.000E-04,MDT	1/30
> 2.800E-04, 2.500E-04,	1,400E-04,	9.200t-05,	4,106E-05,	1.300E-05,MDT	1/40
0 4.3002-06, 8.600E-08,	4.300E-11,	U. /		MDI	1/50
UAIA(W0(5,1),1=1, *4)/				MUT	1780
1 4.100E-05, 4.100E-05,	4.100E-05,	4.3001-05,	4.500L-05,	4.700E-05,MDT	1//0
2 4.900c-05, 7.1002-05,	9.000E-05,	1.6005-04,	2.4002-04,	3.200E-04,MUT	1/00
3 4.3UUL-04, 4.7002-04,	4.1002-04,	5.6UUL-04;	6.100t-04,	0,2006-04,MD1	1/20
4 6.2002-04, 6.0002-04,	5.600E-04,	5.100E-04,	4.70CE-04,	4.300E-04,MDT	1800

Law Autom travel

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5 3.600F-04, 3.2005-04, 1.700E-04, 9.200E-05, 4.100E-05, 1.300E-05,NDT	1810
E 4.300E-06, 8.600E-08, 4.300E-11, 0. / MDT	1820
DA TA (HO (6,1),I=1, 34)/ MDT	1830
1 5.400E-05, 5.400E-05, 5.400E-05, 5.000E-05, 4.600E-05, HDT	1840
2 4.500E-05, 4.900E-05, 5.200E-05, 7.100E-05, 9.000E-05, 1.300E-04,NOT	1850
3 1.600E-04, 1.700E-04, 1.900E-04, 2.100E-04, 2.400E-04, 2.600E-04,MOT	1860
4 3.20NE-04, 3.500E-04, 3.800E-04, 3.800E-04, 3.800E-04, 3.900E-04, 3.800E-04,HDT	1870
5 3.600E-04, 3.400E-04, 2.000E-04, 1.100E-04, 4.900E-05, 1.700E-05,MDT	1880
6 4.000E-C6, 8.60E-08, 4.300E-11: 0. / NOT	1890
HMIX(I)=HNO2 VOLUME MIXING RATIOS TIMES E+9 FROM EVANS PROFILE NOT	1900
DATA HHIX/940.00.1.0.33.0.8.1.2.1.4.1.6.1.8.1.9.2.0.2.1.2.3.3.0.3.MDT	1910
17,4,2,5,2,6,0,3,8,2,6,0,22,6*0,0/ MDT	1920
DATA (VSB(KKK), KKK=1,9)/23.,5.,23.,5.,5.,50.,23.,0.2,0.5/ MDT	1930
DATA HZ(1)/10H RURAL /, HZ(2)/10H RURAL /, MOT	1940
1HZ(3)/10H MARITIME / HZ(4)/10H MARITIME / HZ(5)/10H URBAN / MDT	1950
2HZ(6)/10HTRCPCSPHFR/,HZ(7)/10HUSER DEFIN/,HZ(8)/10HFQG1 (ADV)/, MOT	19E0
3HZ (9)/13HF0G2 (RAD)/ MDT	1970
4, HZ (10) / 10H BACK STRA/, HZ (11) / 10H AGED VOL /, HZ (12) / 10H FRESH VGL /HDT	1980
S ,HZ(15)/10H MET DUST / MOT	1990
DATA SEASN(1)/10HSPRIG SUMM/, SEASN(2)/10HFALL WINTR/ MDT	2000
DATA VULCN(1)/10HSTPAT BKGR/, VULCN(2)/10HAG VO-HOVO/, MDT	2010
1VULCN(3)/10HFR VO-HIVO/,VULCN(4)/10HAG VO-HIVO/,VULCN(5)/10HFR VO-HOT	2020
2HUVO/ HDT	2030
HNIX(29)=1.0E-50 HDT	2040
HNIX(9) = HNIX(29) HDT	2050
HZ(13)=H7(11) HDT	20€0
HZ (14)=HZ (12) MDT	2070
RETURN	2080
END	20 90

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A.

	SUBROUTINE ASMOL	NSM	10
С		NSM	2ú
Ċ	USED FOR USER DEFINED ATMOSPHERIC MODELS (MODEL=0 OF 7)	NSH	20
C	DEFINES ALTITUDE JEPENDENE VARIABLES Z,P,T,MH,HC AND HAZE	NSM	40
С	LOADS HAZE INTO APPROPRATE EN LOCATION	NSM	50
Ç	• · · · · · · · · · · · · · · · · · · ·	NSM	60
	CONHON /CARD1/ MODEL, IHAZE, ITYPE, LEN, JP, IY, M1, H2, H3, HL, LEMISS, RO	NSH	70
	1, TBOUND, ISEASN, IVULCN, VIS	NSF	80
	COMMON /CARC2/ H1,H2,ANGL:,RANGE,EETA,HMIN,RE	NSR	90
	COMMON /CARH3/ V1, V2, 0V, AVH, CO, CH, H(15), E(15), CA, F1	NSH	100
	COMMON /CNIRL/ LENSI, KMAX, H, IJ, J1, J2, JMIN, JEXIRA, IL, IKHAX, NLL, NF1	1251	110
	$1, 1 \in \mathbb{N}$	HSH NCH	120
	CURHUN / HUAIP/ 24-43 / (/,34) / (/,34) / H(/,34) / H(/,34)	NCM	120
	1 ; SEASN(2); VUECN(5); VSB(9); H2(15); H1X(34)	NST	140
	COMMON RELHOP(34), HSIOR(34), EH(15, 34), (CH(4), YH(15), 18(15)	NCN	170
	COMMON HLAT (34,15), WPA(H(66,15), 1887(68)	NOR	100
	COMMON APSC (4,40); EXT((4,40); VX2(40)	NCM	170
	F(A) = EXP(13,9766-14,9595+A-2,43882+A+A)+A		100
		NON	7.96
		NOR	240
		NON	210
			220
	TECTVOLUNTLETT / VOLUNTI	NCN	230
~	IF(ISEASN, LE, U) ISEASN=I	NGM	240
ι	TUR HOUEL EG ZERU	NSM	250
		NOR	200
		NCM	280
		NCH	200
	VIS1=U.	NCM	290
c	ANAZETU.	NCM	340
ι		NCH	320
	IF (T+NI+0) FRING 100 Do 65 V-4 Mi	NSH	330
		NCN	320
		NCH	360
		NSH	360
		NSH	370
	TE (M.E.C.O) PEAD AS. HISPIT.II.THE.DD.PH.WH(T.K).WO(T.K).RANGE	NSH	320
	TE (M_EQ.D) DETNT QD_ H12(7,41)THEADPARKAM(7,K)AC(7,K)AC	NSH	390
	TE (M_{c} (T, R) 9 FAD AD, 7 (K) P(7, K) TMP, DP, RH, WH(7, K), WD(7, K), AHA7F.	YNSH	400
	1 THAT TEAL TWIN A	NSB	410
		NSH	4 20
	PRINT 95. 7 (K) -P (7.K). THP. DP. RH. WH (7.K) - WD (7.K) - AHAZE. VIS1. IHA1. 7	SNSH	430
	1 FA1 . T VID 1	NSP	440
r	THAT IS THATE FOR THIS LAYER	NSM	450
č	ISFAT IS ISFASN FOR THIS LAYER	NSH	460
č	TYULL IS IVUCN 538 THE LAYER	NSP	470
-	IF(ISFA1.FQ.D) ISFA1=ISEASN	NSM	4.60
	IF (IHA1.GT. 0.0R. IVUL1.GT.J) GO TO 10	NSM	490
	ITYAER=IMAZE	NSM	500
	IF (Z(K).GT.2.0) ITVAFR=6	NSH	510
	IF (7(K).GT.9.0) TTYAER=IVULCN+9	NSM	520
	IF (7(K),GT,3C.) ITYAFR=15	NSM	530
	IHA1=IHA7E	NSM	540
	IVUL1=IVULCN	NSK	550
	GO TO 15	NSM	5£)
10	IF(IVUL1.GT.N)ITYAER=IVUL1+9	NSH	570
	IF(IHA1.GT.0) ITVSER=IHA1	NSM	580
	IF(ITYAEP.ST.15) ITYAER=15	NSM	590
	IF(IHA1.LF.C) IHA1=JHA2E	NSM	E 0 0

-				
		IF(IVUL1.LE.C) IVUL1#IVULON	NSH	€10
	15	IF (K.E.9.1) GO TO 2"	NSM	E 20
		IF (N.EQ. 7. AND. ITYAER.EQ.6. AND.7(K). GT. 2. D) GC TC 17	NSK	€30
		IF (ITYAER.ED.JCH(TC1)) GO TO 20	NSP	E 4 0
7		IC1=IC1+1	NSK	650
		N= I C1+10	NSF	660
		IF (](1.LF.4) 60 10 20	NSH	670
				600
		TTYAEP=TCH(TC+)	101 121	7 8 0
	20	ICH (IC1) = ITYAFR	NSM	710
		J=IFIX(?(K)+1.(E-5)+1	NSM	720
		IF (Z(K), GE, 25.0) J= (7(K)-25.0)/5.0+26.	NSH	720
		IF (7(K),GE,SC.0) J=(7(K)-5C.0)/20.0+31.	NSM	740
		IF (Z(K),GE.7C+C) J=(7(K)+70+0)/30+6+32+	NS₽	750
		IF (J.GT.3) J=33	NSM	760
		FAC=7(K)-FL(AT(J-1))	NSH	770
		IF (J.LT.26) GO T) 25	NSM	780
		FAG=(/(K)+5.UFFLUAT(J=26)-25.)/5.	NSR	798
		IF (J_605+31) FAC=(Z(K)=20+0)/20+ TF (J_05-22) FAC=(Z(K)=20-0)/20	NS P	CUU #10
		1F (0+95+22) FRC=(/(K)=/0+0)/00+	NCM	820
	26	IF (FAD:01+1+() FAC-1+0	NSM	810
		T(7.K)=TME+T0	NSM	840
		TF (M1.GT, 0) F(7.K)=P(M1.J)*(P(M1.L)/P(M1.J))**FAC	NSM	850
		IF (M1.GT.0) T(7.K)=T(M1.J)*(T(M1.L)/T(M1.J))**FAC	NSM	860
		IF (H2.GT.9) WH(7,K)=HH(H2,J)*(HH(H2,L)/HH(H2,J))**FAC	NSM	870
		IF (WH(7,K).GT.0.") GO TO 35	NSM	E 80
		IF (RH.GT,0.0) GO TO 30	NSM	890
		CPK=T0+0P	NSM	500
		TT=TO/DPK	NSM	910
		WH (7, K)=DFK*F(TT)/T(7, K)	NSH	650
	**		NSM	930
	30			940
		PUD=_01+PU	n c n M 2 M	550
		NH2(1,0-(1,C-RH0)*RH5AT#RU*T(7,K)/P(7,K))	NSH	970
		WHIT.K) = RHSAT*RHD/DN	NS H	980
	35	CONFINUE	NSM	5 90
	• ·	IF (M3.GT.0) WO(7,K)=WO(M3,J)*(WO(M3,L)/WC(M3,J))**FAC	NSM	1000
		HSTOP(K) = 0	NSM	1010
		IF (HMIX(J).LF.0.) FC TO 40	NSM	1020
		IF (HMIX(L).LE.C.) GC TO 40	NSM	1030
		HSTOP(K)=HMIX(J) #(HMIX(L)/HMIX(J))##FAC	NSM	1640
	40	CONTINUE	NSM	1050
		EH(7,K)=0.	NSH	1060
		EH(12, K) = 0.	NS M	1370
		EH(123,K)='a	NSH	1000
		EH(15,K)-C		1090
		TESTHATESED.D) GO TO 60	NSM	1110
			NSH	1120
		IF (AHA7E, 50, C.0) GU YO 45	NSM	1130
		EH (N, K) = AH A75	NSH	1140
;		AHAZE IS IN LOWTPAN NUMBER DENSITY UNITS	NSH	1150
		GO TC 55	HS M	1160
	45	CALL AERPRE (J,VIS1, HAZ1, IHA1, ISEA1, IVUL1, NN)	NSM	1170
		CALL AS OPRE (L, VIS1, HAZ2, IHA1, ISEA1, IVUL1, NN)	NSM	1180
		HAZE=0.	NSP	1190
		TE (THA71.1E.P.O.).OR.(HA72.1E.C.D.) GO TO 50	NSM	1200

	HAZE=HAZ1 ♥ (+AZZ/HBZ1) **FA3	NSM	1210
	50 EH(N.K)=HA7E	NSH	1220
	55 AHOL=HZ (ITYAFR)	NSH	1230
	TE (AHB 7E-NE-D-) GO TO 60	NSN	1240
	IF (7(K) F 2.0) AHOI 1=47(THA1)	NSH	1250
	$T_{F} = (17(K), GT, 2, 0), AND, (7(0), 1F, 30, 1), AND (2=SFASN(TSFA1))$	NSM	1260
		NSH	1270
	50 DOTNI 95. 7 (K). 0 (7 (K). 1 (7 (K). ND. DE. VH (7 (K). ND (7 (K). FE (N (K). VIS)	1. TENSH	1280
	$(A + T \in SA + T \cup U \cup A + T \cup A \in A \cup A + A \cup A \cup$	NSM	1200
	FRI I DE I JI VOLI JI TREKJANOLI JANOLEJANOL DJANOL	NSM	1360
			4340
		10-01-0 10-01-0	4330
		101	1 7 7 0
		1101	47/0
	$\mathbf{U} = \mathbf{U} \mathbf{U} \mathbf{U} \mathbf{U} \mathbf{U} \mathbf{U} \mathbf{U} \mathbf{U}$	NSH	1340
	75 CONTINUE	NSE	1350
_	RETURN	NSH	1300
C		NSM	1370
	80 FORMAT (3F10.2,2F5.1,2E10.3,E10.3,F7.3,3I1)	NSM	1320
	85 FORMAT (3F10.3,2F5.1, 2E10.3,2F10.3)	NSM	1390
	90 FORMAT (1°X,26HINPUT HETEOROLOGICAL DATA\/10X,2HZ=,F7+2,7H KH,	P=,NSM	1400
	1F7.2,6H MR,T=,F5.1,15H C, DEW PT.TEMP,F5.1,17H C, REL HUMIDITV	=,F5NSM	1410
	2.1,16H %, H20 DENSITY=,1PE9.2,7H GH H-3/10X,15H OZONE DENSITY=	,E9.NSM	1420
	32;16H GM M-3, RANGE=,0FF10,3;4H KM)	NSM	1430
	95 FORMAT (3F10,3,2F5,1,3E10,3,F10,3,4I3,4(1X,A10))	NSM	1440
	100 FORMAT (24H MODEL ATMOSPIERE NO. 7,/4X,6HZ (KM),3X,6HP (M8),4)	K,49NSM	1450
	1HT (C) DEN PT XRH H20(GH.H-3) 03(GM.H-3) NO. DEN.,30%,15HAERO	SCL NSH	1468
	2PROFILE, 6X, 10HEXTINCTION)	NSM	1470
	ENC	NSM	1480

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	SUBROUTINE PROF	HPR	10
С	REVISED 12 DEC 1979	HPR	20
C	DEFINES THE ATMOSPHERIC DENSITY PROFILE OF THE MCLEGULAR AND	HPR	30
C	AEROSOL AMOUNTS FOR THE MODEL SELECTED	HPR	40
C		HPR	50
	COMMON /CARD1/ NOJEL, IHAZE, ITYPE, LEN, JP, IH, H1, H2, M3, ML, IEMISS, RO	HPR	60
	1 ,TBOUND,ISEASN,IVULCN,VIS	HPR	70
	COMMON / CAREZ/ H1, H2, ANGLE, RANGE, BETA, HMIN, RE	HPR	80
	GONMON 7CARE37 V1, V2, UV, AVH, CO, CW, W (15), E (15), CA, PI	HPR	90
	COMMON /CNIRL/ LENSI, KMAX, M, IJ, J1, J2, JMIN, JEXTRA, IL, IKMAX, NLL, NP1	HPR	100
	I, IF INU, NE, IKLO	HPR	110
	COMMON 2 MDA 187 2 (34) + (7,34) + (7,34) + (7,34) + (1(7,34)	HPR	120
	1 SEPSN(2),VULON(7),VUG(9),HL(1),HHLX(34)	HPR	130
	CONTRAL SELFOR (34) N3 (08 (34) JEN (13) (34) (08 (4) JAN (12) (88 (12)		140
	COMMON ABSC(L.40), SYTC(L.50), UY2/L00		440
	$\mathbf{F} \left[\mathbf{A} \right] = \mathbf{F} \left[\mathbf{V} \left\{ \mathbf{A} \right\} + \mathbf{F} \left\{ \mathbf{A} \right\} + \mathbf{A} \left\{ \mathbf{A} \right\} + $	HOD	120
		нор	180
	00 5 J=1 + KHAX	HER	1 4 1
	5 WLAY(I.J)=0.	HPR	200
С	RV = H20 GAS CONSTANT	NPR	210
•	AVN=0.55-4* (V1+V2)	HPR	220
	AVW= AVW+ AVW	HPR	230
	CO=77.46+.459*AVW	HPR	240
	CH= 43.487-0.347340 VH	HPR	250
	IF(TBOUND.LE.C.ANA.(M1.LE.0.0R.H.E0.7))T00UND=T(H,1)	HPR	260
	IF(TPOUND.LE.0.AND.M1.GT.D.AND.M.LT.7) THOUND=T(M1,1)	HPR	270
	IF (JP.EQ.0) PRINT 45	HPR	280
	IF (JP.EQ.0) PRINT 50	HFR	290
	IF (N.LT.7) ML=NL	HPF	300
	RV= 4.6150E - 3	HP R	310
	CO 25 I=1,HL	HPR	320
	PS≈P(H,I)/1013.0	HPR	230
	TS=273.15/T(M,I)	HPR	240
	MIEMPENH(M,I)	HPR	350
	$IF(\mathbf{H}_{1},\mathbf{U}) * (\mathbf{U},\mathbf{A}\mathbf{N}') * \mathbf{M}_{1} + (\mathbf{V}_{1}) * \mathbf{S}_{2} = (\mathbf{M}_{1},\mathbf{I}) * \mathbf{I} \times \mathbf{I} \times \mathbf{I}$	HPR	360
	$\frac{1}{1} = \frac{1}{1} = \frac{1}$	HPR	370
	17(72,6);40,400,7,11;7) H1=74=H7(72,1)	HPR	386
	RELOUTLI		290
	1, 12,17,80,82,807,70,17,10 GHOSTD-(DS44017,0)4(TS/277,45)/DV	HDE	400
	RND518-17-18-18-01-17-02-01-12-27-813-27-20-00-00-00-00-00-00-00-00-00-00-00-00-		410
10	DEAL14WTEMP	HED	410
	X = PS* TS	HES	220
	PT= PS+SQR1(TS)	HPR	450
	EH(1,I)=F*FT*0.9	HPR	460
	EH(2,1)=X+PT++0.75	HPR	470
	EH(4,T)=0.0*PT*X	HPR	480
	PPN=4.56F-5*D*277.15/TS	HPR	4 90
	TS1=(296.0/272.15)*TS	HPR	5 6 0
	EH(5,I)=0+PPW+EXP(6,0#+(151-1.0))+0.002+0+(PS-PFW)	HPR	510
	EH(10,I)=D*(PFW+0.12*(PS-PPH))*EXP(4.56*(TS1-1.0))	HPR	520
	EH(6,I)=X	HPR	530
С	SUBROUTINE AERPRE COMPUTES EH(7,1)	HPR	540
C	EH(7,I)=AFRSOL FOP 0-2KM	HPR	550
ç	EH(12,I) = AERSOL FOR 2-9KM	HPR	560
C	EH(13,I)=DEFSCL FOR 9-30KH	HPR	570
C	EH(14,1) = AS RSCL FOP 3"-100 KK	HPR	580
	IF THINT ') CALL AFRPRF (I,VIS,HAZE,IHAZE,ISEASN,IVULCN,N)	HPR	590
	IF (M+EQ+7) GO TO 15	HPF	€00

		FH(7,T)=0.	NER	618
			HPR	628
			HPR	630
		EH(14-1)=0.	HPR	E40
		EH(15.I)=0.	HPR	650
		EH(N-I)=HA7E	HPR	660
	15	CONTINUE	HPR	670
		EH(15,I)=RELHUH(I)*EH(7,I)	HPR	€80
		IF (ICH(1),GT.7)EH(15.I)=RELHUM(I) *EH(12.I)	HPR	690
		EH (8,1) = 46, 6667* WO (H, T)	HPR	700
		IF (M3.GT.0.AND.M.LT.7) E4(8,I)=46.667*NO(M3,I)	HPR	710
		EH(3,I) = EH(2,I) = PT = 0.4	HPR	7 20
С		EH(11, I)=HNO3 ABSORBEP AMOUNT (ATH-CN)/KH	HPR	7 30
		EH(11,I)=PS+TS+HMIX(I)+1.0E-04	HPR	748
		IF (M.FQ.7) EH(11,I)==S*TS*HSTOR(I)+1.0E-04	HPR	750
		EH(9,1)=1.0	KP R	7 E Q
		REF=1.JE-6+ (CO+X+1D13.D/273.15-PPN+GW)	NPR	770
		IF (I.EQ.HL) GD TO 20	HPP	7 80
		P2=P(H, I+1)	HPR	790
		T2=T(M,I+1)	HPR	035
		N2=WH(M,I+1)	NPR	810
		IF(H1.GT.0.ANC.H.LT.7) F2=P(H1,I+1)	HPR	£20
		IF (M1,GT,0,AND,M,LT,7) T2=T(M1,1+1)	HPR	830
		IF (M2.GT.O.AND.M.LT.7) W2=WH(M2,I+1)	HPR	840
		PPH=4.56E-6+H2+T2	HPR	850
		EH(5,I)=0,5*(REF+1,0E-6*(30*P2/T2+PPX+CW))	HPR	AE0
	20	IF (I.EQ.ML) EH(9,I)=0.	HPR	870
		IF (JP+NE+0) GO TO 25	HFR	058
		P1=P(M,I)	HPR	650
		T1≈T(M, I)	HPR	910
		IF (M1.GT.U.ANC.H.LT.7) P1≃P(M1,1)	HFR	918
		IF (M1.GT.O.ANC.M.LT.7) T1=T (M1,I)	HPR	920
		PRINT 43, I,7(I),>1,T1,(EH(K,I),K=1,6),EH(9,I),E+(8,I)	HFB	936
	25	CONTINUE	HPR	540
		IF(JP+E0+0) NRITE (6,55)	MPR	950
		D0 35 1=1,4L	HPR	966
		IF (JP.NE.0) GO TO 30	HPR	970
		P1=P(M,I)	HPR	980
		T1=T(M,I)	HPR	990
		IF(M1,GT.C.ANC.M.L1.7) P1=P(M1,1)	MPR	1000
		IF (M1.GT.U. ANC.M.L1.7) 11=1 (M1,1)	HPR	1010
		PRINT 40, 1,2(1), P1, 11, (EM(K,1),K=10,11), EM((,1),(EF(K,1),K=12,1)	THAK	1020
	- 1	1,RELHUM(I)	HPF	1030
	30	EH(9,1)=EH(9,1)+1.	HPR	1040
	39		MPR	1050
~		RETORN		1000
C.		FORMAT 171 ADED 2 EQ 7.EQ.7.19 108510.31	NPP	1040
	40	FURTHE LING""FFJ6C9FJ6C9FJ6091A94"CELU60) FORMAT (444 ///409.204 400770NTÅ) (DDAFT/FC/)		1000
	49	-FURTHE LITISFFFLUASCUN NUMIFUNIAL PRUFILESFF - Furthe Litisfffluascun numifunial Prufilesff	ALCE	1100
	20	- FUKENII 146 - 10938926461908916790891619089161908906290894440027908926009 47.2002 67.80026690016600166464066557564856364536476026908933	496	1110
	E.F.	INTERNET ATMALIZITE AND AND TOWNED TO A DESCRIPTION AND A DESCRIPT	ENPR	1120
	22		HHPP	1130
		A FOA JAN' JOA JANNES LA 12 JUANANNOO CJUAJANKE KATUAJANKE KE JUAJANKEKS JUAJA 28504 - XV. OM (AFGIADA) - 5X. 2008)	HCP	1140
	•	EPENNESSES STREET TO FERRIE	HEP	11.0
		FUD		

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		SUBROUTINE AERPRE (),VIS,HAZE,IHAZE,ISEASN,IVULCN,N)	AER	10
С		WILL COMPUTE HORIZONTAL PROFILES FOR AEROSOLS	AEF	20
		COMMON/PRFDTA/7HT(34), HZ2K(34,5), FAHI50(34), FAHI23(34), SPSU50(34)	, A ER	30
		1595023(34), 2851F H (34), VONDEN (34), HIVDEN (34), EXVOEN (34), BASISS (34)	JALR	40
		ZYUNDOS(34) 1NI YUSO(34) 1 XYOSO(34) 10MNA M(34) 17UUU(34) 1 ZYUNDOS(34) 1NI YUSO(34) 1 XYOSO(34) 10MNA M(34) 17UU(34) 1	ALR	40 60
			AFR	70
		EATA (VS(J), J=1.5)/5023105424/	AFR	80
		$H \Delta Z E = 0$,	AEF	90
		CALL PREDIA	AER	100
		N= 7	AER	110
		IF (IHA7E.SC.O) RETURN	AE R	120
		IF (7HT (I). GT. 2, 0) GO TO 15	AER	120
			ALR	140
	5		AER	160
			AFR	170
	10	$CONST = 1 \cdot / (1 \cdot / VS(J) - 1 \cdot / VS(J - 1))$	AFR	1 4 0
		HAZE=CONST*((HZ2K(I, J) - HZ2K(I, J-1))/VIS+HZ2K(I, J-1)/VS(J)+HZ2K(I,	JAER	190
	:	1)/VS(J-1))	AE R	200
		RETURN	AER	210
	15	IF (ZHT(I)+G(+9+0) GO TO 35	AER	550
		N=12	AER	230
		$U(NS) = 1 \cdot (1 \cdot (23 \cdot -1 \cdot (5^{\circ} \cdot)))$	AER	240
		TF (150 42N+01+1) GU (U 25 TF (175 1 F-23.) HA7F-SDSH23(T)	AFC	250
		TF (VIS.16.23.) PETIPN	AFS	278
		IF (7HT(I).GT,4.0) GO TO 20	AER	2 80
		HAZE=CONST*((SPSU23(1)-SPSU50(1))/VIS+SPSU50(1)/23SFSU23(1)/50.	JAER	290
		RETURN	AER	300
	20	HAZE=SPSUSD(I)	AER	310
		RETURN	AER	320
	25	IF $(VI \otimes L \otimes L \otimes I)$ HAZE=FAMIZS(I)	AER	30
		17 (VIS-LE-73-) METURN TE /741(11) ET 4 04 EO TO X0	AFC	249 360
		- 1F - 17 HI (1) + 01 + 4207 - 00 - 10 - 50 - HA7 F= CONST# ((FAWT23(T) + FAWTEA (T)) / VIS+ FAWTEA (T) / 23, - FAWT23(T) / 50,	1AFR	360
		RELURN	AER	370
	30	HAZE=FAWIGO(I)	AER	3 80
		RETURN	AER	390
	35	IF (7HT(I)+GT+30+0) GO TO 75	AER	400
		N=13	AER	410
			AER	420
		$\frac{1}{1} = \frac{1}{1} $	AER	420
		$\frac{1}{1} = \frac{1}{1} $	ACC	450
		GO TO (40,45,50,50,45). IVUICN	AER	460
	40	HAZE=BASTSS(I)	AER	470
		RETURN	AER	480
	45	HAZE=VUMOSS(I)	AER	490
		RETURN	AER	500
	50	HAZE=HIVUSS(I)	AER	510
			AER	520
	22	TE (TVHLON, FO, 0) RETHON	ACR	560
		$G_{0} = G_{0} = G_{0$	AFR	550
	60	HAZE= BASTEW(I)	AER	560
		RETURN	AER	570
	65	HAZE=VUMOFW(I)	AER	580
		RETURN	AER	5 50
	70	HAZE=HIVUFW(I)	AER	600
		RETURN	AE R	£10
	75	N=14	AER	620
		IF (IVULCN. CT. 1) GO TO 80	AER	£30
		MR/EFUMNA1911) CETURN	ACC	040 680
	8.0	ME FURN ((875 - VIITANO (33)	AFD	660
	00	RETURN	AFP	670
		END .	AFR	680

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	1 1.85E-03, 2.12E-03, 2.45E-03, 2.80E-03, 3.60E-03, 5.23E-03,	PRF	610
	2 8.11E-03, 1.27E-02, 2.32E-02, 4.65E-02, 1.00E-01, 5.50E-02,	PRF	620
	3 6.10E-03, 2.40E-03, 1.28E-03, 7.76E-(4, 7.60E-05/	PRF	630
	DATA(UPNATM(I),I= 27, 34)/	PRF	640
	1 3.326-05, 1.646-05, 7.996-06, 4.016-06, 2.106-06, 1.606-07,	PRF	650
	2 9.31E-10, °. /	PRF	660
	nata(vutono(1), 1 = 27, 34)/	PRF	E 7 O
	1 7.602-05, 2.452-05, 7.992-06, 4.012-06, 2.102-06, 1.602-07,	PRF	680
	2 9.31E-10, 0.	PRF	690
	DATA(VUTOEX(I), I = 27, 34)/	PRF	700
	1 7.602-05, 7.208-05, 5.352-05, 6.602-05, 5.042-05, 1.(32-05,	PRF	710
	2 4.50E-07, 0. /	PRF	720
	DATA(EXUPAT(I),I= 27, 34)/	PRF	730
	1 3.32E+05, 4.25F-35, 5.59E-05, 6.60E+05, 5.04E-05, 1.03E+05,	PRF	740
	2 4.50E-07, 2. /	PRF	750
00C	0-2KM	PRF	760
CCC	HZ?K=5 VIS PROFILES- 50KM,23KM,10KM,5KM,2KM	PRF	770
003	» 2-9K M	PRF	780
CCC	FANISC=FALL/NINTER SOKM VIS	PRF	790
CCC	FAHI23=FALL/WINTER 23KM VIS	PRF	800
000	SPSL50=SPRING/SUNYER 50KM VIS	PRF	810
CCC	SPSU23=SPRING/SUMMER 23KM VIS	PRF	820
CCC	> 9- 2 NKM	PRF	830
000	BASTEN=BACKGROUND_STRATOSPHERICFALL/WINTER	PRF	840
000	VUHCEN=MOPERATE VOLCANIC FALL/WINTER	PRF	650
000	HIVUFW=HIGH VOLCANIC FALL/WINTER	PRF	860
CCC	EXVUEN=EX [®] REME VOLCANIC FALL/WINTER	PRF	870
CCC	BASTSS,VU4053,HIVJSS,EXVUSS= SPRING/SUMMER	PRF	880
000	>37-10NKM	PRF	890
CCC	UFNATF=NORMAL UFPER ATMCSFHERIC	PRF	500
CCC	VUTCNE=TRANSITION FROM VOLCANIC TC NCRMAL	PRF	÷10
000	VUTCEX=TRANSITION FROM VOLCANIC TO EXTREME	PRF	250
CCC	FXUPATEEXTREME UPPER ATMOSPHERIC	PRF	930
000	READ IN AFRESEL MODELS - EXTINCTION AND ABSORPTION COEFFICIEN'S	PRE	÷40
	RETURN	PRF	950
	END	DDE	963

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		SUBROUTINE GEC	GEO	10
С			GEO	20
č		SPHERICAL GEOKETRY WITH REFRACTION	6 F O	30
ċ		DEFINES ARSORGER AMOUNTS FOR THE ATMOSPHERIC SLANT FATH	GEC	46
ċ		USED TO SET UP VERTICAL PROFILE ARRAY VH AND DEFINES MATRIX	GEC	50
č		HLAY, FOR USE IN SUPROUTINE PATH	GEO	60
č			GEO	70
•		CONMON ZCARE1/ MODEL THATE TTYPE I EN UP THAN 1-M 2-M3-ML TEMISS 50	GEO	80
		, TROUND, TSCASN, TVULCN, WTS	6.90	çů
		COMMON /CASD2/ H1.H2.ANGLE.RANGE.BETA.HEIN.RE	GEO	1 0 0
		COMMON / CASE3/ V1. V2. DV. AV H. CD. CH. V(15) . E (15) . CA. PT	GEO	118
		COMMON / CNT61 / LENST. KNAX. M.T. L. JA J2. UNTN. JEXTRA.TL. TKMAX.NI L. NEA	GEO	120
		I TETNDANI TKIO	GEO	120
		CONMON /MOATA/ 7(36) -P(7.36) -T(7.36) -WH(7.36) -WO(7.36)	GEO	140
		-56881(2), which is a visit of the second state of the second s	CEO.	150
		CONNEN RELINGE (34) - HSTOR(34) - EH(15,34) - TCH(4) - VH(15) - TX(15)	GEO	160
		COMMON WEAV (36.15) . WPATH(58.15). THEY (68)	GEO	170
			6.50	180
			6.5.0	190
			650	280
		TE (TETND-EG. 1) CALL ANGL (HI-HP-ANGLE-RETALIENST.H.NL.PE.DT.HL)	650	210
		TETNEN	650	220
			GED	230
			666	240
			6E0	250
			650	260
	5	CONTINUE	620	270
		BET AS 0. 1	ČĒ Õ	280
		Se 0.	610	290
			660	310
r		NOW DEETNE CONSTANT DRESSURE PATH DUANTITES EF(1-2)	GED	310
		MacA*ANGLE	GEO	320
		SPHI=STN(Y)	S.F.C	330
		R1= (RF+)(1) # SPHT	GEN	340
		TE (H1-ST-7(NL)) 30 TO 10	GEO	350
		Go Io 21	GEO	360
	1.0	X= (RF+7 (N1))/(RF+11)	GEO	370
	10	TE (SPHT-GT-X) GO TO 15	GEO	380
			GE O	195
			GEO	400
		SPHT= SPH1 /X	GEO	410
		ANGLE = 1 BO . O - ASTN (SPHT)/CA	GEO	420
			GEO	430
		G0 T0 27	6.50	440
	15	HMTN=RI-RF	GEO	450
		BRINT 235. HMIN	CED	460
		60 TO 210	CEO	470
	20		GEO	480
			CEO	400
			6.50	6.0.0
		CALL PRINT (HELYN, N. NDI, TP)	GEO	546
			650	520
		TX1=TX(9)	GEO	530
		DO 25 K=1.KFAX	GEC	540
	25		GEO	550
	6.2		GEO	560
		$ \begin{array}{c} \mathbf{T} \mathbf{T} \mathbf{T} \mathbf{T} \mathbf{T} \mathbf{F} \mathbf{F} \mathbf{C} \mathbf{A} \mathbf{I} \mathbf{A} \mathbf{B} \mathbf{C} \mathbf{A} \mathbf{A} \mathbf{A} \mathbf{A} \mathbf{A} \mathbf{A} \mathbf{A} A$	650	578
		IF (ANGLE.GT.90.0) 50 TO 90	GEO	660
	3.0	TE (ANGLE.ST.90.0.AND.NP1.GT.0) J1=J1+1	GEN	5 G N
	00	J2=N	GEO	660
			~ ~ ~ ~	

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	IF (ITYDF.6C.T) CO TO 35	GEC	610
	CALL FOINT (H2.YN.N.N.TP)	GEO	€20
		GEÓ	6.30
	75 (NC-CT_C) 17-17-4	640	61.0
20		010	600
22		000	050
		GED	e eo
	EH(K,J1)=F(K)	GEO	670
	IF (ITTPF+EC+3) GD 10 40	GEC	680
	EH(K,J2+1)=TX(K)	GEO	690
40	CONTINUE	GFO	707
	IF (J1.60,J2) TX1=TX1+YN-FH(9,J1)	GEC	710
64444	NOW DEETNE VERTICAL FATH QUANTITIES VH	GEO	720
•	TE (JP-EC.C) ERINI 225	C.F.O	730
		650	71.0
		600	750
4)		000	7.50
	00 FB [=01,02	GEU	(00
	x1=2(1)	GE 0	770
	x2=2(I+1)	GEO	780
	IF (I.EQ.J1) ¥1=H1	GEO	790
	IF (I.EQ.J2) X2=H2	GEC	800
	CZ=X2-X1	GEO	810
	IF (T.FQ.NI) C7=7(I)=7(I-1)	GEC	820
	DS≠D7	GEO	820
c		65.0	840
U.		620	640
		660	620
		GEU	000
	PHI=ASTN(<phi*rx) ca<="" td=""><td>GEO</td><td>870</td></phi*rx)>	GEO	870
	RET = THE TA+PHT	GEC	680
	SALP=RX #SPH T	GEO	e90
	1F (SPHI.GT.1.E-10) DS= (RE+X2)*SIN(BST*CA)/SPHI	GEC	900
	8ETA=9ETA+9CT	GEO	910
	PST= BET 4 + PHT- ANGLE	GE O	e 20
		6.5.0	C 70
		650	040
		010	050
		CE O	950
	DO 70 K=1, KPAX	GEC	660
	EV=DS*++H(K, 1)	GEO	67U
	IF (I.EQ.NL) GO TO 50	GEO	990
	IF (EH(K,)).2C.C.P.OP.EH((,)1+1).EQ.0.0) GO TO 55	GEO	6 80
	IF (A95((FH(K,I)/EH(K,I+1))-1.0).LT.1.0F-6) GC TC 60	GEO	1000
	EV=CS+(FH(K,I)+FH(K,I+1))/ALOG(EH(K,I)/EH(K,I+1))	GEO	1010
	GO TO 60	GEO	1020
50	TE (EH(K-T)-EC-C-C) 60 TO 55	GEO	1620
	TF (FH(x, T-1), FO, 0, 0) FO TO 56	GED	1040
	TE CONSTRUCTURE THE CONSTRUCTION OF A DESCRIPTION OF THE CONSTRUCTION OF A DESCRIPTION OF A	650	1060
	IT THOUSING THE TEAN STUDY THE USED OF TO TO DURING THE STUDY OF THE S	020	1050
	ev = ev / a E 0.6 (eH (K, 1 - 1) / :H (K, 1))	GEU	1060
	GO TO 50	GEO	1070
55	E V= 0 •	GEC	1080
60	AH(K)=AH(K)+EA	GE C	1090
	IF (1.F0.JSTUF) 50 TO 65	GEO	1100
	₩LAY(I,K)=FV+W(K)	GEO	1110
	W(K)=0.	GEC	1120
		GFC	1130
		CEC	4140
פס		000	1140
		GEC	1150
	WLAY(J2+1,K)=H(K)	GE 0	1166
	₩4Ҟ)=0.	GEO	1170
	JEXTRA=1	GEO	1180
70	CONTINUE	GE 0	1190
-	IF (JP.FC.O) FRINT 24F. I.X1. (VH(L),L=1.8).PSI.PHI.EETA.THETA.SR	GE 0	1200

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		IF (JP.E0.0) PRINT 240. X2. (VH(L).L=10.14).DS	650	1210
		IF (I.GE.NL) GO TO 75	GEO	1220
		IF (I+1.EQ.J2) EH(9,I+1)=YN	GEO	1230
		IF (I,FQ,J1) EH(9,I)=1X1	GEO	1240
		RN=EH(3,1+1)/EH(9,1)	GEO	1250
		SPHI=SPHI*RX/FN	GE O	1260
	~~	IF (SALP.GF.FN) SPHJ=SALP	6E0	1270
	15		GEO	1280
~			GEO	1290
U	8.0		SEO	1300
	00		610	1310
		TE (N.GT.B) WIKI-PANGETTY/M	GEU CE O	1370
		VH(K) = H(K)	650	1300
	85	CONTINUE	020	4360
		GO TO 200	GEC	1366
	90	CONTINUE	GEC	1370
С		DUHNWARD TRAJECTORY	GEO	1380
		K 2= 0	GEC	1390
		IF (NP1.E0.1) J1=J1-1	GEO	1460
		J2=J1+1	GEC	1410
		J=J1+1	GEO	1420
			GEO	1430
		IF (H2.61.7(31+1).08.91.60.90 100 100	GEO	1440
		$\frac{1}{1} \left(\frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1} \right) = \frac{1}{1} \left(\frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1} \right)$	GEC	1450
		DALL FOIN' (DZYTNYNYNYZYLY)	GEO	1460
	95		6E0	1470
		TX2=TX(9)	CEC	1400
		YN2=YN	650	1500
		IF (H2.LT.H1) H=H2	650	1510
		J2=N	GEC	1520
		IF (J1.EQ.J2) TX2≑TX1+YN2~EH(9,N)	GEO	1530
		IF (H2.GT.H1) TX1=1X2	GEO	1540
		IF (J1.E9.J2.AND.H2.LT.H1) YN1=TX2	GEC	1550
	100	A0= (RE+H1) * CPHI*YN1	GEO	1560
		IF (H2.GE.H1) YN2=YN1	GEO	1570
			GžO	1580
		HEIN-AUTORY, D-PE	SEC	1590
		IF (1.027-01) HMINSAU/TU.1-(E	GEO	1600
		TE (HNTN-15,7(T+1)) CC TO 110	GEO	1610
	1 1 5		610	1620
	110	X=HMIN		1030
		IF (HMIN.LE.0.0) GO TO 120	650	1660
		CALL POINT (X, YN, N, NP, IP)	GEO	1660
		JHIN=N	GFO	1670
		TX3=TX(9)	GEO	1680
		IF (J2.FQ.N.OF.J1.EQ.N) TX3=YN2+TX(9)-EF(9,N)	GEC	1690
		IF (TX3+LT+0+0) TX3=TX(9)	GEO	1700
		JF (J1+ 20-N-AND+H2+5E+H1) GO TO \$15	GEO	1710
		HMINFAU/IXS-RF	GEO	1720
	4.5	IF (PHSUX-HMIN).61.0.,001) CO TO 110	GEO	1730
	117	15 (J) 50 N AND AN UF JON AND-THE	GEO	1740
		IN NORDENANDARDINGLANCIGU TNERIKS TE (H2.CV.H4) TY2HTY3	GEC	1750
		TF (H2_GF_H1) .12=N	GEO	1/60
		IF (H2.SE.H1.CR.H2.IT.HHTW) HEHMTN	660	1780
		PRINT 250, HMIN	620	1700
		IF (H2.LT.HMIN) JZ=N	GEO	1.800
			959	2000

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Table A1. Listing of Fortran Code LOWTRAN 5 (Cont.)

=====		
	IF (H2.LT.HMIN) PRINT 270, HMIN	GEO 1810
	60 10 125	GEO 1820
120	PRINT 250, HNTN	GEO 1830
	TF (H2,LT,H1) GO TO 175	GEO 1840
	TE (TTYPE, ED. 3.0R. H2. GE. H1) PRINT 255	GEO 1850
		GEO 1860
		GED 1870
		GE 0 1880
		GEO 1890
		6101 1970
		GEO 1910
C # # # #	NON REFEAR VERTICAL PATH ALIANTITIES VH	GEN 1920
4 7 6	$\mathbf{T} \mathbf{C} = \{0 \in [\mathbf{n}, \mathbf{n}\} \in \mathbf{O} \in \mathbf{N}\} $	GEO 1930
129		GEO 1940
		CCA 1950
	UU 179 1=1, NE	GEO 1950
		CEO 1076
	REF = EH(9,J)	GEO 1970
	IF (I.EV.1) REFETNI	GEC 1980
	IF (I.E(1,1.ANU.K2.ET.1) REF = YN2	GEU LYSU
	IF (J,E'A, J2, AND, K2, EQ. D) PEF=1X2	620 2600
	IF (I.NE.1) X1=7(J+1)	GEC 2010
	X2=2(J)	GEO 2020
	IF (J.E7.J2.AND.K2.E0.0) X2=H	GEO 2030
	IF (J.EQ.J.NIN.AND.K2.EQ.1) X2=HHIN	GEC 2040
	HH= (PE+X1) * SPH I-VE	GEO 2050
	IF (HM.GT.Z(J).AND.HM.GT.X2) X2=HM	GEO 206D
	RX=(RE+X1)/(RE+X?)	GEO 2070
	DS=X1-X7	GEO 2080
	ALP=90.0	GEO 2090
	THET=ASIN(SFHI)/CB	GEO 2100
	SALP=RX+SPHJ	GEO 2110
	IF (ABS(X2-HM).ST.1.(E-5) ALP=ASIN(SALP)/CA	GEC 2120
	BET=ALP-THFT	GEU 2130
	1+ (SPHI, GT, 1, 0"-10) PS=(RE+X2) *SIN(BET+CA)/SPHI	GEO 2140
	THETA=180.0~THET	GFO 2150
		GEO 2160
	PST=BETA-ALC-ANGLE+180.0	GEO 2170
	SR=SR+0S	GEC 2180
	DO 150 K=1.KMAX	GEO 2190
		GEC 2200
	$B_{i} = FH(K_{i}, j+1)$	GE 0 2210
		GEO 2220
	TE (1. EO. 12. AND. H2. IT. H1. ANT. H2. GT. 0. 03 AJSW(K)	GEO 2230
	TE ($I \in \mathbb{N}$, $M \in \mathbb{N}$ AND H_2 , G_2 , H_1) $A_1 \equiv T \times (K)$	GEC 2240
	TE (C_{1} =	GEO 2250
		GEO 2260
		GEO 2270
		GEC 2280
	$IF = \{J_{+}, J_{-}, J$	CEN 2200
1 30	1F (A), EU.U.U.U.U. (A), EU.U.U.U.U.U.U.U.U.U.U.U.U.U.U.U.U.U.U.	CEO 2300
	IF (ABS([AJ/8J/1,0]+10]+10]+10]+10]	GEU 2310
		CEO 2330
		660 2370
135		000 2320
	60 10 145	080 2340
140	EV=0.0	6E0 2350
145	> VH(K) = VH(K) V	0EU 23EU
158) WLAY (J,K)=EV	GEO 2370
	IF (JP, 20, 0) FRINT 245, J, X1, (VH(L), L=1,8), PSI, ALP, PETA, THETA, SR	GEO 2380
	IF (JP, ED, 9) PRINT 240, X2, (VH(L),L=10,14),D5	PE0 5340
	IF (J.FR.JP.AND.HP.SE.H1) GO TO 180	GEQ 2400

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Table A1. Listing of Fortran Code LOWTRAN 5 (Cont.)

		IF (J.EQ.JHIN.AND.KZ.EQ.1) GO TO 170 GE	EO 2	2410
		IF (J.NE.1) RN=REF/TH(9,J-1) GE	EO 2	420
		IF (J.EQ.J2+1) RN=REF/TX2 GI	EO a	2430
		IF (J.EQ.J2.AND.K2.EQ.0) RN=REF/YN2 GE	E O 2	440
		IF - (J.EQ. (JMIK+1). AND. K2.EQ.1) RN=REF/TX3 GE	te a	450
		IF (SALP.GF.RN) RN=1.0	FD 2	460
		SPHT=SALP*RN G	FO 2	470
	4 6 6			400
	1 2 2			
	100	1F (HELRICE: U.U) GO 10 190 61	EU 2	:5 U U
		IF (LEN.EU.C) PRINT 2ED GI	E 0 2	2510
		IF (LEN,EQ,C) GO TO 190 GE	E O 2	2520
		IF (LEN.EQ.1) PRINT 265 GE	EO 2	2530
		K2=1 . GI	EO 2	2540
		X1=X2 Ge	E O 2	550
		IF (ABS(X1-HMIN).LF.0.001) GO TO 190 G	FO 2	EED.
			En 2	570
				500
		$\frac{1}{2} \int \frac{1}{2} \int \frac{1}$	E G 2	590
		E=BETA GI	EO 2	2600
		FH=180.0-ASIN(SPHI)/CA GE	E O 2	2610
		TS= SR GE	E O 2	620
		PS≠PSI GI	E0 2	2630
		00 165 K=1. KMAX GI	EO 2	2640
	165	E(K)=VH(K) GF	FO 2	650
		60 10 125	F 0 2	FFN
	170			2670
				000
~				0.90
U			E 0 2	2740
		PHI=PH GI	EO 2	2710
		00 175 K=1,KMAX GE	E 0 2	2720
	175	VH(K)=2.*VH(K)-E(K) G	EO 2	2730
		GO TO 190 GI	EO 2	2740
	180	DO 185 K=1, KNGX GI	E0 2	2750
	185	YH(K)=2~0*YH(K) Gi	E 0 2	2760
		86TA=2.9785TA GI	FO 2	2770
		SR= 7 - 0+ SR	Fn 2	7780
				2700
				000
		SPHIESIN(ANGLETCA) G	EO a	2610
		IF (SPHILLTERN) SPHIESPHIZEN GI	EO 2	28 20
		GO TO 30 GI	E O 3	2830
	190	CONTINUE GI	E0 2	2840
		IF (ANGL%-67-90-0) PRINT 215, HM G	EO 2	2050
		CO 195 K=1,KMAX G	EO 2	2860
		W(K) = VH(K)	FO 2	2870
	195	CONTINUE	Fn	ARO
	200			
	244		EU (20 9 0
			E Ü 2	
		W(112 to y - 2 u) + W(11) + 1 = 1 + 0 + N(10) + N(11) = 0	EQ 3	2 10
		IF(R(7), U(1,0,0, ANU, ICH(1), UE, 7) N(15)≈H(15)/N(7) G	EO 3	2920
		IF (W(12)+GT+0+9+AND+IPH(1)+GT+7) W(15)=W(15)/W(12) G	EO 3	2930
	205	WRITE (6,275) (W(I),I=12,15) G	20 2	2940
		I=1 GI	E0 2	2950
	210	RETURN G	E0 2	2960
С			FO	970
	215	FORMAT (7510.3) G	FO S	C AO
	220	FORMAT (/10% THE FOULAIENT SPA LEVEL ARCORRER AMOUNTS/ 244 4424 4424	FO 1	29 o.
		ATER MADNED POS ETC. ATAL ATERCE ATERCE AND AND ATER TO	20 1	10.00
		ARTER THIOUS COS COS VLORE RATEOUS CURPT REV. LURD		

(4) A. D. Baltan, A. Battan, Mich. Mich. J. Phys. B 44, 100 (1985).

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2T)		MOL	SC	A T		٩E	R1 -			0	201	iÉ (l	J-V)	124	X,7	HGM	CH	-2,1	0X,	2 H K	GEO	3010
3H,	10×.5	HATM	C M	,15)	(,21	IKN .	9٢,	7 H	GH 1	СМ-	2, :	ιOΧ,	2HK	H-1	1X,	5X,	10 X	, 6H	атн і	C M)	GEO	3020
225 FO	RMAT	(1 H1	./1	όx.	204	ý	ERT	IC	۹L	PRO	FÍL	ES,	11,	1×,	2HI	D,3	X, 3	HALT	, 6X	, 3H	GE O	3030
11/2	0.7%.	4 HC 0	2+ .	6X • 2	2HO3	, 9X	121	IN2	.6X	.8 H	H2 (0 (1)) M) ,	4X,	4 H H	ois	, 6 X	,4H#	VER1	, 9X	GEO	3040
2.6	HOBO	V).5	x	HPS	I. 6X	. 3H	PH I	.6	x.4	нее	TA .	4X.	5HT	HET	A.4	x , 5	ĤRA	NGE.	1.1	4ו	GEO	3650
358		-4X.	ZHH	21 (4M) .	5X .	444	INO.	3.6	X . 4	нае	R2	EX .	4 H A	ERS	. 6 X	•4 H	AE R4	+ 3X	Ś	GEO	3060
48×	-6809	ANDE	115		,	,											• • • •			, , .	GEO	3070
230 FO	PHAT	1/10	¥. 8	н Ж	(1-8) = 8	(7 1	4.	3)/	74X	• F 1	4.3	.28	X.F	14.	37)					GEO	30.60
235 FO	RMAT	(69)	TR	AJE	TOF	YN	ISS	FS	FA	RTH	s a	THO	SPH	ERE	• C	LCS	EST	015	TAN	СЕ	GEO	3090
105	APPR	OACH	. TS	.F 1	n.z.	4 8 .	1.1	Υ.	188	FND	0.6	C C	1 CU	I AT	TEN	5					GE C	31.00
240 60	PHAT	148.	EA.	X .1	1 . 1	255	10.	3.	561	. 110	FŽ.	2.	/1								GF 0	3110
245 FO	PHAT	114	ER.	3.1	D 8 F 1	0.3	. D E	LE F	9.4	7	. 13	- ,,	•								GEO	3120
260 50	DMAT	184	ынт	N =		0.3	,				• • •										G F O	3120
255 50	DMAT	1644	0.	ты	TNTE	056	cτς		APT		D	Тн	CH A	NCE	r r	ο τ	YDE	2 1		H2	650	3148
299 10	0 0	VU1				196	V 1.	· -	~ 1, 1			• • • •	0174	1106		• •					GE O	3160
260 50		1864		010:	- 00	ть	0.0		ыc	e r 0		214	04.5	F -	SHO	015	12	DATL	4 T.A	KEN	6 FO	3160
200 -0	C00	1045					- N -		1.5			.1.3	040	· • ·	0110	N IL	51		, , ,		650	3470
1.	PUR	LUNG			1 30	·	2 1 2						***	c			T 0		TAK	E M.	020	24.80
265 10	RMAI	(85H		010	10 1		0 -		115	r vr		113	CAS	E -	LON	GEG		и п	IAN	E N .	020	3100
1	FOR	SHUR		ATH	55.4		N =							~ ~						* ^	600	2140
270 FO	RMAT	(748	[_H 2	W P (S SE		ESS	5 1	MAN	HM	ΠŅ	AN	JHA	2 8	EEN	ĸE	25.1	EQU	JAL	10	GEO	3200
1	HMJ	ЧΙ.	E+	HZ	= , F	10.	3)			.											SEU	3210
275 FO	RMAT	(130	1 X y 4	HAE	PZ,1	0X,	417	ER	3,1	υ×,	4H <i>t</i>	AER4	+,5X	, 9н	IK •H	• M	EAN	,/10	UX , 1	0 R	GEO	3220
180	12-15)=,4	(19	E14,	, 3)/	')															GEO	3230
280 FO	RNAT	(118	1×, 1	1 H N	ITRI	C A	CIC))													GEO	3240
• EN	D	•																			GEO	3250

...

		SUBROUTINE ANGL (H1.H2.ANGLE.B1.LEN.M.NL.RE.FI.ML)	ANG	10
		COMMON / HDATA/ 7(34), P(7.34), T(7.34), HH (7.34), HO (7.34)	ANG	20
	1	-SEASN(2), VIII CN(5), VSE(9), H7(15), HMTX(36)	ANG	20
		COMMON PELNUM (34), HSTOP(34), EH(15,34), TCH(4), VH(15), TX(15)	ANG	40
		COMMON U = V(24, 45) = U = V(24) + C = V(24) + C = V(24)	ANG	60
		CONTROL ADDRESS (A) = A = A =	ANG	£0
				20
ž			ANC	
2			ANG	80
C		THIS SUGROUTINE CALCULATES THE INITIAL ZENITH ANGLE (ANGLE)	ANG	
C		TAKING INTO ACCOUNT REFRACTION EFFECTS GIVEN H1,H2, AND BETA	ANG	100
0		(WHERE GETA IS THE FARTH CENTRE ANGLE SUBTENDED BY HI AND H2),	ANG	110
C		ASSUMING THE REFRACTIVE INDEX TO BE CONSTANT IN A GIVEN LAVER.	ANG	120
C		FOR GREATER ACCURACY INCREASE THE NUMBER OF LEVELS IN THE MODEL	ANG	130
0		ATMOSPHERE.	AirG	140
0			ANG	150
C		THIS SUBROUTINE CAN BE REMOVED FROM THE PROGRAM IF NOT REQUIRED.	ANG	160
Ċ		***************************************	*ANG	170
		IP=99	ANG	180
		CA=PI/180.	ANG	190
		X1 = RE + H1	ANG	200
		X2=RF+H2	ANG	210
			ANG	220
			ANG	230
			ANG	240
		DI-01 04	ANG	250
			ANG	260
		TELENIANYANGA TELENIANYANGA	ANG	270
			ANC	5.80
			ANC	200
			ANC	300
			ANC	240
	_		ANG	310
	5		ANG	320
		FBT=0	ANG	330
		HET A= 0.	ANG	340
		6ET 1 = 0	ANG	350
		BET 2= 0	ANG	360
		FBT1=0	ANG	370
		FBT 2=9	ANG	3 8 0
		FBT3=0.0	ANG	390
		IF (P1.LE.0.0) GO TO 10	ANG	400
		Y≠Z•₩THET	ANG	410
		IF (Y-PI.GT.1.0F-8) GO TO 45	ANG	420
		IF (IP.E0.100) GO TO 30	ANG	430
		XMIN=X2+COS(A1)-RE	ANG	440
		IF (XMIN-H1) 40,20,20	ANG	450
	10	HMIN=H2	ANG	460
		H2=H1	ANG	470
		H1=HMIN	ANG	4 80
	1.5		ANG	4 20
			ANG	5 0 0
		SPHT 1.0	ANG	510
			ANG	520
	20		ANG	5.70
	2.0	CALL POINT (H1.YN.N.NP.TP)	ANG	540
			ANG	550
			ANG	560
	76	TALTIAL 77	ANG	= 70
	20		ANG	5.0
			ANG	500
		JC+N TC / M ED 101 TV4-TV4.4VN-CN/D 143	ANG	6.00
		IF TUINEUNUZZ IKIEIKITINEENTYNJJIZ	A 11 U	່ວມຢ

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3	30 D0 35 J=J1.J2		
	X1=RE+7(J)	ANG	610
	X2=RE+7(J+1)	ANG	€20
	IF (J.FQ.J1) Y1=RE+H1	AN G	630
	IF (J.E0.J2) X2=RE+H2	ANG	640
	SALP= X1 +SFH1/X2	ANG	650
	ALP=ASIN (SALP)	ANG	€ 60
	RN=EH(9,J+1)/EH(9,J)	ANG	670
	IF ((J+1).EQ.J2) RN=YN/EH(9.J)	ANG	680
	IF (J.E9. J1) FN=E4(9, J+1)/TX1	ANG	6 90
	IF ((J+1).EC.J2.ANP.J.EQ.J1) RN=YN/TX1	AN G	7(0
	BET=THET-ALF	ANC	710
	FB=+TAN(ALP)	ANG	720
	IF (J.NE.J1) FR=FB+TAN(THET)	ANG	730
	F91=F8T+F8	ANG	741
	BEIASBETASAET	ANG	750
		ANG	760
			770
		ANC	700
	TE (SALA CE DUE OU DUE	ANG	
	SPHT-SALDADY	ANG	CUU A 1 0
	THE TARTAL CLAR	ANG	8 20
39	5 CONTINUE	ANG	830
	TE (At t E, R, R) CO TE ter	ANG	820
	GO TO 115	ANG	RFA
40	CONTINUE	ANG	860
	TANGE-TANG	ANG	870
	ANGLE=PI-ANGIE	ANG	880
	TN=ANGLE	ANG	8 50
	ANG= ANGLE/CA	ANG	900
	IF (H1.LE.0.0) GO TO 15	ANG	910
45	CONTINUE	ANG	920
	IP=101	ANG S	930
	CALL POINT (H1.YN. N. NF1. TP)	ANG	940
	TX1=1X(9)	ANG	250
	YN1=YN	ANG	360
	IF (NP1.E0.1) N=N-1	ANG	370
	J2= NL	ANG 9	180
	IF (M.FG.7) J2=ML	ANG S	9 9 0
	J1=N	ANG 10	000
	J=J1+1	ANG 10	10
	IF (H2.GE.H1) GO TO 65	ANG 10	20
	CALL POINT (H2, YN, N, NP, IP)	ANG IU	1.30
		ANG 10	40
	TN2=TN	ANG 10 BNC 40	50
		ANG 10	30
60	1- (J1+CU+J2) (X2=YN1+TX(9)~EH(9yJ1)	ANC 10	80
	V1=0F17 (141)	BNG 10	90
	X2=RE+7(1)	AND 11	60
	TE (J. 60. 11) VI-55-44	ANG 11	10
	IF $(J_a \in B_a, d_2)$ $\chi_2 = \chi_2 = \chi_2$	ANG 11	20
	SAL P= X1 + SPHT/ X2	ANG 11	30
	HNIN: X1 +SPH T- FF	ANG 11	46
	IF (SALP.LE.1.0) GO TO SE	ANG 11	50
	SALF=SPHI	ANG 11	€Ū
	IF (HMIN.GT.H2) GO TO AO	ANG 11	70
55	ALP=ASTN (SALP)	ANG 11	80
	THE T=ASIN(SCHI)	ANG 11	90
		ANG 121	Ü Ü

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		ANG	1210
		ANC	1730
	76 1 - 05 1 - 70 E 8 - 1 A (A (A)	ANC	1220
	ΤΟ (ΙΝΕ.) (ΙΝΕ.) ΤΟ ΕΡΞΕΡΞΤΑΝ(ΤΗΣΤ)	ANG	1240
	A TILLERY AFP	ANG	1250
		ANG	1260
	RE = RE T/CA	ANG	1270
		ANG	1280
	IF (X2.E0.9E+H7) C=PI-ALP	ANG	1290
	REF=FH(9,J)	ANG	1300
	IF (J.EQ.J1) RFF=YN1	ANG	1310
	IF (J50-J2) REF=TX2	ANG	1320
	IF (J+F9+1) GO TO 60	ANG	1330
	RN=EH (9,J)/EH (9,J~1)	ANG	1340
	IF (J.E.9. J1) FN=YN1/EH(9,J-1)	ANG	1350
	IF (J.EQ.J2+1) RN=PEF/TX2	ANG	1360
	IF (J.EQ.J2) RN=HEF/YN2	ANG	1370
	IF (SALP.GE.PN) PN=1.	ANG	1380
	SPHIESPLP* KN	ANG	1390
	IF (7(J), (2, H2) (0 10 60	ANG	1400
6 N		ANG	1410
00	AL-AC TE (ABS(7/1)_N2).)T (.0E_10.AND.).NE.() AC TO 65	ANG	1420
	1 TAPS/2/3/97/2/101100-11 TARDADAR(1) GU TU US	ANG	1460
65		ANG	1450
• -	x1=RF+7(J+1)	ANG	1460
	$TF (J_2 E Q_2 J_1) X_1 = RE + H_1$	ANG	1470
	IF (J.E2.J2.AND.J.NF.J1) X1=RE+H2	ANG	1480
70	x2=PE+7(J)	ANG	1490
	HMIN=X1+CCHI-RE	ANG	1500
	TF (HMIN.LF.0.0) 50 TO 110	ANG	1510
	IF (Z(J).LT,HMIN) 50 TO 80	ANG	1520
	REF=EH(9, J)	ANG	1530
	IF (J.E9.J2) REF=YN	ANG	1540
	SALP-X1*SPHJ/¥2	ANG	1550
	ALP=ASIN(SALP)	ANG	1560
	THE T=A SIN (SFHT)	ANG	1570
	RET=ALP-THET	ANG	15 80
	FGTTON(ALF) - TAN(THET)	ANG	1590
	FB12=FB12+FP	ANG	1600
		ANG	1610
	571 N = 32 (1432)2 N = 41 62/64	ANG	1620
		ANG	4640
		ANG	1650
		ANG	1660
	SPHI=S&LP*RN	AN G	1670
	GO TC 55	ANG	1680
75	TX3 = YN1 + TX(0) - H(0, J1)	ANG	1690
	YN1=TX3	ANG	1760
	JF (ABS(H2-7(J+1)).LF.1.0E-5) YN1=TX(9)	ANG	1710
	IF (A95(H1-7(J+1)),L5,1,0E-5) YN1=TX(9)	ANG	1720
	RN=1+0	ANG	1730
	GO TO PS	AN G	1740
8 O	CALL POINT (HMIN, YN, N, NF, IP)	ANG	1750
	IP=102	ANG	1760
		ANG	1770
	1F (J.EV.J1.PNU.H2.5E.H1) GO TO 75	ANG	1780
	1F (J, 57, J1, U4, J, EU, J2) (X3=TN2+1X(9) = EH(5, J)	ANG	1790
	17 (MM(N+01+M2) X*=TX(9)	ANG	1900

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			<u></u>
	IF (J.EQ. J1.AND. HHIN.GT.H2) GO TO 75	ANG	1810
	EN=RFF/TX3	ANG	1820
	IF (SALP.GE.RN) RN=1.	ANG	1870
	SPHI=SALP*RN	ANG	1840
	X=X1*SPHI-RF	ANG	1850
	CIF=ABS(HMTN-X)	ANG	1860
	HMIN=¥	ANG	1870
	IF (DΣF-1.CE-5) #5.85.80	AN G	1060
85	X2=RE+HMIN	ANG	1890
	THET=ASIN(SFHI)	ANG	1900
	IF (RN.EQ.1.8) FPT3=-TAN(THET)	ANG	1910
	IF (RN.E0.1.0) GO TO 90	ANG	1920
	CNX=(TX3-1.0)*ALOG((TX3-1.0)/(REF-1.0))/(X2-X1)	ANG	1930
	FBT3=-TAN(TFET)*(1.º-1.0/(1.0+TX3/(X2+DNX)))	ANG	1940
90	BET=0.5+PI-THET	ANG	1950
	BET 2= BET 2+BET	ANG	19€0
	BMIN=BET1+BET2	ANG	1970
	IF (H2.GE.H1) GO TO 100	ANG	1980
	BET=PET 1+2. *BET2	AN G	1990
	D81=81-9ET1	ANG	2000
	CB2=EET-B1	ANG	2010
	DB 3=ABS (BHIN- F1)	AN G	2620
	IF (D9%.GT.CB1.AND.D8°.GT.DE1) GO TO 110	ANG	2930
	IF (C82,GT,CP3) 60 TO 95	ANG	2040
	IF (032.6T.CB1) GO TO 110	ANG	2050
	RETA=BET	ANG	2060
	FRT=FBT1+2.0*(FBT2+FPT3)	ANG	Z070
	LEN=1.	ANG	2080
	GO TO 115	ANG	20.60
95	BETA=BET1+PET?	ANG	2100
	F8T=F8T1+F9T2+F9T3	ANG	2110
	GO TO 115	ANG	2120
100	PETA= 2. 0* (9F) 1+BET?)	ANG	2120
		ANG	2140
	FRI=2.0*(FB+1+FB+2+FP+3)	ANG	2170
	FRINI 130, Jate: April ar Bil ar Bi	ANG	2100
	IF (H2:10:H1) 60 (0 115	ANG	2100
	1P=103	ANG	2100
	IF INPLEV.IF JI=JI+1	AND	2230
	SPH1=SIN(PNOL:)	ANG	2540
		ANG	2220
	TE (EDUT CE ENA DU-4	ANG	2230
	IF (JFA(2024MA) MANA14	ANG	2240
		440	2260
	CO TO 25	ANS	2260
4.05	CALL DOTAT (NO VILLA NO. TO)	6NG	2270
105	CALL FUINT VILYINYNYNYNYNYNYNYNYNYNYNYNYNYNYNYNYNYNY	ANG	2280
		ANG	2290
	.12=.11	ANG	2300
	TE (SPHT.GE.RN) RN=1.	ANG	2310
	SPHT=SPHT/PN	ANG	2320
	THET=ASTN(SPHI)	ANG	2330
	GO TO 75	ANG	2340
110	BFT A=BFT1	AN G	2350
	LEN=D.	ANG	2360
	FPT=FRT1	ANG	2370
115	THET=ANGLE+(P1-RFTA)/(1.+FBT/TANG)	ANG	2380
	DBETA=RETA/CA	ANG	2390
	P=BET1/CA	ANG	2400

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Table A1. Listing of Fortran Code LOWTRAN 5 (Cont.)

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Table A1.	Listing of	Fortran	Code	LOWTRAN	5	(Cont.)	
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	THIFTHET/CA	ANG	2410
	PRINT 175, PETA, DEFTA, FET, TH1, TANG	ANG	2420
	IF (THET.GT.TN.OR.THET.LT.TM) THET=(TN+TH)/2.	ANG	2430
	TH1=THET/CA	ANG	2440
	PRINT 135, RET1,9,FBT,TH1	ANG	2450
	TN1=TN/CA	ANG	2460
	TM1=TM/CA	ANG	2470
	PRINT 14C, TN,TM,TN1,TM1	ANG	2480
	SPHJ=SIN(THET)	ANG	2490
	TANG=TAN(THFT)	ANG	2500
	IT=IT+1	ANG	2510
	DBE = ABS (B1 - PETA)	AN G	2520
	DTH= ABS (ANGLE-THET)	ANG	2530
	IF (IT.EC.1C) THFT=".F*(ANGLE+THET)	ANG	2540
	IF (IT-E0-10) GO TO 120	ANG	2550
	IF (OBE.GT.1.PE-7.AND.DTH.GT.1.OE-7) GO TO 5	ANG	2560
120	ANGLE=THET/CA	ANG	2570
	PRINT 145, ANGLE+IT	ANG	2580
	RETUPN	ANG	2590
125	H1=H2	ANG	2600
	ANGLE=C/CA	ANG	2610
	FRINT 145, ANGLE,IT	ANG	2620
	RETURN	ANG	2630
		ANG	2640
130	FORMAT (16,F16,7,8F13,8)	ANG	2650
135	FORMAT (14H TCTAL BETA = , E14.6, F15.6, 7H, FOT = , E14.6, 7H THET =, F	1ANG	56€0
	10.6,5HTANG=,F17.6)	ANG	2€70
140	FORMAT (5F12.6)	ÁNG	2680
145	FORMAT (8%,/1H+, 14H7ENITH ANGLE =, F7. 3, 60H DEGREES \ RECOMPUTEC	ANG	2690
	1 FROM SUEROUTINE ANGL (ITTERATION, I3, 1H))	ANG	2700
	ENU /	AN G	2710

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		SUBROUTINF FEINT (X, YN, N, NP, IP)	POI	10
C		REVISED 12 CEC 79	POI	20
		COMMON /CARC1/ MONEL, THAZE, ITYPE, LEN, JP, IH, H1, H2, H3, HL, IEMISS, RC	POI	30
	1	,TBOUND, ISEASN, IVULCN, VIS	PUI	40
		CONMON /CART?/ H1, H2, ANGLE, RANGE, BETA, HMIN, RE	POI	50
		CONMON /CARC3/ 41, V2, DV, AVH, CO, CH, H (15) , E (15), CA, PI	POI	€O
		CONMON /CNTRL/ LENST, KHAX, M, IJ, J1, JL, JHIN, JEXTRA, IL, IKMAX, NLL, NP1	POI	70
	1	, IFIND, NL, IKLO	P01	30
		COHMON /HDATA/ 7(34), F(7,34), T(7,34), HH(7,34), HO(7,34)	POI	50
	1	, SEASN (2), WULCN (5), VSB (9), HZ (15), HNIX (34)	PUI	100
		CONMON RELHUM (34), HS TOR (34), EM (15, 34), IUM (4), VM (15), 1X(15)	PUI	119
		CONMON HLAY (34,15), HPA (H(58,15), (HEY(58)	P01	120
~		COMMON APSC(4,40), Exic(4,40), VX2(40)	9001 901	1.0
C .		AND AND AND AND THE WEAR OFFICE THEY ADDRE AND BELOW	DOT	460
L.		SUBRUUTINE FUINT LUMPDIES THE MEAN KERK, INDER ABUVE AND BELOW	DOT	160
L C		A GIVEN ALTITUDE AND INTERFOLATES EXPONENTIALLY TO DETERMINE THE	POT	170
č		EULIVALENT ABSORAER ABOUNTS AT THAT RETITUDE.	POT	180
Ċ			*P0 T	100
2			POT	200
ř		Y TS THE RETENT IN DIRECTION	POT	210
ř		TY IGN AND WE ARE HEAD REFRACTIVE THIRS A 20VE AND AFLOW X	POT	220
č		N TS THE LEVEL INTEGER CORPESSIONTING TO X OR THE LEVEL BELOW X	POI	230
ř		NP = 1 TE X CONCTORS WITH MODEL ATMOSPHERE LEVEL . IF NOT NP = 0	POI	240
č		TY(1-A) ARE ABORRER ANDUNTS PER KM AT HEIGHT X	POI	250
č		· · · · · · · · · · · · · · · · · · ·	*POI	260
Ŷ		N=N1	POI	270
		NP=C	POI	280
		IF (X.LT.0.0) X=Z(1)	POI	250
		IF (X.GT.7(NL)) GO TO 20	POI	300
		CO 5 I=1,NL	POI	310
		N= I	POI	320
		IF (X-Z(I)) 10,20,5	P01	330
	5	CONTINUE	POI	340
	10	J2=N	POI	350
		N=N-1	POI	360
		MH1=M	PCI	370
		IF (M1.GT.0.AND.M.LT.7) MM1≠M1	POI	380
		MH2=M	POI	390
		IF (M2.GT.C.ANC.M.LT.7) NH2=H2	P01	400
		FAC = (x - y(x))/(Z(J2) - Z(N))	PUI	410
		PX1=P(MH1,N)+(P(MH1,J2)/P(MM1,N))++FAU	P01	420
		TX1 = I(M+1, N) + (I(M+1, J')) / (M+1, N) + F = 0	001	430
		WX1=NH(M12,N) + (WH(M02,J2)/WH(M02,N)) + FAG	POT	440
		TX(3)=(0+PX)/X1+4,5E5-6+PX)/TX1+U	DOT	460
		$ X(2) = (0)^{p} \{P(1, j, 2)\} (\{(1, 1, j, 2)\} + (n + 20) = 0^{p} P(1, 1, n) = (j, 2)^{p} (\{(1, 1, j, 2)\}) = (j, 2)^{p} (j, 2) = (j, 2)^{p} (j,$	POT	470
		1X(1)=0UTP(MM1,N)/1(MM1,N)=4+20C=0.We(MM2,N)/((MM1,N)/0) Ty/0)=0=C=_C#/TY/2)	POT	480
		$\{X_i\} = \{i_i\} = \{i_j\} = \{i_j$	POT	400
			POT	500
			POT	510
		TE (K.SO.9) 60 TO 15	POT	520
		TY(K)=0.00 10 11	POI	530
		TE (EH(K.N).GT.1000.0) GD TO 15	POI	540
		TE (X.1 C.1BD.P) TX(K)=FH(K.N)+FAC*(FH(K.J2)+EH(K.N))	P01	550
		TE (EH(K.N) .FO.D.D.OR.EH((.J2).E0.0.0) GO TO 15	POI	5ED
		T X (K) =F H (K, N) * (E H (K, J2) /E4 (K, N)) **FAC	POÍ	570
	15	CONTINUE	POÍ	580
	- '	GO TC 75	PCI	590
	20	NP=1	POI	600

`				
		IF (IP.E0.0) GO TO 30	P01	610
		00 25 K=1.KMAX	POI	620
	25	TX(K)≂EH(K,N)	POI	E 30
	30	$TX(9) = EH(9, N) - 1_{c}$	POI	640
		YN=0.0	POI	650
c		CARDS P 24 AND 50 THROUGH 59 ARE NO LONGER REQUIRED	POI	660
-		IF (N.GT.1) YN=EH(9,N-1)-1.0	P01	€70
	35	CONTINUE	POI	680
	•	1 (IP.E0.1) FRINT 45. X.N.NP.TX(9), YN.IP.(TX(K).K=1.8)	P01	690
		IF (IP.EC.1) PRINT 40, (TX(K),K=12,14)	POI	700
		TX(9) = TX(9) + 1.	POI	710
		YH=YN+1.	POI	720
		RETURN	POI	730
с			POI	740
-	40	FORMAT (//5X.114 TX(12-14)=.3E10.3/)	POI	750
	45	FORMAT (/. 2 CH FRUM POINTN HEIGHT = . F 19. 4.6H KH.N = . I 3.4H. NP= . I2. 28	H,POI	760
		IREF. INDEX ABOVE & BELOW X=.ZE11.4.4H.IP=.I3./.12X.36HEQUIV. AGS	ORPOI	770
		2AFR AMOUNTS PER KY AT X=.5E10.3)	POI	780
		END	POI	7 90

Table A1. I	Listing of	Fortran	Code	LOWTRA	AN 5	(Cont.)
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		EYA	10
~	SUBROUTINE EXAMIN	EVA	20
C	A AND A METHOD AND ADDADATION CORPORTATIONS FOR THE FORM	EVA	10
C .	LOADS EVINCTION AND APSORPTION COEFFICIENTS FOR THE FOOR	E V B	20
C A	AEROSUL ALTITUJE R. GIONS	E VA	50
¢		E VA	50
	COMMON /CAPDI/ HUTE, IMAZ: , ITTPE, LEN, JP, IN, H1, H2, H3, HL, IEHISS, RU	EXA	20
	1, TBOOND, ISFASN, TVUECN, VIS		
	GOMMON /TARIZZ HI,HZ, ANGLE, RANGE, FETA, HMIN,RE		60
	COMMEN /CAFLS/ V1, V ² , UV, AVH, CO, CR, W(15), E(15), CA, P1		100
- 1	COMMON ZENTELZ LENST, KHAX, MD, IJ, J1, J2, JHIN, JEXIRA, IL, IKHAX, NLL, NM	1EXA	100
	1,IFIND,NL,IKLD	EXA	110
	COHMON /HDATA/ Z(34),P(7,34),T(7,34),HH(7,34),HC(7,34)	EXA	120
	1 , SEASN(2), VULCN(S), VSB(9), H7(15), HMIX(34)	EXA	130
	COMHEN RELHUM(34),HSTOR(34),EH(15,34),IGH(4),VH(15),TX(15)	EXA	140
	COMMON WLAY (*4,15),WPATH(58,15),TBRY(68)	EXA	159
	COMMON ARSC(4,40), EXT ⁽ (4,40), VX0(40)	EXA	160
	COMMON ZEXTETAZ VX2 (40), $UREXT(40,4)$, $RURABS(40,4)$, $URBEXT(40,4)$,	EXA	170
	1URBARS(40,4),CCNEXT(40,4),OCNARS(40,4),TRCEXT(40,4),TROABS(40,4),	EXA	180
	2FG1EXT(47),FG1085(40),FG2EXT(40),FG2885(40)	EXA	190
	3. BSTEXT(4(), PSTABS(40), AV)EXT(40), AV0ABS(40), FV0EXT(40	EXA	500
	4), FYDARS(40), FMFFXT(40), DYFARS(40)	EXA	210
	DIMENSION RHICKE (4)	ĒΧΑ	220
	PATA (PHZONE(T), T=1, 4)/(0, 76, 80, 99, 7)	EXA	230
		EXA	240
		EXA	250
		FYA	260
		FYA	270
		FYA	280
		EVA	200
		EVA	774
		EVA	210
			210
	ITC=ICH(M)-7	C X A	320
	WRH = W(15)	EXA	0.00
	IF (ICH(M).EQ.F.AND.M.NE.1) WRH=70.	EXA	340
С	THIS CODING COES NOT ALLOW TROP RH DEPENDENT ABOVE EH(7,1)	EXA	350
С	DEFAULTS TO TROPOSPHERIG AT 70. PERCENT	EXA	36ú
	00 10 I=2,4	EXA	370
	IF (WRH.LT.FHZONE(J)) GO TO 15	EXA	380
	10 CONTINUE	EXA	360
	I=4	EXA	4 C O
	15 JI=I-1	£ΧΑ	410
	IF (HRH. GT. 0.0.AND, WRK.LT.99.) X= ALCG(100.0-WRH)	EXA	420
	x1=ALOG(100,0-RH70NF(II))	EXA	430
	X2= ALOG (100.0-RHZONE (I))	EXA	440
	IF (WBH - GF - 99 - 0) X = X 2	EXA	450
	TE (HRH-LE-0-0) X=X1	EXA	460
		EXA	670
		EXA	480
	8050 (119 M) - 0 (6 YT C (M) - 0 (EXA	490
		EX.	500
		FXA	510
c		EXA	520
U	$\frac{1}{2} \frac{1}{2} \frac{1}$	EXA	570
	00 TO 160971962929299790279 11A	FYA	560
		EYA	560
	$\mathbf{T} = \mathbf{A} \cup \mathbf{U} \in \{\mathbf{M} \mid \mathbf{M} \in \mathcal{A} \mid \{\mathbf{M} \in \mathcal{J} \mid \mathcal{J}\}\}$	EVA	550
	72240 US (KUK AS (N+1))	EVA	500
	(1 = AL UL; (* UK PB > (N , 1 1))	E V A	510
		C X A E V A	500
	25 Y2=ALOG(0CN 5 X (N, I))	E XA	596
	Y1=ALOG(OCNEXT(N,II))	EXA	euu

ΓF.

	$72 \pm \Delta I OG (CCNAPS(N_1))$	EXA	610
	$71 \pm 61.06 (0 \Gamma N ABS(N + T T))$	EXA	620
		EXA	6.30
70		EXA	640
30		FYA	650
		EVA	660
			670
	Z1=ALOG(UMMAHS(N,L1))		6.4.4
	G0 10 4 ^m	5.AA	690
35	Y2= ALOG (TROEXT (N. 1))	EXA	
	Y1=ALOG(TROEXT(N+T1))	EXA	700
	72=ALOG(TKOABS(N,I))	EXA	/10
	Z1=ALOG(TROABS(N,II))	EXA	720
40	Y=Y1+(Y2-Y1)*(X-X1)/(X2-X1)	EXA	730
	ZK=Z1+(72-Z1) *(X-X1) /(X2-X1)	EXA	740
	ABSC(M,N)=EXP(7K)	EXA	750
	EXTC(M,N)== XP(Y)	EXA	760
	GO TO 80	EXA	770
45	TE (ITA.GT.14) GO TO 75	EXA	780
	JF (ITC.LT. 1) GO TO 80	EXA	790
	GO TO (50,55,60,65,70,65,70), ITC	EXA	800
50	485C(M.N) =FG1 495(N)	EXA	810
	FXTC(N,N) = FG1FXT(N)	EXA	820
	GO TO 80	EXA	630
55	4850 (N. N) = FG2485 (N)	EXA	840
	FTC(H,N) = FG2FTT(N)	EXA	850
		EXA	860
6.0	ABSC (N. N) = PSTABS (N)	EXA	870
00	EVIC(N, N) = BSTEXI(N)	EXA	680
		EXA	890
60	ADSC(M_N) = AV0 ABS(N)	FXA	900
0.9		EXA	910
		FYA	920
70		EYA	930
70		FYA	940
	Exi((((()))))))))	FYA	C F n
		FYA	960
/5	ABOU(N)AUTEADO(N)	FYA	67N
	EXIC(A,N) = DRECKICAT	EYA	0.80
00		EVA	con
85	CONTINUE	E **	1000
_	PRINT 95	5 V A	1010
С	PRINT 100; (VX2(N);(EX)((1)N);ADD((1)N);H=1;4);N=1;40)	EXA	1020
	RETURN	E X A E V A	4030
C		CXA	4040
90	FORMAT (7H LCH y415)	E X A	1040
91	FORMAT (40H FXEINCTION AND ABSORPTION COEFFICIENTS)	E X A	1020
100	FORMAT (F10.4.8F10.5)	EXA	1000
	END	EXA	1070

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Table A1. Listing of Fortran Code LOWTRAN 5 (Cont.)

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SUBROUTINE EKIDIA , EXT 10 AEROSOL EVIINCTION AND ARSOPPTION DATA EXT 30 EXT 40 CUMHON /EXIDIA/VX2(40), RUXEXI(40,4), RURABS(40,4), UREEXI(40,4), EXT 30 EXT 40 CUMHON /EXIDIA/VX2(40), RUXEXI(40,4), RUCEASI(0), JUREEXI(40,4), EXT 50 IURBABS(40,4), CONEXI(40,4), CONABS(40,4), RUCEXI(0,4), RUXES(40,4), EXT 50 2761EXI(40), FC185(40), IUPEXI(40,4), RUXEASI(40), FV0EXI(40 EXT 40, JUREXI(14), JUREXI(14), JUREASI(40), FV0EXI(40) EXT 40 CUMHON /EXIDIA/VX2(40), IUPEXS(40), IVPEXI(40), FV0EXI(40) EXT 40 CUMHON /EXIDIA/VX2(40), IUPEXS(40), IUPEXI(40), FV0EXI(40) EXT 40 CUMHON /EXIDIA/VX2(40), IUPEXS(40), IUPEXI(40), IUPEXI(40) EXT 40 CUMHON /EXIDIA/VX2(40), IUPEXS(40), IUPEXI(40), IUPEXI(40) EXT 40 CUMHON /EXIDIA/VX2(40), IUPEXS(40), IUPEXS(40), IUPEXI(40) EXT 40 CUMHON /EXIDIA/VX2(40), IUPEXS(40), IUPEXS(40), IUPEXI(40) EXT 40 CUMHON /EXIDIA/VX2(40), IUPEXS(40), IUPEXS(40), IUPEXI(40), IUPEXS(40), IUPEXS(4				
C DOUNDOUL CLINIC CLINIC AND AND AND OPPIION DATA EXT 50 C AFROSOL FYINKTINCTAV X2(40), AND AND OPPIION DATA EXT 50 C UMHON JEXTFINCTUAV X2(40), RUXEXI(40,4), RURABS(40,4), UREEXI(40,4), EXT 50 JURBADS(40,4), OCNEXI(40,4), OCNABS(40,4), RUCEXI(40,4), RUXES(40,4), EXT 50 JURBADS(40,4), OCNEXI(40,4), OCNABS(40,4), RUCEXI(40), FVOEXI(40) S CSIEXI(40), FGTABS(40), 10(728)(40), FVOEXI(40), FVOEXI(40) AND S(40), FVEEXI(40), JUREABS(40), EVEXI(40), FVOEXI(40) C 2000, 'S 1000, '3.371, '5.500, '6.943, 1.0600, 1.5380, EXT 100 C 2000, '2.000, '2.5000, '2.5000, '2.000, '3.0000, '2.2000, '2.2001, '2.7001, '2.7010, '2.7010, '2.7010, '2.7010, '2.7010, '2.7010, '2.7010, '2.7010, '2.7010, '2.7010, '2.7010, '2.7010, '2.2000, '1.0,0000, '1.2,2010, '2.7110 C 7.9000, '2.7500, '2.5000, '3.0,000, '1.50000, '1.4000, '1.22000, '2.1500 C 116,5000, '2.13000, '2.50000, '3.0,000, '2.000, '1.4,931, '2.4077, 'EXT 150 C 116,5000, '2.13000, '2.50000, '3.0,000, '0.5019, '1.17,2000, 'EXT 150 C 116,5000, '2.13000, '2.50000, '3.0,000, '0.7523, '4.1543, '2.4077, 'EXT 150 C 11709, '1.3704, '1.2231, '1.3247, '1.1196, '10437, '0.9996, 'EXT 150 C 11709, '1.3704, '1.2231, '1.3247, '1.1196, '10437, '0.9996, 'EXT 150 C 10474 (RUEXTI(13), 'TI, '0.1/2, '0.7029, '0.7196, '0.7791, 'EXT 150 C 105,07456, '0.6680, '0.6032, '0.94949, '0.5554, '4.2171, '2.4323, 'EXT 250 C 10756, '0.6680, '0.6032, '0.75316, '4.2171, '2.4323, 'EXT 250 C 15100, '1.5408, '1.7433, '1.1222', '1.3023, '1.1076, '1.0023, 'EXT 250 C 15100, '1.5408, '1.7433, '1.2222', '1.3023, '1.1076, '1.0023, 'EXT 250 C 15100, '1.5408, '1.7433, '1.2222', '1.3023, '1.1076, '1.0023, 'EXT 250 C 1.5100, '1.5408, '1.7433, '1.2222', '1.3023, '1.1076, '1.0023, 'EXT 250 C 1.5100, '0.7764, '0.4633, '0.9753, '0.4647, '0.9794, 'EXT 250 C 1.5100, '0.7764, '0.4633, '0.9753, '0.4647, '0.9794, 'EXT 250 C 1.5100, '0.7764, '0.4633, '0.9753, '0.4647, '0.9794, '2.5784, 'EXT 250 C 1.5100, '0.7764, '0.4633, '0.9764, '2.5794, '1.5106, 'EXT 250 C 1.5104, '1.19454, '1.5756, '1.00000, '7.5145, '1.2074, '1	SUBFOUTINE FYIDIA		EXT	10
AEROSOL FYTINCTION AND ARSOPPTION DATA EXT 50 C <td>C</td> <td>•</td> <td>EXT</td> <td>20</td>	C	•	EXT	20
C UNDAU /FYTTA/W X2(A), PURE Y1(A), A, QUADS('.0.4), URPEFXT(4), A), CYT 20 CUNNUM /FYTTA/W X2(A), PURE Y1(A), A, QUADS('.0.4), TROADS('.0.4), TROADS('.0.4), CYT 20 ZGIEXT(AD), FGIAS('.2), CZ XT(4,0), FGZX('.0), A), TROADS('.0.4), TROADS('.0.4), TROADS('.0.4), TROADS('.0), A), TROADS('.0), A)			FYT	30
CUHHOW /FXTGTA/VX2(H), FUEXT(L0,4), FUGXAS(1,0,4), TRCAAS(40,4), EXT 50 IURDABS(10,4), OCNEXT(40,4), OCNAAS(40,4,4), TRCZT(10,4), TRCAAS(40,4), EXT 50 IURDAS(10,4), FG1AS(40), FG2XT(40), FG2AS(40) XT 60 AT 7000 (7.7010), TSTAPS(40), AVCAXT(40,4), TRCZT(10,4), TRCAAS(40,4), EXT 50 OATA (VX2(1), I= 1, V)/ XT 100 * 2000, 7.000, .337(), .5500, .6903, 1.0600, 1.5360, EXT 100 * 7.0000, 7.700, 2.500, 2.700, 3.0000, 0.7.9232, 3.7560, EXT 100 * 7.9000, 7.200, 8.5000, 5.0000, 9.2000, 10.0000, 10.5910, EXT 100 * 7.9000, 7.200, 8.7500, 2.5000, 10.0000, 10.5910, EXT 100 * 10.000, 7.1000, 7.5000, 10.0000, 10.5910, EXT 100 * 10.000, 7.11.500°, 12.5000, 14.0000, 15.4000, 17.2000, EXT 100 TT 200971, 1.7462, 1.3500, 14.0000, .5723, .41543, .2407C, EXT 100 * 10.000, 2.1000, 25.000, 1.00000, 40.0000/ EXT 100 * 10.000, 2.1000, 25.000, 10.0000, 10.0000, 17.2000, EXT 100 * 10.000, 11.500°, 12.5000, 1.00000, .5723, .41543, .2407C, EXT 100 * 0.4081, .04394, .12234, 13247, 1196, .10437, .09956, EXT 100 * 0.0152, .00051, .0512, .00494, .05544, .E60C0, .07791, EXT 200 * 0.756, .0684°, .0532, .04949, .05544, .E60C0, .00512, .00076, EXT 200 * 0.756, .0684°, .0532, .04949, .05544, .E60C0, .09522, .00776, EXT 200 * 0.756, .0684°, .0532, .04949, .057515, .42171, .24237, EXT 200 * 0.756, .06751, .07073, .07797, .07776, .07794, EXT 200 * 0.756, .0756, .07521, .159561, 100000, .75315, .42271, .24237, EXT 200 * 0.756, .0706, .0734, .05727, .05791, .05645, .06639, .07443, EXT 200 * 0.746, .02727, .03724, .05724, .05747, .05184/ * 1.00499, .04473, .05524, .07797, .07776, .07794, EXT 300 * 0.744, .09499, .06744, .05597, 1.00000, .76035, .43228, .25348, EXT 300 * 0.744, .09474, .0577, .05657, .05747, .05184/ * 1.64076, 1.47866, 1.40139, 1.00000, .76035, .43228, .25348, EXT 300 * 0.744, .09474, .09574, .05574, .05184/ * 1.0546, .14077, .05657, .05747, .05184/ * 1.0546, .14077, .05657, .05747, .05184/ * 0.7346, .07677, .05657, .05747, .05184/ * 0.7346, .07677, .05658, .05747, .05184/ * 0.744, .02770, .03674, .05744, .	C MEROSOL CRITECTION AND ANSOPPTION DATA		Ext	۵ <u>۵</u>
<pre>UDD105(40,4).OCNCXT(40,4).CONADS(40,4).TTCCXT('0,4).TROADS(40,4), EXT F0 SFGEXT(40).GADS(40).VEXT(40).AVOADS(40).FVOEXT(40 A),FVOEXT(40),GADS(40).VEXT(40).AVOADS(40).FVOEXT(40 A),FVOEXT(40),GADS(40).VEXT(40).AVOADS(40).FVOEXT(40 A),FVOEXT(40),GADS(40).VEXT(40).AVOADS(40).FVOEXT(40 A),2000, TOGO, 3,301, 5500, .5500, .5500, .5500, .23023, 3,550, EXT 10 A),2000, T,2500, 2,5000, 2,5000, 6,2000, 6.2000, 10.0000, 10.5500, EXT 10 A),0000, 4,2000, 6.7001, 9.2000, 10.0000, 10.5500, EXT 10 A),0000, 11.500, 12.5000, 14.0000, 15.0000, 16.4000, 11.5510, EXT 10 A),0000, 11.500, 12.5000, 14.0000, 72003, 41643, 2007, EXT 10 DATA (WUEXT(1,1),71,40,0).VEXT(40,7200, EXT 10 DATA (WUEXT(1,1),71,40,0).VEXT(40,7200, EXT 10 C),1000, 11.500, 1.0050, 1.0000, 7203, .0116, 0007, EXT 10 DATA (WUEXT(1,1),71,40,0).VEXT(40,730,90,0116,0007, 10.9956, EXT 10 C),1056, .0604, .6022, .04940, .07531, .04077, .09956, EXT 10 C),1056, .0604, .6022, .04940, .0554, .10010, 0.9956, EXT 10 C),1056, .0604, .6022, .04940, .0554, .10010, 0.9956, EXT 20 C),10756, .0604, .6022, .04940, .0553, .04304/ EXT 20 C),10756, .0604, .6022, .04940, .0553, .11076, .01937, .09956, EXT 20 C),1060, .17608, .12214, .12224, .13023, .11076, .10323, EXT 20 C),10756, .06047, .06573, .0733, .0737, .07934, EXT 20 C),10604, .06729, .00743, .07731, .24323, EXT 20 C),10756, .00728, .00753, .07737, .07736, .07943, EXT 20 C),10704, .171455, .157957, .100006, .7605, .43228, .25346, EXT 20 C),10704, .07443, .05734, .00741, .02774, .01736, .01943, EXT 20 C),10704, .07443, .05734, .00744, .05339, .07443, EXT 20 C),10704, .07443, .05724, .00744, .05459, .00746, .07944, EXT 20 C),114099, .00724, .00744, .05734, .00744, .05747, .05144/ C),244099, .00724, .00744, .0525, .22444, .2554, .2554, .25744, .27344, .07744, .277 C),0144, .00744, .00524, .00744, .00744, .00744, .00744, .00774, EXT 30 C),01724, .00744, .00574, .05144/ .00744, .00744, .00744, .00744, .00574, .05144/ .00774, EXT 30 C),01744, .00474, .05574, .105144/ .00744, .00574, .05144/ .007744, EXT 30 C),0146, .00744, .00574, .051</pre>	COMMON ZEYTPTAZYYZZANI, PUREYTZAN, AL RURARSZA	(.6).URPEXT(60.6).	FXT	50
<pre>2FG1EXT4.03, FG1ABS(4,47), FG21X1(40), FG21X1(40), FG21X1(40), FG1ABS(40), FG21X1(40), FG21X1(40)</pre>	11000000000000000000000000000000000000	T() D. 4) - TROARS(40,4) -	FYT	60
<pre>S1 S1TEXT4.0, S1TAD5.40, LUPEXT4.21, AUDABS(40), FVDEXT(40</pre>	2FG1FXT(40), FG148S(40), FG27XT(40), FG28PS(40)		FXT	7.0
<pre>Ni_F_UAAS_(4_0), '*E(XT14_0), 'M*2_S(1_0)''''''''''''''''''''''''''''''''''''</pre>	3. PSTEXT(40).9STAPS(40).4V0EXT(47).4V0BS(4	0), EVOEXT(40	EXT	60
DATA ((V2(1), 1=), 1, 10) .6503, .6543, 1.0600, 1.5360, EXT 110 * 2000, '2000, '2,500, 2,500, 2,7000, 3.000, '2,923, '3,7500, EXT 110 * 4,5000, '0,000, '5,500, 6.000, '6,200, 12,000, 12,200, EXT 120 * 4,5000, '1,000, '1,2,500, 14,000, '6,200, 10,000, 10,5910, EXT 140 * 11,000, 11,500', 12,500, 14,000, '1,5000, 116,4000, 17,2000, EXT 160 DATA (KUEXT(1,1), '1-1, 41)/ 12,00201, 1,14472, 1,5000, 1,00000, '75203, '41543, '24076, EXT 160 DATA (KUEXT(1,1), '1-1, 41)/ 12,00201, 1,14472, 1,50500, 1,00000, '75203, '41543, '24076, EXT 160 2,14739, '13304, '12234, '13247, '11196, '10437, '09955, EXT 160 2,14739, '13304, '12234, '13247, '11196, '10437, '09955, EXT 160 3,0046, '0,680', '0,6132, '0,9499, '0554, '1620, '0,6942, EXT 260 4,0441, '0,4399, '12184, '12658, '12829, '0,9152, '0,076, EXT 200 6,05722, '0,0517, '0,5177, '0,5279, '0,75316, '42171, '24323, EXT 260 7,004, '1,7465, '1,5961, '1,00000, '75316, '42171, '24323, EXT 260 2,016451, '0,6259, '12430, '12222, '13233, '11076, '10323, EXT 260 3,02477, '0,6726, '12430, '12222, '13233, '1076, '12323, '1266, EXT 300 6,05704, '0,7443, '1334, '13405, '20316, '12873, '1506, EXT 300 6,05704, '0,7443, '13744, '0,05741, '0,0773, EXT 300 7,10446, '1,1976, '0,1334, '0,0006, '76095, '43224, '25348, EXT 300 7,1044, '1,7456, '1,57962, '1,00006, '76095, '43227, '13566, E	6).FV04P5(48).FMEEXT(49).DMEAB5(48)		EXT	¢ΰ
<pre>* 2000* 2000* 3371* 5500; 6543, 1.0600, 1.922, 3.7500; EXT 10 * 2.0000; 2.2500; 2.500; 2.7000, 3.0000; 3.2923, 3.7500; EXT 120 * 4.5000; 7.0000; 5.5000; 4.60000; 9.2000; 10.0000; 10.5910; EXT 120 * 7.9000; 7.2000; 2.5000; 4.8000; 9.2000; 10.0000; 10.5910; EXT 150 * 10.000; 11.5000; 12.5000; 4.8000; 15.000; 12.4000; 17.2000; EXT 150 * 10.5000; 21.3000; 25.0000; 13.0000; 40.0000; 40.0000; EXT 150 * 10.5000; 12.3000; 75.000; 1.0000; .75203, .4194], .09956; EXT 170 12.09231; 1.74572; 1.50500; 1.40000; .75203, .4194], .09956; EXT 150 * 14.5000; 11.3000; 1.20000; .75203, .4194], .09956; EXT 150 * 101300; 11.0000; 1.00000; .75203, .4194], .09956; EXT 150 * 101300; 11.0000; 1.00000; .75203, .4194], .09956; EXT 150 * 101300; 11.0000; 1.00000; .75203, .4194], .09956; EXT 150 * .01451, .04399, .07651, .07025, .07049, .01952, .00952, .00716; EXT 250 0.5722, .07051, .05177, .045829, .00554, .16000; .07931, EXT 250 0.5722, .07051, .05177, .045829, .00554, .16000; .09962; EXT 250 0.50544, .174155, 1.59661, 1.00000, .75515, .42171, .24323, EXT 250 2.16105, .17608, .12430, .13222, .13823, .11075, .103323, EXT 250 2.16105, .17608, .12430, .13222, .13823, .11075, .103323, EXT 250 2.16105, .13608, .05533, .04467, .04519/ DATA (RUREXT(1,3) I=1, 40)/ 12.0704/3, .11455, 1.5553, .04647, .04519/ DATA (RUREXT(1,3) I=1, 40)/ 12.0704/3, .01553, .04647, .02519, .07743, EXT 300 0.144, .09709, .04519, .00100, .80542, .5059, .07443, EXT 300 0.144, .09709, .04519, .00100, .80542, .5059, .12259, EXT 300 2.14456, .14677, .13244, .13205, .27344, .08741, .07703, EXT 300 2.14456, .14677, .13241, .1305, .20316, .22673, .11506, EXT 320 2.14456, .14677, .13244, .13054, .20316, .20653, .03662, EXT 300 2.21645, .14677, .13241, .13051, .00654, .00563, .00562, EXT 300 2.21646, .12601, .14557, .16215, .16766, .14954, .14022, EXT 300 2.14456, .1447, .13524, .16139, .12006, .20574, .10518/ 4.10244, .19441, .17443, .2514, .15724, .15144, .00741, .07703, EXT 300 2.21646, .12772, .06552, .07285, .01316, .00664, EXT 300 2.21646, .12777, .16552, .10214, .205</pre>	DATA (VX2(T), T = 1, VD)/		EXT	100
<pre></pre>	* .20003000337155006963	. 1.0600. 1.53FD.	FXT	110
<pre> 4.5000, 4.0000, 4.5000, 6.0000, 6.000, 6.000, 6.000, 7.2000, 7.2000, EXT 140 7.9000, 7.2000, 7.2000, 7.2000, 9.2000, 10.0000, 10.5510, EXT 140 11.000, 11.500, 12.5000, 14.000, 9.2000, 10.0000, 10.5510, EXT 150 0ATA (RUEXT(T,1), T,14, 41)/ 2.09201, 1.74452, 1.50500, 1.40000, .75203, .41543, .24076, EXT 150 2.14709, .13704, 1.2234, .13247, .1196, .10437, .09956, EXT 150 4.0461, .04399, .07661, .07025, .07089, .07196, .07791, EXT 150 4.0461, .04399, .07661, .07025, .07089, .07196, .07791, EXT 150 5.07456, .06487, .06322, .04949, .05554, .1600, .09622, EXT 250 05722, .07051, .05177, .04589, .00304/ 20544, 1.74155, 1.59561, 1.00000, .75516, .42171, .24323, EXT 250 2.15100, .176654, .1224, .13222, .13223, .11076, .10323, EXT 250 2.09544, 1.74155, 1.59561, 1.00000, .75516, .42171, .24323, EXT 250 2.15100, .176054, .12430, .12222, .13233, .11076, .10323, EXT 250 3.09475, .08728, .98075, .07792, .07797, .47576, .407943, EXT 250 5.07380, .06489, .05533, .04467, .04519/ DATA (RUEXT(T,3), I=1, 40)/ 12.0708/, 1.1455, .15533, .04647, .04519/ DATA (RUEXT(T,13), I=1, 40)/ 12.0708/, .11456, .157962, 1.00000, .76095, .43228, .25340, EXT 300 DATA (RUEXT(T,3), I=1, 40)/ 12.0708/, .14677, .05134, .13005, .20316, .12873, .11506, EXT 300 DATA (RUEXT(T,3), I=1, 40)/ 1.00000, .60429, .05747, .05184/ .00563, .06962, EXT 320 2.14456, .14677, .13241, .13005, .20316, .12873, .11506, EXT 300 1.6076, 1.47868, 1.4039, 1.00000, .80622, .50598, .32259, EXT 350 2.14456, .12677, .06583, .05747, .05184/ .00563, .05962, EXT 300 1.60774, .05674, .05184/ .00563, .005962, EXT 300 1.60764, 1.47868, 1.4039, 1.00000, .80524, .50598, .32259, EXT 350 2.0468, .26777, .06563, .05747, .05184/ .02665, .039662, EXT 300 1.60764, 1.47868, 1.4039, 1.00000, .80524, .50595, .32259, EXT 350 2.0468, .26777, .06563, .05747, .05184/ .02677, .07443, .02774, .05267, .033647, EXT 450 3.1544, .07774, .05656, .05747, .0</pre>	* 2.0000, 2.2500, 2.5000, 2.7000, 3.0000	3.3923. 3.7500.	FYT	120
<pre>* 7.0000, #.2000, #.700, #.700, 9.0000, 9.2000, 10.0000, 10.5910, EXT 140 * 11.0001, 11.500, 12.5000, 50.000, 9.0000, 40.0000/ EXT 160 DATA (RUPEXT(1,1), T=1, 4))/ 12.00291, 1.74572, 1.30500, 1.00000(, .75203, .41543, .24076, EXT 160 C.14739, .13304, .12234, .13247, .11196, .10437, .09956, EXT 160 C. 04481, .04399, .12184, .17654, .12629, .01164, .09956, EXT 160 C. 04481, .04399, .12184, .17654, .12629, .01164, .09956, EXT 200 C. 04481, .04399, .12184, .17654, .12629, .01162, .0076, EXT 210 C. 04481, .04399, .12184, .17654, .12629, .01164, .09956, EXT 220 C. 05722, .06051, .05177, .04529, .04304, .00104, .09956, EXT 250 C. 05722, .06051, .05177, .04529, .04304, .00104, .09956, EXT 250 C. 05722, .06051, .05177, .04529, .04304, .00104, .10223, EXT 250 C. 11100, .17465, 1.59561, 1.00000, .75315, .42171, .24323, EXT 250 C. 05746, .07224, .06739, .07739, .04524, .00132, .07762, .07743, EXT 270 OATA (RUPEXT(T,2), i 1, 40)/ EXT 20 C. 05380, .06280, .0529, .04529, .04519/ EXT 300 C. 05380, .06484, .05329, .04527, .04519/ EXT 300 C. 05380, .06484, .05329, .04721, .06546, .06539, .07462, EXT 320 C. 16459, .04544, .05533, .04467, .04519/ EXT 300 C. 05380, .07484, .05339, .04467, .04519/ EXT 300 C. 05380, .07444, .05339, .04467, .04519/ EXT 300 C. 16457, .171456, 1.57962, 1.00000, .76059, .43228, .25348, EXT 320 C. 16456, .07744, .03146, .03610, .00563, .00962, EXT 320 C. 16456, .07444, .03146, .03610, .00563, .00962, EXT 320 C. 16456, .07444, .03146, .03610, .00563, .00964, EXT 300 C. 23464, .2777, .06668, .05747, .05184/ EXT 300 C. 01964, .147844, .14577, .16215, .15766, .14994, .14032, EXT 400 C. 01964, .14324, .14577, .02527, .03431, .03654, .03964, EXT 300 C. 01964, .143844, .12561, .15784, .11745, .15786, EXT 300 C. 01964, .11397, .005652, .00574, .005614, .00561, .00567, EXT 400 C. 01964, .0310, .06627, .02745, .03340, .03564, .03578, .03444, .03664, .05335, .04647, EXT 400 C. 01964, .03310, .06684, .05535, .03464, .03578, .03467, EXT 400 C. 01964, .03310, .06684, .05530, .03340, .03344, .03664, .05375, .04647,</pre>	* 4.5000, 5.0000, 5.5000, 6.0000, 6.2000	£.5000. 7.2000.	EXT	178
<pre>* 11.0001, 11.600, 12.5000, 14.0000, 15.0000, 15.0000, 17.2000, Ext 150 * 18.5000, 21.3000, 25.0000. 30.0000, 40.0000/ Ext 170 * 18.5000, 21.3000, 25.0000. 30.0000, 40.0000/ * 1730, 17452, 1.30500, 1.00000, .75203, .41543, .24076, Ext 170 * 2.09291, 1.74572, 1.30500, 1.00000, .75203, .41543, .24076, Ext 170 * .01799, .02494, .07661, .07025, .07089, .07791, Ext 20 * .04481, .04394, .17186, .17658, .1229, .07089, .07791, Ext 20 * .07456, .06687, .06132, .04949, .05654, .06010, .07696, Ext 210 * .07456, .06687, .05177, .04529, .04304/ * .04481, .01507, .04529, .04304/ * .24076, .07943, Ext 20 * .07456, .06687, .05177, .04529, .04304/ * .24076, .07943, Ext 20 * .07456, .06687, .05538, .10070, .75316, .42171, .24323, Ext 260 * .09475, .08724, .98073, .07639, .07797, .07536, .07943, Ext 240 * .209544, 1.74156, 1.59881, 1.00000, .75316, .42171, .24323, Ext 260 * .09475, .08724, .98073, .07639, .07797, .07536, .07943, Ext 260 * .07380, .06680, .05538, .04867, .04519/ DATA (RUPEXT(1,3), I=1, 40)/ * .04594, .076443, .05538, .04867, .04519/ DATA (RUPEXT(1,3), I=1, 40)/ * .00704, .171456, 1.57962, 1.000006, .76095, .43228, .25348, Ext 320 * .10441, .09709, .09318, .09308, .09709, .02791, .1506, Ext 320 * .10451, .09709, .09318, .03184, .00141, .0763, .00862, Ext 320 * .07656, .07044, .07443, .03146, .08100, .00563, .00962, Ext 320 * .07656, .07044, .07443, .05184, .00810, .00563, .00962, Ext 320 * .07656, .07044, .07443, .05184, .00810, .00563, .00962, Ext 320 * .09573, .07665, .05930, .055152, .055616, .05006, Ext 320 * .01954, .20772, .18532, .17345, .25114, .20006, .17366, EXT 400 * .01954, .20772, .18532, .11076, .09617 * Ext 400 * .01954, .02772, .03534, .00544, .02745, .01366, EXT 400 * .01954, .02772, .18532, .07545, .01366, EXT 400 * .01954, .02772, .18532, .10754, .02817, .02574, .03574, .2744 * .20245, .01310, .01627, .02512, .05616, .05006, Ext 400 * .02355, .01366, .023070, .03300/* Ext 400 * .02355, .01366, .023070, .03300, Ext 400 * .01546, .02364, .02374, .02247, .03535, .04644, .03575, .04647, .03576,</pre>	7.9000, A.2000, 8.7001, 9.0000, 9.2000	. 10.0000. 10.5910.	FXT	140
<pre>* 18, 5000, 21, 3000, 25, 0000, 30, 0000, 40, 0000/ EXT 100 DATA (RUPEXT(1,1), 1=1, 4)/ 12, 00291, 1.74572, 1.30500, 1.000000, .75203, .41543, .24076, EXT 160 2.14739, .13304, .12234, .13247, .11196, .10437, .09956, EXT 160 3.07456, .05440, .07661, .07025, .07026, .07196, .07791, EXT 200 4.04481, .04399, .12184, .12658, .12829, .09152, .08076, EXT 210 5.07456, .06680, .05127, .04549, .04304, .05554, .06076, EXT 210 CATA (RUPEXT(7,2), .1, 59681, 1.00000, .75115, .42171, .24323, EXT 250 2.15100, .174569, .12430, .13222, .13823, .11076, .07943, EXT 270 DATA (RUPEXT(7,2), .1, 59681, 1.00000, .75115, .42171, .24323, EXT 250 2.15100, .174569, .04724, .90673, .07734, .015766, .07943, EXT 270 0.074 CAUX 00726, .90675, .005791, .06549, .005639, .07443, EXT 270 0.074 CAUX 004899, .04525, .12165, .12741, .12776, .00532, .07962, EXT 260 5.07380, .006804, .05329, .07791, .06645, .00539, .07443, EXT 270 0.074 CAUX 004899, .04525, .12165, .12741, .12776, .00532, .07462, EXT 260 5.07380, .006804, .05329, .07791, .00563, .07564, .07943, EXT 270 0.074 CAUX 004899, .04525, .12165, .12741, .12776, .00553, .07462, EXT 260 5.07380, .006804, .05329, .07791, .06641, .00553, .07462, EXT 260 5.07380, .00704, .07443, .03533, .04667, .04519/ EXT 300 0.074 CAUX 00484, .07443, .05533, .04867, .04519/ EXT 300 CAUX CAUPAD, .07443, .03546, .00810, .00563, .00962, EXT 320 5.07766, .07044, .07443, .03446, .08610, .00563, .00962, EXT 320 5.07766, .07044, .07443, .03446, .08610, .00563, .00962, EXT 320 5.09873, .10167, .05652, .05747, .05184/ EXT 370 0.11 CAUFA, LUPAD, .07443, .03446, .008146, .008610, .00563, .00962, EXT 320 5.07766, .07044, .07443, .03446, .008610, .00563, .00962, EXT 320 5.09873, .01044, .07443, .05144, .008610, .00563, .00962, EXT 320 5.09873, .01044, .07443, .05544, .05454, .05747, .05184/ CAUA (RUPAP(11,1), I=1, 401/ EXT 400 A.16076, 1.47864, 1.40379, 1.00000, .80652, .50595, .32259, EXT 320 5.02367, .03392, .07214, .05530, .055152, .05616, .05006, EXT 400 CAUA (RUPAP(11,1), I=1, 401/ EXT 400 A.16109A, .01271, .02530, .</pre>	* 11.0000, 11.5000, 12.5000, 14.8000, 15.0000	. 15.4000. 17.2000.	FXT	150
DATA (RUBERT(I,1), I=1, 4)/ 1 2.09291, 1.74452, 1.50500, 1.00000, .75203, .41543, .24076, EXT 180 2.14739, .13304, .12234, .13247, .11196, .10437, .09956, EXT 160 4.04481, .04399, .12184, .12234, .13247, .11196, .10437, .09956, EXT 160 5.07456, .06887, .05032, .00949, .05654, .06010, .96952, .08076, EXT 210 0ATA (RUBERT(I,2), I=1, 40)/ 12.09544, 1.74165, 1.59981, 1.00000, .75316, .42171, .24323, EXT 250 2.15102, .13608, .12231, .10252, .13823, .11076, .10733, EXT 250 2.15102, .13608, .12231, .12222, .13823, .11076, .10743, EXT 270 0AFA (RUBERT(I,2), I=1, 40)/ 4.04899, .04725, .21265, .12741, .12776, .07943, EXT 270 0.40899, .04725, .21265, .12741, .12776, .07943, EXT 270 0.40899, .04725, .21265, .12741, .12776, .07943, EXT 270 0.0174 (RUBERT(I,3), I=1, 40)/ 1.2.0704/, 1.71456, 1.57982, 1.00006, .76095, .43220, .25348, EXT 320 0.0174 (RUBERT(I,3), I=1, 40)/ 1.2.0704/, 1.71456, 1.57982, 1.00006, .76095, .43220, .25348, EXT 320 0.0174 (RUBERT(I,3), I=1, 40)/ 1.2.0706, .07044, .07443, .01467, .02316, .12873, .11506, EXT 330 3.10441, .09709, .00791, .02761, .03653, .00563, .00562, EXT 360 5.07566, .07044, .07443, .01467, .05134, .00741, .07703, EXT 320 1.66076, 1.07677, .06658, .05747, .05184/ 0.0524, .07764, .07777, .16532, .17348, .25144, .20006, .17366, EXT 320 2.23468, .22777, .18532, .17348, .25144, .20006, .17366, EXT 320 3.16139, .15424, .14557, .16215, .16766, .149645, .10396, .27595, .32559, EXT 320 3.16139, .15424, .14557, .16215, .16766, .14964, .14032, EXT 410 0ATA (RUBERT(I,1), I=1, 40)/ 1.66716, .12977, .05516, .05930, .05152, .05816, .05947, .05348, EXT 420 5.09873, .10418, .13524, .15924, .16139, .15949, .15778, EXT 420 5.01966, .02370, .02101, .05652, .02245, .0316, .05946, EXT 420 5.01966, .02370, .02101, .05652, .02745, .01316, .00866, EXT 420 5.01966, .02370, .02101, .05652, .02745, .01316, .00866, EXT 420 5.02957, .02342, .07479, .02627, .03343, .03144, .03586, EXT 420 5.02957, .02342, .07479, .02627, .03433, .03144, .03564, EXT 520 5.02957, .02342, .07477, .025	* 18,5000, 21,3000, 25,0000, 30,0000, 40,000	/	EXT	1 60
1 2.09291, 1.74472, 1.30500, 1.00000, .75203, .41943, .24076, EXT 180 2 .14739, 1.7304, .12234, .13247, .11196, .10437, .09956, EXT 160 4 .04481, .04399, .07165, .07075, .07039, .07136, .07793, EXT 210 5 .07456, .06887, .16037, .04949, .05654, .12829, .09152, .18076, EXT 210 0 ATA (PUPFXT(7,2), .16177, .04589, .04304, .1000, .075316, .42171, .24323, EXT 250 2 .15100, .17608, .12433, .12222, .13823, .11076, .10323, EXT 250 3 .09475, .08728, .96073, .07639, .07797, .07576, .07943, EXT 270 0 ATA (PUPFXT(7,2), .12, .10000, .75316, .42171, .24323, EXT 250 2 .15100, .17608, .12433, .12222, .13823, .11076, .10323, EXT 260 3 .09475, .08728, .96073, .07639, .07797, .07576, .07943, EXT 270 4 .04899, .04525, .12165, .12741, .12778, .09032, .07943, EXT 280 5 .07380, .06880, .05329, .07491, .06846, .04519, .07443, EXT 270 0 ATA (RUPEXT(1,3), .121, 40)/ 1 2.07082, 1.71456, 1.57962, 1.00006, .76095, .43228, .25346, EXT 320 2 .16456, .14677, .13234, .13405, .20316, .12873, .11506, EXT 320 2 .16456, .14677, .13234, .13405, .20316, .12873, .11506, EXT 320 2 .16456, .14677, .13234, .13405, .20316, .08640, .08663, .08962, EXT 260 5 .07766, .07044, .07434, .08146, .08840, .08663, .08962, EXT 360 5 .07766, .147984, 1.40179, .12595, .12348, .08741, .07763, CXT 350 5 .07766, .147984, 1.40179, .08146, .08614, .07674, .08962, EXT 360 5 .07766, .147984, 1.40179, .105000, .80652, .50595, .32259, EXT 250 2 .23468, .22772, .18532, .17348, .25144, .20006, .17386, EXT 420 5 .09873, .10418, .13541, .13582, .13262, .11070, .09994, EXT 420 5 .09873, .01462, .01310, .01627, .02133, .02165, .02367, .03578, EXT 440 2 .01968, .02270, .02101, .05652, .02785, .01314, .03578, EXT 420 5 .02367, .03542, .0777, .02507, .03380/ CATA (RUPAPC(1,1), .1=1, .007/ 3 .01462, .01310, .01627, .0213, .02165, .03578, .04644, EXT 420 5 .02457, .03542, .07774, .073464, .059376, .04032, .03487, EXT 450 5 .02457, .03542, .07277, .02627, .03380/ CATA (RUPAPS(1,2), .1=1, .007/ 5 .02456, .02816, .07277, .02633, .03514, .03578, .04644, EXT 550	BATA (RUREXT(T-1) -T=1. 41)/	-	EXT	170
2 .14709, 13304, 12234, 13247, 11196, 10437, 09956, EXT 140 4 .0481, 04399, 12184, 12658, 12629, 09152, 10076, 17731, EXT 200 5 .07456, 10686, 15517, 04589, 04304/ 12.09544, 1.74165, 1.59561, 100000, 75316, 42171, 24323, EXT 250 0ATA (RUFEXT(T,2),1=1,40)/ 12.09544, 1.74165, 1.59561, 1.00000, 75316, 42171, 24323, EXT 250 3 .09475, 08722, 08728, 07639, 07797, 407576, 07943, EXT 270 04489, 04525, 12165, 12741, 12778, 04589, 04304/ 0474, 04899, 04525, 12165, 12741, 12778, 04539, 07797, 407576, 07943, EXT 270 0476, 04899, 04525, 12165, 12741, 12778, 04639, 07943, EXT 270 0476, 04899, 04525, 12165, 12741, 12778, 04639, 07962, EXT 280 5 .07360, 066463, 05533, 00487, 04519/ 12.0708, 1.11456, 1.57987, 1.00000, 76095, 43228, 25348, EXT 320 C .16456, 14677, 13234, 11305, 20316, 12873, 11506, EXT 320 12.0708, 1.17456, 1.57987, 1.00000, 76095, 43228, 25348, EXT 320 C .16456, 14677, 05648, 005477, 05184/ 4 .05247, 05511, 01704, 07443, 00144, 00410, 00863, 00862, EXT 340 4 .05247, 05511, 1977, 16658, 05747, 05184/ 11.66076, 1.47865, 1.40139, 1.00000, 80652, \$5595, 32259, EXT 350 2 .23468, 22777, 16525, 11244, 08610, 00863, 00962, EXT 350 11.66076, 1.47865, 1.4017, 11522, 11328, 11305, EXT 320 11.66076, 1.47865, 1.4017, 11522, 11328, 115778, EXT 420 3 .16139, 15424, 14557, 15215, 16766, 14944, 14032, EXT 410 4 .12968, .22077, 06553, 11076, 09601/ 0474 (RUPEX(14), 1214, 40)/ 1 .667196, 11377, 08505, 05930, 05152, 05316, 00867, EXT 420 5 .02873, 10448, 1.2551, 113582, 01275, 01316, 00867, EXT 420 5 .02875, 07342, .72177, 02527, 03433, 03144, 03578, EXT 420 5 .02557, 07342, .72177, 02527, 03433, 03144, 03578, EXT 420 5 .02557, 07342, .72177, 02527, 03330, 05152, 05316, 00867, EXT 440 CATA (RUPAS(1,2), II-1, 401/ 1 .67548, .22641, .27671, .075380, 04684, .05335, 04644, EXT 420 5 .02557, 07342, .72177, 02527, 03330, 05152, 02367, 03374, 03578, EXT 450 5 .02357, .07342, .72177, 02527, 03330, 05452, 02367, 033437, EXT 450 5 .02357, .07345, .7247, .05389, 04684, 02327, 03307/ EXT 520 4 .07345, .0785	1 2.09291. 1.74587. 1.50500. 1.00000 75203	41943 24070.	FXT	180
<pre>1 .09199, .08445, .07261, .07005, .07089, .07196, .07791, EXT 200 4 .04481, .04394, .12144, .12612, .12629, .09152, .08076, EXT 210 5 .07456, .0688^, .15032, .04949, .05544, .16010, .95962, EXT 220 6 .05722, .04061, .05177, .04529, .04304/ EXT 240 1 2.09544, 1.74165, 1.59961, 1.00000, .75316, .42171, .24323, EXT 250 2 .15100, .17608, .12430, .13222, .13823, .11076, .10323, EXT 260 3 .09475, .08724, .0673, .07639, .07797, .07576, .07943, EXT 270 4 .04999, .04765, .12155, .12741, .12776, .09032, .07962, EXT 280 6 .06304, .06480, .05329, .07741, .06646, .07943, EXT 270 0ATA (RUPEXI(1,3), T=1, 40)/ EXT 310 0ATA (RUPEXI(1,3), T=1, 40)/ EXT 310 1 2.0708/, 1.71456, 1.57967, 1.00006, .76095, .43228, .25348, EXT 320 2 .16445, .06744, .03533, .04467, .04519/ EXT 310 1 2.0708/, 1.71456, 1.57967, 1.00006, .76095, .43228, .25348, EXT 320 2 .164456, .14677, .13274, .13405, .2016, .12873, .11506, EXT 320 3 .10441, .09709, .04919, .00328, .09709, .08763, .06663, .06962, EXT 320 5 .07766, .07044, .07433, .01446, .08100, .08063, .00863, .00862, EXT 320 5 .07766, .07044, .07443, .05144/ .00547, .14577, .05184/ EXT 370 DATA (RUPEXI(1,4), T=1, 40)/ UATA (RUPEXI(1,4), T=1, 40)/ 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10448, .12663, .11076, .09501/ UATA (RUPEXI(1,4), T=1, 40)/ 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .019874, .10418, .12633, .11076, .09601/ UATA (RUPAP(1,1), .1=1, 40)/ 4 .12948, .02700, .02101, .06592, .02745, .01316, .00866, EXT 420 5 .02955, .07300, .05930, .05152, .05816, .00806, EXT 420 5 .02955, .07300, .05930, .05152, .05816, .00866, .23578, .03538, EXT 400 2 .01462, .01310, .01627, .02817, .03538, .03514, .03578, .04614, EXT 470 3 .01462, .01310, .01627, .02817, .03538, .03514, .03598, EXT 400 2 .01976, .01377, .04247, .02827, .03380/ UATA (RUPAPS(1,2), .1=1, 401/ 1 .07235, .03614, .01357, .03538, .04614, EXT 470 3 .01462, .01377, .01262, .02817, .03538, .04614, EXT 450 5 .02855, .07500, .03241, .03525, .036614, .01627, .03538, .03667, EXT 5</pre>	2 .1473913384122341324711196	.10437	EXT	1 00
<pre>4 .04441, .01394, .12161, .12652, .12659, .09152, .00745, EXT 210 5 .07456, .0688^, .06032, .04949, .05854, .12029, .09152, .08756, EXT 210 DATA (RUFFXI(7,2), /:1, 40)/ 1 2.09544, 1.74165, 1.59561, 1.00000, .75316, .42171, .24323, EXT 260 2 .15100, .13608, .12430, .13222, .13823, .11076, .10323, EXT 260 3 .09475, .00728, .0073, .07539, .07797, .07576, .07943, EXT 260 6 .06304, .06439, .06329, .07791, .06646, .06639, .07443, EXT 260 6 .06304, .06439, .06539, .07791, .06546, .06639, .07443, EXT 260 CATA (RUPEXT(1,3), I=1, 40)/ 1 2.07007, .07645, .157962, 1.00006, .76095, .43228, .25348, EXT 360 C .16455, .4677, .06648, .08467, .04519/ EXT 310 CATA (RUPEXT(1,3), I=1, 40)/ 1 2.07007, .0744, .157962, 1.00006, .76095, .43228, .25348, EXT 360 C .016051, .0779, .07919, .08410, .00363, .08962, EXT 360 6 .016051, .0767, .06658, .03747, .05144/ EXT 370 CATA (RUPEXT(1,4), T=1, 40)/ 1 1.66076, 1.47866, 1.40139, 1.00000, .80652, .50595, .32259, EXT 360 6 .016051, .0767, .06658, .05747, .05144/ EXT 370 CATA (RUPEYT(1,4), T=1, 40)/ 1 1.66076, 1.47866, 1.40139, 1.00000, .80652, .50595, .32259, EXT 360 C .016051, .0767, .06658, .05747, .05144/ EXT 370 CATA (RUPEYT(1,4), T=1, 40)/ 1 1.66076, 1.47866, 1.40139, 1.00000, .80652, .50595, .32259, EXT 360 C .016051, .0767, .06658, .05747, .05144/ EXT 370 CATA (RUPAPTC), 1.3514, .15924, .15139, .11506, EXT 320 C .23468, .22772, .18532, .113562, .15149, .11070, .09994, EXT 420 C .09877, .10416, .1351, .15522, .15245, .01316, .00867, EXT 420 C .01968, .02370, .02117, .02575, .01316, .00867, EXT 420 C .01968, .12617, .05612, .02785, .01316, .00867, EXT 420 C .01968, .12617, .01565, .02785, .01316, .00867, EXT 420 C .01968, .02370, .02117, .02527, .03380/ EXT 510 C .02557, .03542, .12574, .05380, .04684, .05355, .04614, EXT 520 C .02557, .03570, .02165, .02367, .03578, EXT 450 C .02557, .03570, .02165, .02367, .03377, EXT 450 C .02557, .03563, .02464, .05335, .04614, EXT 520 C .02784, .01377, .01667, .02867, .02367, .03407, EXT 520 C .02785, .07500, .3241, .05380, .04684, .05335, .0461</pre>	N . 19190 08660 07661 07025 07089	0719607791.	FXT	200
5 .07456, .0688, .0607, .0507, .04949, .05254, .1(0010, .96962, EXT 220 0ATA (RURFXI(7,2), .151, 40)/ 12.09544, 1.74165, 1.59561, 1.00000, .75316, .42171, .24323, EXT 260 2.15100, .17608, .12430, .13222, .13823, .11076, .10323, EXT 260 3.09475, .06728, .12430, .13222, .13823, .11076, .07943, EXT 270 4.04899, .04625, .12165, .12741, .12778, .09032, .07962, EXT 260 0.07300, .06880, .06329, .04867, .04519/ 0ATA (RUFEXI(1,3), .1=1, 40)/ 12.0708/, 1.71456, 1.57967, 1.00006, .76095, .43228, .25348, EXT 320 0ATA (RUFEXI(1,3), .1=1, 40)/ 12.0708/, 1.71456, 1.57967, 1.00006, .76095, .43228, .25348, EXT 320 0ATA (RUFEXI(1,3), .1=1, 40)/ 12.0708/, 1.71456, 1.57967, 1.00006, .76095, .43228, .25348, EXT 320 0ATA (RUFEXI(1,4), .157967, 1.00006, .76095, .43228, .25348, EXT 320 2.16456, .07044, .07443, .08146, .08741, .07703, EXT 340 4.00244, .07044, .07443, .08146, .08563, .08562, EXT 340 5.07266, .07044, .07443, .08146, .08510, .00563, .08562, EXT 340 1.66076, 1.47846, 1.40179, .15295, .12348, .08741, .07703, EXT 340 5.07266, .27772, .18532, .17348, .25114, .20006, .17366, EXT 400 3.16139, .15424, .14557, .16766, .14964, .14022, EXT 340 4.12968, .220772, .18532, .17348, .25114, .20006, .17366, EXT 400 3.16139, .15424, .14557, .16766, .14964, .14022, EXT 340 4.12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5.09873, .10418, .13261, .155924, .16139, .15949, .15778, EXT 420 4.12968, .12601, .03505, .02767, .03360, .05316, .05006, EXT 420 3.01462, .01310, .01627, .02013, .02145, .03316, .00867, EXT 450 4.02265, .02760, .23070, .02111, .05525, .01316, .00867, EXT 450 4.02265, .02750, .02367, .02367, .03380/ EXT 450 4.02354, .10514, .01677, .02267, .03380/ EXT 450 5.02557, .003562, .07750, .02367, .03380/ EXT 450 5.02557, .00362, .07774, .02267, .03380/ EXT 450 5.02557, .03464, .01677, .02267, .03380/ EXT 450 5.02456, .02846, .01777, .02857, .03380/ EXT 550 4.07845, .02846, .01777, .02857, .03380/ EXT 550 5.02846, .02846, .03101, .03575, .03360/ EXT 550 0ATA (RUPA95(1,7), 1=1, 40)/	6 .0448104399121841265812829		FXT	210
6 .06722, .0F0F1, .05177, .04528, .04304/ DATA (RUFFX1(7,2), /=1, 40)/ 1 2.09544, 1.74165, 1.59681, 1.00000, .75315, .42171, .24323, EXT 250 3 .09475, .08724, .98073, .07639, .07797, .07576, .07943, EXT 270 4 .04899, .04525, .12165, .12741, .12776, .09032, .07962, EXT 280 5 .07380, .06800, .06329, .07791, .06645, .05539, .07443, EXT 270 0 6 .05304, .06463, .05329, .07791, .06645, .05539, .07443, EXT 290 DATA (RUFEXT(1,3), 1=1, 40)/ 1 2.07082, 1.71456, 1.57562, 1.00006, .76095, .43228, .25348, EXT 300 DATA (RUFEXT(1,3), 1=1, 40)/ 1 2.07082, 1.71456, 1.57562, 1.00006, .76095, .43228, .25348, EXT 320 2 .11456, .16076, .10704, .07443, .08320, .09799, .02791, .04601, EXT 320 3 .10471, .09709, .08913, .09320, .09709, .02791, .04601, EXT 320 5 .07265, .07044, .07443, .08146, .08810, .08763, .08962, EXT 360 6 .00051, .07645, .07443, .005747, .05184/ 2 .27464, .22772, .18532, .17344, .35149, .20006, .17386, EXT 320 2 .24648, .22772, .18532, .17344, .35149, .20006, .17386, EXT 360 C .00051, .47884, 1.40139, 1.00000, .80652, .50595, .32259, EXT 360 1 1.66076, 1.47884, 1.40139, 1.00000, .80652, .50595, .32259, EXT 360 2 .22464, .22772, .18532, .17344, .35149, .20006, .17386, EXT 420 3 .16139, .15424, .14557, .15215, .15766, .11994, .14032, EXT 420 4 .12968, .12601, .13551, .13582, .3226, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .15139, .15949, .15778, EXT 420 1 .67196, .11977, .08505, .05930, .05152, .05816, .05006, EXT 420 2 .01968, .02070, .02017, .02152, .05816, .05006, EXT 420 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 480 4 .02235, .03570, .06775, .017265, .02367, .03538, EXT 480 4 .02255, .02557, .03362, .06775, .01245, .00345, .03114, .03569, EXT 520 1 .62555, .02564, .02617, .02013, .02165, .02367, .03538, EXT 480 4 .02255, .02500, .23241, .03598, .04684, .05335, .04614, EXT 520 5 .02356, .02816, .02861, .03741, .04289, .04484, .04337, EXT 550 4 .07845, .03851, .05684, .07272, .08038, .03970, .04314, .03569, EXT 550 5024166, .02816, .03601, .035	5 .0745606880050320494905854		EXT	220
DATA (RUPFX1(T,2), ,=1,40/ 1 2.09544, 1.741F5, 1.59681, 1.00000, .75315, .42171, .24323, EXT 240 2 .15100, 1.37008, .12430, .12222, .13243, .11076, .10323, EXT 260 3 .09475, .08726, .98073, .07639, .07797, .07576, .07943, EXT 270 4 .04899, .04525, .12165, .12741, .12778, .09032, .07962, EXT 280 5 .07380, .06800, .06329, .07791, .06646, .066539, .07443, EXT 290 6 .06304, .06443, .05533, .04867, .04519/ DATA (RUPEXT(I,3), 1=1, 40)/ 1 2.07082, 1.71456, 1.57962, 1.00006, .76095, .43228, .25348, EXT 320 2 .14456, .14677, .13234, .13405, .20346, .12873, .11506, EXT 320 3 .10441, .09709, .08419, .09324, .09709, .08701, .36641, EXT 340 4 .08247, .05411, .11905, .12595, .12348, .08741, .07703, EXT 340 5 .07766, .07044, .07443, .08146, .08410, .08563, .08962, EXT 340 4 .08247, .05411, .11905, .12595, .12348, .08741, .07703, EXT 340 5 .07766, .07044, .07443, .08146, .08410, .08563, .08962, EXT 340 1 1.66076, .10474, .14577, .16551, .15514/ EXT 370 DATA (RUPEXT(I,4), .1=1, 40)/ 1 1.66076, .124786, 1.40349, 1.00000, .80652, .56595, .32259, EXT 340 3 .16139, .15424, .14557, .16215, .15764, .14954, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .17348, .15114, .20006, .17386, EXT 420 5 .09873, .10418, .13241, .15924, .15139, .15949, .15778, EXT 420 5 .09873, .10418, .13241, .15924, .15139, .15949, .15778, EXT 420 5 .09873, .10418, .13241, .15924, .15139, .15949, .15778, EXT 420 5 .02557, .02362, .02177, .02652, .02365, .005816, .05006, EXT 420 4 .02235, .03962, .02777, .02652, .02375, .01316, .00667, EXT 420 5 .02557, .02342, .02177, .02627, .03943, .03114, .03696, EXT 420 5 .02557, .02342, .02177, .02627, .03943, .03114, .03696, EXT 420 5 .02557, .02345, .01677, .02627, .03943, .03114, .03696, EXT 400 4 .02623, .10814, .03771, .07671, .02627, .03943, .03114, .03696, EXT 500 5 .02456, .02864, .07272, .08034, .03467, EXT 550 4 .07835, .02864, .07272, .08034, .03477, EXT 550 4 .07835, .02864, .07627, .02862, .02429, .02432, .03467, EXT 550 0 .02845, .02846, .03601, .03575, .03663/ EXT 590 0	6 .0572706051051770458904304		FXT	230
1 2.09544, 1.74165, 1.5968, 1.00000, .75315, .42171, .24323, EXT 250 2 .15100, .17608, .12430, .12222, .13823, .11076, .10323, EXT 260 3 .09475, .08724, .98073, .0769, .0777, .07576, .07943, EXT 270 4 .04899, .04525, .12165, .12741, .12778, .09032, .07962, EXT 280 5 .07380, .06880, .06329, .07791, .06686, .06539, .07443, EXT 290 0 .05304, .06843, .05329, .07791, .06686, .06539, .07443, EXT 300 DATA (RUPEXI(1,3), 1=1, 40)/ 1 2.07087, 1.71456, 1.57967, 1.00006, .76095, .43228, .25348, EXT 320 2 .16456, .14677, .13334, .13405, .20316, .12873, .11506, EXT 320 2 .16456, .04644, .07443, .08146, .08810, .08761, .0703, EXT 360 4 .00247, .05511, .11905, .12595, .12348, .08744, .07703, EXT 360 5 .07266, .07044, .07443, .08146, .08810, .00563, .08962, EXT 360 2 .23468, .22772, .18632, .17348, .35114, .20006, .17366, EXT 460 2 .23468, .22772, .18632, .17348, .35144, .20006, .17366, EXT 460 3 .16139, .15424, .14557, .16215, .16766, .14954, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13561, .10924, .105147 DATA (RUPEY(1,1), 1=1, 40)/ 1 .66176, .147846, 1.40179, .06552, .02785, .01316, .05006, EXT 420 5 .09873, .10418, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .12563, .11076, .096017 DATA (RUPAPS(1,1), 1=1, 40)/ 1 .67196, .119371, .08505, .05930, .05152, .05816, .05006, EXT 420 2 .01968, .02070, .02101, .05652, .02785, .01316, .00867, EXT 420 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 450 3 .02557, .07342, .72177, .02627, .03943, .03114, .03696, EXT 450 3 .01546, .01373, .01627, .02813, .02165, .02376, .04647, EXT 450 3 .01546, .01373, .01627, .02813, .02165, .02376, .04647, EXT 450 3 .01546, .01373, .01627, .02827, .03380/ CATA (RUPAPS(1,2), .7=1, 40)/ 1 .5295, .07500, .7342, .62777, .02627, .03340, .03114, .03696, EXT 520 3 .01546, .01373, .01627, .02852, .02869, .04032, .03477, EXT 450 3 .01546, .01373, .01627, .02852, .02869, .02367, .04647, EXT 550 4 .07334, .03956, .03601, .03575, .035637	$nata (RUPExt(t_2) = (=1, 40))$	1.	FXT	240
2 .16100, .1%608, .12430, .12222, .13823, .11076, .10323, EXT 260 3 .09475, .08728, .98073, .07639, .07797, .07576, .07943, EXT 270 4 .04899, .04725, .12165, .12776, .40932, .07743, EXT 270 5 .07380, .06880, .06329, .05721, .06846, .06639, .07443, EXT 290 6 .06304, .06443, .05533, .04867, .04519/ OATA (RUPRYN(I,3) I=1, 40)/ 1 2.0708 ³ , 1.71456, 1.57962, 1.00006, .76095, .43228, .25348, EXT 320 2 .16456, .14677, .13234, .13405, .20316, .12873, .11506, EXT 320 3 .104A1, .09709, .04919, .09380, .09709, .08741, .06614, EXT 340 4 .06247, .05414, .07443, .08146, .08810, .00563, .08962, EXT 360 5 .07266, .07044, .07443, .08146, .0810, .00563, .08962, EXT 360 5 .07266, .07044, .07443, .08146, .05184/ DATA (RUPRYN(I,4), T=1, 40)/ 1 .66076, 1.47886, 1.40139, 1.00000, .80652, .55595, .32259, EXT 360 2 .23468, .27777, .18532, .17348, .15114, .20006, .173866, EXT 420 3 .16439, .15424, .14557, .16215, .16766, .14964, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09973, .10418, .13241, .15924, .15139, .15949, .15778, EXT 430 6 .15184, .13848, .12563, .11076, .09601/ DATA (RUPRYN(I,1), I=1, 40)/ 1 .67196, .11937, .08505, .05930, .05152, .05816, .05006, EXT 420 5 .09973, .10418, .13241, .15924, .16139, .15949, .15778, EXT 440 2 .01968, .02376, .02101, .05652, .02785, .01316, .00867, EXT 440 2 .01968, .02376, .0714, .0724, .03380/ CATA (RUPABS(I,2), I=1, 40)/ 1 .67196, .11937, .08505, .05930, .05152, .05816, .05006, EXT 440 2 .01978, .03962, .04779, .07265, .02785, .01316, .00867, EXT 450 1 .62957, .07342, .07217, .02527, .03340/ CATA (RUPABS(I,2), I=1, 40)/ 1 .02353, .01661, .02416, .02316, .07414, .04829, .03487, EXT 520 2 .02457, .03544, .01624, .07272, .08380/ CATA (RUPABS(I,2), I=1, 40)/ 1 .02454, .02416, .03410, .03575, .03563/ 0 .04352, .04437, EXT 520 4 .07354, .03854, .06684, .07272, .08036, .03977, .03247, EXT 520 0 ATA (RUPABS(I,3), I=1, 40)/ 5 .02416, .02416, .03410, .03575, .03563/ 0 ATA (RUPABS(I,3), I=1, 40)/ 5 .02457, .03654, .03601, .	1 2.09544. 1.74165. 1.59981. 1.00000		EXT	250
3 .09475, .08728, .78675, .17639, .07797, .17576, .07943, EXT 270 4 .04899, .04525, .12165, .12741, .12778, .09032, .07943, EXT 280 5 .07360, .06630, .06329, .05791, .06646, .06639, .07443, EXT 290 0 .06304, .06443, .05539, .04867, .04519/ EXT 310 DATA (RUPEXI(1,3), I=1, 40)/ EXT 310 2 .16456, .14677, .13234, .13405, .20316, .12873, .11506, EXT 320 2 .16456, .14677, .13234, .13405, .20316, .12873, .11506, EXT 320 3 .10471, .09709, .00919, .09380, .09709, .08791, .J6601, EXT 340 4 .00247, .05611, .11905, .12595, .12348, .08741, .07703, EXT 340 5 .07766, .07044, .07443, .08146, .08810, .00563, .08962, EXT 340 6 .08051, .07677, .06658, .05747, .05184/ EXT 340 1 1.66076, 1.47886, 1.40139, 1.00000, .80652, .50595, .32259, EXT 360 2 .23468, .22772, .18532, .17344, .3514, .20006, .17386, EXT 340 3 .16139, .15424, .14557, .16215, .16766, .14964, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10448, .13251, .13582, .13228, .11070, .09994, EXT 420 6 .15184, .13048, .12563, .11076, .09601/ EXT 440 2 .01968, .02370, .02101, .05652, .02785, .01316, .00867, EXT 440 2 .01968, .02370, .02101, .05652, .02785, .01316, .00867, EXT 440 2 .01968, .02370, .02101, .05652, .02785, .01316, .00867, EXT 470 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 480 4 .022370, .05151, .13580, .02365, .02367, .03538, EXT 480 4 .022370, .01211, .01627, .02013, .02165, .02367, .03538, EXT 480 2 .01968, .02370, .07342, .0771, .07285, .01316, .00867, EXT 470 3 .01462, .01310, .01627, .02013, .02465, .02367, .03538, EXT 480 4 .022370, .07342, .07717, .07285, .00380/ 2 .001829, .10894, .01627, .02367, .03538, .03114, .03696, EXT 510 2 .001829, .01829, .01829, .01629, .02862, .03487, EXT 50 3 .01546, .01373, .01627, .02852, .02829, .02432, .03487, EXT 50 4 .07845, .03854, .09684, .07272, .04038, .03947, .03247, EXT 550 4 .07845, .03854, .05684, .07272, .04038, .03947, .03247, EXT 550 4 .07845, .03854, .05684, .07277, .04032, .04032, .04399, EXT 570 0 .03734, .034	2 .1510813608124301322213823		FXT	260
4 .04899, .04555, .12155, .12741, .12770, .00032, .07463, EXT 280 5 .07380, .06880, .06329, .05791, .06645, .06539, .07443, EXT 290 0 .06104, .064447, .05533, .04867, .04519/ DATA (RUPEXT(I,3),I=1, 40)/ 1 2.07087, 1.71456, 1.57967, 1.00000, .76095, .43228, .25348, EXT 320 2 .16456, .14677, .13234, .13405, .20316, .12873, .11506, EXT 320 3 .10441, .09709, .0A919, .09380, .09709, .08791, .J66u1, EXT 340 4 .00247, .05414, .07443, .08146, .08610, .08741, .07703, EXT 340 4 .00247, .05414, .07443, .08146, .0810, .08743, .08741, .07703, EXT 340 1 .66076, 1.47865, 1.40139, 1.00000, .80652, .56595, .32259, EXT 360 6 .08051, .07677, .06658, .05747, .05184/ DATA (RUREXT(I,44), T=1, 40)/ 1 .66076, 1.47865, 1.40139, 1.00000, .80652, .56595, .32259, EXT 360 2 .23468, .22777, .18532, .17348, .25114, .20006, .17386, EXT 460 3 .16139, .15424, .14557, .15215, .16766, .14954, .140322, EXT 410 4 .12968, .12601, .13551, .13522, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .16139, .15949, .15778, EXT 420 6 .15184, .13847, .12563, .11076, .09601/ 0 ATA (RURPEYI, 1, 1, I=1, 40)/ 1 .67196, .11937, .08505, .05930, .05152, .05616, .05006, EXT 420 2 .01968, .02070, .02101, .05652, .02785, .01316, .00867, EXT 450 1 .67196, .11937, .08505, .05930, .05152, .05616, .05006, EXT 460 2 .01968, .02070, .02101, .05652, .02785, .01316, .00867, EXT 470 3 .014627, .02101, .05652, .02785, .03177, EXT 450 5 .02557, .07342, .0777, .02627, .03943, .03144, .03696, EXT 470 3 .01462, .01310, .01627, .02813, .02367, .03578, .04414, EXT 520 1 .62956, .075010, .3241, .63297, .03380/ EXT 520 2 .01829, .01849, .01962, .02852, .00807, EXT 50 2 .02857, .07342, .02177, .02627, .03943, .03144, .03696, EXT 450 3 .01544, .01373, .01671, .05380, .04684, .05335, .04644, EXT 520 1 .02845, .02846, .03601, .03441, .04829, .04032, .03447, EXT 540 3 .01544, .02845, .03610, .03575, .03563/ 0 .02845, .02846, .03644, .07272, .08038, .03977, .03247, EXT 540 3 .01544, .02846, .03601, .03575, .03563/ 0 .07334, .03846, .07677,	3 .0947508728986750763907797	0757687943.	EXT	2 70
5 .07300, .06800, .06323, .07721, .02646, .05639, .07443, EXT 290 0 .06304, .06447, .05533, .04867, .04519/ DATA (RUPEXT(I,3),I=1,40)/ 1 2.07007, 1.71456, 1.57967, 1.00000, .76095, .43228, .25348, EXT 320 2 .16456, .14677, .13234, .13405, .20316, .12873, .11506, EXT 320 3 .10441, .09709, .08919, .09380, .09709, .08791, .36601, EXT 340 4 .05247, .05417, .105595, .12348, .08741, .07703, EXT 360 5 .07266, .07044, .07443, .08146, .08810, .08563, .08962, EXT 360 6 .08051, .07677, .06658, .05747, .05184/ DATA (RUFEXT(I,4),T=1,40)/ 1 .66076, 1.47886, 1.40139, 1.00000, .80652, .56595, .32259, EXT 360 2 .23468, .22772, .18532, .17348, .25114, .20006, .173866, EXT 400 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .12241, .15924, .14529, .16766, .14094, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .12241, .15924, .16139, .15778, EXT 430 6 .15184, .13844, .12563, .1013, .02165, .02367, .03538, EXT 420 2 .01968, .02076, .02101, .06552, .02785, .01316, .00066, EXT 440 2 .01968, .02076, .02101, .05930, .05152, .05816, .05006, EXT 450 1 .67196, .13977, .08505, .05930, .05152, .05816, .05006, EXT 450 2 .01968, .02076, .02101, .05652, .02785, .01316, .00066, EXT 460 2 .01968, .02076, .02101, .0552, .02785, .01316, .00466, EXT 460 2 .01968, .02076, .02101, .0552, .00343, .03114, .03696, EXT 450 1 .62956, .18811, .07677, .02627, .03380/ EXT 510 EXT 520 CATA (RUPAES(I,2), I=1, 401/ 1 .62968, .10811, .07671, .05380, .04684, .05335, .04644, EXT 530 4 .02835, .03500, .3241, .63297, .03380/ EXT 520 2 .01829, .1284, .01664, .07272, .08038, .03947, .03247, EXT 540 3 .01540, .01373, .01672, .02627, .03483, .03947, .03447, EXT 540 3 .01544, .01373, .01674, .02852, .02649, .02632, .03487, EXT 540 3 .01544, .01373, .01667, .02852, .03636, .03947, .03247, EXT 540 4 .02835, .03854, .06684, .07272, .08038, .03947, .03247, EXT 540 5 .02816, .02816, .03101, .03741, .04829, .04032, .04349, EXT 540 5 .02816, .02816, .0310	4 .0489904525121651274112778	090.3207962.	FTT	28.0
6 0.6304, .06443, .05533, .04867, .04519/ EXT 300 DATA (RUPEXI(1,3), T=1, 40)/ 1 2.0708/, 1.71456, 1.57962, 1.00006, .76095, .43228, .25348, EXT 320 2 .16456, .16677, .13234, .13405, .20316, .12873, .11506, EXT 320 3 .10441, .09709, .0A919, .09320, .09799, .08791, .36641, EXT 340 4 .05243, .05744, .07443, .08146, .08610, .08653, .08962, EXT 360 5 .07266, .07044, .07443, .08146, .08610, .08653, .08962, EXT 360 6 .08051, .07677, .06668, .05747, .05184/ DATA (RUFX)I(1,4), T=1, 40)/ 4 .12668, .12772, .18532, .17348, .25114, .20006, .17386, EXT 420 3 .16139, .15424, .14557, .16215, .16666, .14954, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .16139, .15949, .15778, EXT 420 6 .15184, .13848, .12563, .11076, .09601/ 0ATA (RUFAPS'(I,1), I=1, 40)/ 1 .67196, .02370, .02101, .05652, .02367, .03588, EXT 440 2 .01968, .02370, .02101, .05652, .02367, .03588, EXT 440 5 .09973, .03362, .06773, .0213, .02165, .02367, .03578, EXT 420 6 .25557, .07342, .67778, .47265, .08120, .04032, .03177, EXT 420 5 .025557, .07342, .62177, .02627, .03343, .03114, .03696, EXT 440 5 .025557, .07342, .62177, .02627, .03300, .05135, .03616, EXT 450 5 .02557, .07342, .62177, .02627, .03300, .05135, .03116, .05006, EXT 450 5 .02557, .07342, .62177, .02627, .03320, .03114, .03696, EXT 450 5 .02557, .07342, .62177, .02627, .03300, .04684, .05335, .04614, EXT 510 6 .02955, .07340, .73241, .63297, .03300/ 5 .02367, .07342, .62192, .02627, .03300, .04684, .05335, .04614, EXT 520 5 .02557, .07342, .62192, .02627, .02367, .033487, EXT 520 5 .02816, .01373, .01677, .02627, .02829, .02532, .03487, EXT 520 5 .02816, .01373, .01671, .05380, .04684, .05335, .04614, EXT 530 6 .02955, .03864, .07272, .02829, .02432, .03487, EXT 540 5 .02816, .02816, .03101, .03741, .048829, .03997, .03247, EXT 540 5 .02816, .02816, .03601, .03575, .035637 0ATA (RUPAPS(I,3), I=1, 40)/ 5 .02816, .03861, .03601, .03575, .035637 0ATA (RUPAPS(I,3), I=1, 40)/	5 .07 38006880063290579106646	. 16639 07463.	FXT	290
0ATA (RUPEXT(1,3), I=1, 40)/ EXT 310 1 2.0708/, 1.71456, 1.57962, 1.00006, .76095, .43228, .25348, EXT 320 2 .16456, .14677, .13214, .13405, .20316, .12873, .11506, EXT 330 3 .104A1, .09709, .08919, .09380, .09709, .08791, .J66u1, EXT 340 4 .05247, .05611, .11905, .12595, .12348, .08741, .07703, EXT 360 6 .08051, .07644, .07443, .08146, .08480, .08563, .08962, EXT 360 6 .08051, .07677, .06658, .05747, .05184/ DATA (RUPEXT(1,4), T=1, 40)/ 1 1.66076, 1.47086, 1.40139, 1.00000, .80652, .56595, .32259, EXT 360 2 .23468, .20772, .18532, .17348, .25114, .20006, .17386, EXT 400 3 .16139, .15424, .14557, .16215, .16266, .14964, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .16139, .15949, .15778, EXT 420 6 .15184, .13848, .12563, .11076, .02601/ 0XA (RUPAPS(1,1), J=1, 40)/ 1 .67196, .11977, .08505, .05930, .05152, .05816, .05006, EXT 420 2 .01968, .02070, .02101, .05652, .02367, .01316, .00867, EXT 430 4 .02823, .03962, .06773, .075380, .04684, .05338, .03177, EXT 450 5 .02557, .03342, .02177, .02627, .03343, .03114, .03696, EXT 500 6 .02955, .07500, .5241, .05255, .06816, .01652, .004614, EXT 520 1 .66769, .01373, .01677, .02580, .04684, .05338, .03487, EXT 520 1 .02657, .03344, .07277, .02627, .03343,	6 .0630406443055390486704519		EXT	300
1 2.0708, 1.71456, 1.57982, 1.00006, .76095, .43228, .25348, EXT 320 2 16456, 14677, 13234, .13405, .2016, .12873, .11506, EXT 340 4 00524, .09709, 08919, .09380, .09709, 08791, .3601, EXT 340 4 00524, .09709, 08919, .09380, .09709, 08791, .3601, EXT 340 6 08051, .07677, .06658, .05747, .05184/ DATA (RUFRXT(1,4) ,T=1, 40)/ 1 1.66076, 1.47886, 1.40139, 1.00000, .80652, .56595, .32259, EXT 360 2 .23468, .2777, .18532, .17348, .25114, .20006, .17386, EXT 400 3 .66139, .15424, .14557, .16215, .16766, .14954, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13551, .15924, .16139, .15949, .55778, EXT 440 CATA (RUFAPS(T,1), J=1, 40)/ 1 .67196, .01310, .01627, .02013, .02165, .02367, .03538, EXT 440 2 .01966, .02376, .02716, .02111, .05652, .02365, .01316, .00066, EXT 460 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 470 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 480 4 .02823, .03952, .06775, .00785, .00340, .03114, .03696, EXT 460 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 480 4 .02823, .03952, .06775, .0735, .03403, .03114, .03696, EXT 450 5 .02555, .07342, .777, .02627, .03463, .03114, .03667, EXT 510 CATA (RUFAPS(1,2), T=1, 40)/ 1 .79658, .10810, .01677, .02627, .03463, .03114, .03667, EXT 510 CATA (RUFAPS(1,2), T=1, 40)/ 1 .79583, .03144, .01573, .01664, .07272, .08380, .03144, .03694, EXT 530 2 .01829, .01849, .01962, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .01664, .07272, .08484, .03673, .03487, EXT 540 3 .01546, .01373, .01664, .07272, .08484, .03867, EXT 540 3 .01546, .01373, .01664, .07272, .08484, .0399, EXT 570 4 .07835, .03864, .06644, .07272, .08380, .03967, .03247, EXT 540 3 .01546, .03734, .03664, .07272, .083607, .03247, EXT 540 3 .01546, .03864, .06644, .07372, .04032, .04399, EXT 570 0ATA (RUFAPS(1,3), I=1, 40)/ 1 .51899, .02816, .03601, .03575, .035637 0ATA (RUFAPS(1,3), I=1, 40)/ 1 .51	DATA (RUPEXT(1-3) -T=1-40)/		EXT	310
2 114456, 114677, 113234, 113405, 20316, 12873, 11506, EXT 320 3 10441, 00709, 0A919, 09320, 09709, 08791, J8601, EXT 340 4 0024*, 00541, 07443, 08146, 00810, 08741, 07703, EXT 360 5 07266, 07044, 07443, 08146, 008610, 008563, 08962, EXT 360 0 08051, 0767, 06658, 05747, 05184/ DATA (RUFAST(1,4) T=1, 40)/ 1 1.66076, 1.47886, 1.40139, 1.00000, .80652, .56595, .32259, EXT 360 2 23468, 22772, 18532, 17348, 25114, 20006, 17386, EXT 400 3 16139, 15424, 14557, 16215, 16766, 14954, 14032, EXT 410 4 12968, 12601, 13551, 13582, 11278, 13228, 11070, 09994, EXT 420 5 09873, 10418, 13241, 145924, 16139, 15949, 15778, EXT 420 6 15184, 13048, 12663, 11076, 09601/ 0ATA (RUFAPS(1,1), I=1, 40)/ 5 02857, 07342, 0777, 02657, 03463, 035152, 05816, 05006, EXT 460 4 02623, 03967, 02101, 05652, 02785, 01316, 00867, EXT 470 5 02557, 07342, 0777, 02627, 03943, 03114, 03696, EXT 460 5 02555, 07342, 0777, 02627, 03943, 03114, 03696, EXT 450 5 02557, 07342, 0777, 02627, 03943, 03114, 03696, EXT 450 5 02557, 07342, 0777, 02627, 03943, 03114, 03696, EXT 510 CATA (RUFAPS(1,2), I=1, 40)/ 1 07784, 01377, 01677, 02627, 02843, 03114, 03696, EXT 510 CATA (RUFAPS(1,2), I=1, 40)/ 1 07754, 01377, 01677, 02627, 02843, 03114, 03696, EXT 510 CATA (RUFAPS(1,2), I=1, 40)/ 1 0783, 03956, 01377, 01677, 02627, 00343, 03114, 03696, EXT 510 CATA (RUFAPS(1,2), I=1, 40)/ 1 0783, 01364, 01377, 01677, 02627, 02843, 03943, 03114, 03696, EXT 510 CATA (RUFAPS(1,3), I=1, 40)/ 1 07835, 03864, 07684, 077272, 06838, 03977, 03247, EXT 540 3 011546, 01377, 01677, 02852, 02829, 02532, 03487, EXT 520 1 02816, 02816, 03101, 01575, 01826, 02807, 03247, EXT 540 3 013546, 00377, 01677, 02852, 02829, 02532, 03487, EXT 550 0 02816, 02816, 03101, 03741, 048829, 03907, 03247, EXT 550 0 04734, 003956, 03601, 03575, 035637 04734, 003956, 03601, 03575, 035637 04734, 03956, 03601, 03575, 035637 0474 (RUPAPS(1,3), I=1, 40)/ 1 ,51889, 04685, 03607, 03570, 04158, 03660, EXT 500	1 2.07082. 1.71456. 1.57962. 1.0000076095	4322825348.	EXT	320
3 10441, 10709, 08919, 09320, 00709, 08791, 136011, EXT 340 4 05247, 05671, 11905, 12595, 12348, 08741, 07703, EXT 360 5 07265, 07044, 07443, 08146, 08610, 08563, 08962, EXT 360 6 08051, 07677, 06658, 05747, 05184/ EXT 370 DATA (RUREXI(1,4) JE1, 40)/ 1 1.66076, 1.47866, 1.40139, 1.00000, .80652, 56595, 32259, EXT 360 2 .23468, 22772, 18532, 17348, 25114, 20006, 17386, EXT 460 3 .16139, 15424, 14557, 16215, 16766, 14964, 14032, EXT 460 4 .12968, 12601, 13551, 13582, 11076, 09904, EXT 420 5 .09873, 10418, 13241, 15924, 16139, 15949, 15778, EXT 420 6 .15184, 11977, 08505, 05950, 055152, 05616, 05006, EXT 420 1 .67196, 11977, 08505, 05930, 055152, 05616, 05006, EXT 450 2 .02977, 06342, 06779, 07205, 003601/ 0 XTA (RURAPS(1,1), JE1, 40)/ 5 .02557, 06342, 06779, 07205, 00343, 03114, 03696, EXT 460 5 .02557, 06342, 0777, 02627, 03343, 03114, 03696, EXT 510 6 .02955, 07500, 5241, 05530, 04684, 055335, 04614, EXT 510 2 .01829, 01373, 01677, 02527, 03343, 03114, 03696, EXT 510 2 .01829, 01373, 01677, 02527, 03343, 03114, 03696, EXT 510 2 .01829, 01373, 01677, 02527, 03343, 03114, 03696, EXT 510 2 .01829, 01373, 01677, 02527, 03363, 03943, 03144, 03696, EXT 510 2 .01829, 01373, 01677, 02527, 03364, 03977, 03347, EXT 520 1 .62958, 10210, 5244, 055380, 04684, 055335, 046614, EXT 520 2 .01829, 01373, 01677, 02827, 02862, 02867, 03343, 03144, 03696, EXT 510 2 .01829, 01373, 01677, 02852, 06816, 01652, 00367, EXT 540 3 .01546, 001373, 01677, 02852, 028616, 0399, 03977, 03247, EXT 540 3 .01546, 001373, 01677, 02852, 028616, 0399, 27, 03247, EXT 540 3 .01546, 00373, 01677, 02852, 02863, 03970, 04322, 03487, EXT 550 4 .07334, 07366, 03601, 03741, 035637, 035637 00470 (RUPAPS(1,3), J=1, 40)/ 1 .51899, 07876, 03601, 03575, 035637 00470 (RUPAPS(1,3), J=1, 40)/ 1 .51899, 07876, 03601, 03770, 04158, 03660, EXT 500 0444, 04032, 04399, EXT 570 0444, 04032, 0439, EXT 570 0444, 04032, 04458, 03600, 03770, 04458, 03660, EXT 500 0444, 040435, 03660, 03774, 03560, 035637 0444, 04032, 04359, 04456, 03600,	2 .1645614677132341340520316	12873 11506.	EXT	330
<pre>4 .05247, .05601, .11905, .12595, .12348, .08741, .07703, EXT 360 5 .07266, .07044, .07443, .08146, .08810, .08563, .08962, EXT 360 6 .08051, .07677, .06658, .05747, .05184/ DATA (RUFFXT(1,4) ,T=1, 40)/ 1 .66076, 1.47886, 1.40139, 1.00000, .80652, .50595, .32259, EXT 360 2 .23468, .20772, .18532, .17348, .25114, .20006, .17386, EXT 400 3 .16139, .15424, .14557, .16215, .16766, .14944, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .16139, .15949, .15778, EXT 420 6 .15184, .13848, .12563, .11076, .09601/ DATA (RUFAPS(T,1), T=1, 40)/ 1 .67196, .11977, .08505, .05930, .05152, .05816, .05006, EXT 440 2 .01968, .02276, .02101, .05652, .02785, .01316, .00867, EXT 440 4 .02823, .03362, .06773, .07265, .00343, .03114, .03696, EXT 440 4 .02823, .03362, .06773, .07265, .003403, .03114, .03696, EXT 450 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 430 4 .02823, .03362, .06773, .07265, .003403, .03114, .03696, EXT 450 5 .02555, .02780, .73241, .63297, .03380/ EXT 510 CATA (RUFAPS(1,2), T=1, 40)/ 1 .29684, .01373, .01677, .02627, .02463, .03114, .03696, EXT 510 2 .01829, .01849, .01962, .05525, .06816, .01652, .00867, EXT 510 2 .01829, .01849, .01962, .05525, .06816, .01652, .00867, EXT 510 2 .01829, .01849, .01962, .05525, .06816, .01652, .00867, EXT 510 2 .01829, .01849, .01962, .05525, .06816, .01652, .00867, EXT 510 2 .01829, .01849, .01962, .02627, .02429, .02432, .03487, EXT 540 3 .01544, .01373, .01677, .02852, .026838, .03967, .032437, EXT 540 3 .012416, .02364, .07614, .03525, .035637 0ATA (RUPAPS(1,3), T=1, 40)/ 1 .51849, .01373, .01661, .03525, .035637 0ATA (RUPAPS(1,3), T=1, 40)/ 1 .51849, .02867, .03604, .07570, .04158, .03620, EXT 570 0ATA (RUPAPS(1,3), T=1, 40)/ 1 .51849, .03456, .03604, .07577, .03570, .04158, .03620, EXT 570 0ATA (RUPAPS(1,3), T=1, 40)/ 1 .51849, .03656, .03604, .07577, .03570, .04158, .03620, EXT 570 0ATA (RUPAPS(1,3), T=1, 40)/ 1 .51849, .03656, .03601, .03575, .035637 0ATA (RUPAPS(1,3), T=1, 40)/ 1</pre>	3 .1048109709089190938009709		EXT	340
5 .07266, .07044, .07443, .08146, .08610, .08563, .08962; EXT 360 6 .06051, .0767, .06688, .05747, .05184/ DATA (RUFAST(I,4), T=1, 40)/ 1 .66076, 1.47886, 1.40139, 1.00000, .80652, .56595, .32259, EXT 360 2 .23468, .2(772, .18532, .17348, .25114, .20006, .17386, EXT 400 3 .66139, .15424, .14557, .16215, .16766, .14954, .14032, EXT 410 4 .12968, .12601, .13551, .15924, .15339, .15949, .15778, EXT 420 5 .09873, .10418, .13241, .15924, .16139, .15949, .15778, EXT 420 6 .15184, .13648, .12563, .11076, .09601/ DATA (RUFAPS(I,1), I=1, 40)/ 5 .02855, .07362, .06778, .07365, .02165, .02365, .05816, .05006, EXT 460 2 .01968, .02070, .02101, .05652, .02785, .01316, .00667, EXT 470 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 480 4 .02823, .03952, .06778, .47285, .08120, .04032, .03177, EXT 460 5 .02555, .07342, .62177, .02627, .03943, .03114, .03696, EXT 510 CATA (RUFAPS(I,2), I=1, 40)/ 1 .62968, .10811, .37671, .05380, .04684, .05335, .04614, EXT 520 1 .62968, .10811, .37671, .05380, .04684, .05335, .04614, EXT 520 2 .01829, .01373, .01677, .02852, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .01671, .05380, .04684, .05335, .04614, EXT 520 2 .01829, .01849, .01962, .15525, .08816, .01652, .03487, EXT 540 3 .01546, .01373, .01671, .05380, .04684, .05335, .04614, EXT 520 2 .01829, .01849, .01962, .15525, .08816, .01652, .03487, EXT 540 3 .01546, .01373, .01671, .05380, .04684, .05335, .04614, EXT 520 1 .02816, .02816, .03101, .03741, .04829, .04032, .03487, EXT 540 3 .01546, .01373, .01671, .02857, .02867, .02397, .03487, EXT 540 3 .012416, .01373, .01671, .02555, .02616, .01662, .03487, EXT 540 3 .013464, .01373, .01671, .02555, .02616, .0399, EXT 540 3 .013464, .01373, .01671, .02555, .02629, .02429, .02432, .03487, EXT 540 3 .013464, .01373, .01671, .02555, .036637 00734, .03856, .03601, .03774, .04829, .04032, .04399, EXT 570 0 .02816, .02816, .03101, .03741, .04829, .04032, .04399, EXT 570 0 .0734, .03956, .03601, .03575, .035637 0 0474 (RUPAPS(I,3), I=1, 40)/	4 .N6247N5591119051259512348	0874107763.	EXT	3 50
6 .08051, .07677, .06658, .05747, .05184/ DATA (RUREXI(1,4) ,T=1, 40)/ 1 1.66076, 1.44786, 1.40139, 1.00000, .80652, .56595, .32259, EXT 350 2 .23468, .2C772, .18532, .17348, .25114, .20006, .17386, EXT 4C0 3 .16139, .15424, .14557, .16215, .16766, .14964, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .16139, .15949, .15778, EXT 420 0 ATA (RUMPS(1,1), t=1, 40)/ 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 400 4 .02823, .03962, .06779, .07285, .08120, .02365, .03114, .03696, EXT 420 5 .02557, .07342, .02177, .02627, .033043, .03114, .03696, EXT 420 6 .02955, .07500, .5241, .05230, .04684, .055335, .04614, EXT 510 CATA (RUPAPS(1,2), I=1, 40)/ 1 .62584, .01373, .01672, .02627, .03433, .03114, .03696, EXT 510 CATA (RUPAPS(1,2), I=1, 40)/ 1 .62958, .01373, .01672, .02827, .03433, .03114, .03696, EXT 510 2 .01829, .C1849, .01377, .02627, .02843, .03114, .03696, EXT 510 2 .01829, .C1849, .01977, .02527, .02835, .04614, EXT 520 1 .62955, .07500, .5241, .055380, .04684, .055335, .04614, EXT 520 2 .01829, .C1849, .01977, .02827, .02827, .03483, .03144, .03696, EXT 510 2 .01829, .C1849, .01977, .02525, .06816, .01652, .026614, EXT 520 2 .018429, .01373, .01677, .02827, .02829, .02532, .03487, EXT 520 2 .02815, .03854, .06844, .07272, .06838, .03967, .03247, EXT 540 3 .01546, .01373, .01677, .02852, .02829, .02397, .03247, EXT 540 3 .01546, .01373, .01677, .028525, .06816, .01652, .03487, EXT 540 3 .01546, .01373, .01677, .028525, .05836, .04032, .03487, EXT 550 4 .02835, .03854, .06844, .07272, .08489, .03999, EXT 570 5 .02815, .03861, .03601, .03741, .04829, .04032, .04399, EXT 570 0 .07334, .03956, .03601, .03575, .035637 0 ATA (RUPAPS(1,3), I=1, 40)/ 1 .51889, .07805, .03601, .03575, .035637 0 ATA (RUPAPS(1,3), I=1, 40)/ 1 .51889, .07876, .04885, .03570, .04158, .03620, EXT 590	5 .0726607044074430814608810	. 08563 . 08952	EXT	360
DATA (RUFEXT(I,4), T=1, 40)/ 1 1.66076, 1.47886, 1.40139, 1.00000, .80652, .50595, .32259, EXT 360 2 .23468, .22772, .18532, .17348, .25114, .20006, .17386, EXT 400 3 .16139, .15424, .14557, .16215, .16766, .14994, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .16139, .15949, .15778, EXT 420 0 ATA (RUFAPS(I,1), I=1, 40)/ 1 .67196, .11977, .08505, .05930, .05152, .05816, .05006, EXT 460 2 .01968, .02270, .02101, .05652, .02785, .01316, .00867, EXT 470 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 460 4 .02823, .03952, .06775, .07285, .00314, .03696, EXT 460 4 .02955, .07362, .0777, .07265, .00340, .03114, .03666, EXT 450 CATA (RUFAPS(I,2), I=1, 40)/ 1 .62956, .10210, .5241, .63297, .03380/ CATA (RUFAPS(I,2), I=1, 40)/ 1 .62955, .01316, .01677, .02627, .03380/ CATA (RUFAPS(I,2), I=1, 40)/ 1 .62955, .01373, .01677, .02627, .03380/ CATA (RUFAPS(I,2), I=1, 40)/ 1 .62955, .01373, .01677, .02627, .03463, .03114, .03666, EXT 510 2 .01829, .01899, .01962, .05525, .06816, .01652, .00867, EXT 510 2 .01829, .01899, .01962, .02627, .02463, .03467, EXT 540 3 .01544, .01373, .01677, .02852, .02464, .05335, .04614, EXT 520 4 .078353, .03664, .07272, .080380, .04684, .02532, .03467, EXT 540 3 .01544, .01373, .01671, .02852, .02629, .024032, .03367, EXT 540 3 .01544, .01373, .01671, .02852, .02649, .02532, .03467, EXT 540 3 .01544, .01373, .01671, .02852, .02663, .03967, .03247, EXT 550 4 .078353, .03664, .07272, .080380, .04634, .03977, .03247, EXT 550 5 .02816, .02816, .03601, .03741, .04829, .04032, .04399, EXT 570 6 .03734, .03956, .03601, .03575, .035637 0ATA (RUPAPS(I,3), I=1, 40)/ 1 .51899, .02876, .03601, .03575, .035637 0ATA (RUPAPS(I,3), I=1, 40)/ 1 .51899, .02876, .03601, .03575, .035637 0ATA (RUPAPS(I,3), I=1, 40)/ 1 .51899, .02876, .03601, .03575, .035637 0ATA (RUPAPS(I,3), I=1, 40)/	6 .0805107677066580574705184		EXT	370
1 1.66076, 1.47886, 1.40139, 1.00000, .80652, .56595, .32259, EXT 350 2 .23468, .2(772, .18532, .17348, .35114, .20006, .17386, EXT 4(0 3 .6139, .15424, .14557, .16215, .16766, .14954, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .15139, .15949, .15778, EXT 420 6 .15184, .1364, .12563, .11076, .09601/ DATA (RUPAPS(I,1), I=1, 401/ 1 .67196, .01377, .08505, .05930, .05152, .05816, .05006, EXT 440 2 .01968, .02276, .0211, .05652, .02785, .01316, .00867, EXT 470 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 480 4 .02823, .03952, .06779, .07285, .08104, .03696, EXT 460 5 .02557, .07342, .(2177, .02627, .03943, .03114, .03696, EXT 510 CATA (RUPAPS(I,2), I=1, 40)/ 1 .62968, .10811, .37671, .02525, .02815, .04614, .05335, .04614, EXT 520 1 .62968, .10811, .37671, .02525, .02816, .01652, .03487, EXT 520 1 .62968, .10814, .37671, .02827, .02829, .02432, .03477, EXT 520 1 .62968, .10814, .01962, .02827, .02843, .03144, .03596, EXT 520 2 .01829, .01373, .01677, .02852, .02829, .02532, .03487, EXT 520 3 .01546, .01373, .01671, .02580, .04684, .05335, .04614, EXT 520 4 .07835, .03864, .06644, .07272, .08038, .03947, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02432, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02432, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02432, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02432, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02432, .03487, EXT 540 3 .01546, .01373, .01677, .02852, .02829, .02432, .03487, EXT 540 3 .01546, .01373, .01677, .02852, .02829, .02432, .03487, EXT 540 3 .01546, .03864, .07272, .08038, .03977, .03487, EXT 550 4 .07834, .03856, .03601, .03575, .035637 0ATA (RUPAPS(I,3), I=1, 40)/ 1 .51889, .03656, .03601, .03575, .035637 0ATA (RUPAPS(I,4), I=1, 40)/	DATA (RUREXT(1.4) .T=1. 40)/		EXT	3 60
2 .23468, .2(772, .18532, .17348, .25114, .20006, .17386, EXT 400 3 .16139, .15424, .14557, .16215, .16766, .14954, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .16139, .15949, .15778, EXT 430 6 .15184, .13848, .12563, .11076, .09601/ DATA (QUMPES(1,1), 1=1, 401/ 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 430 4 .02823, .03962, .06779, .07285, .08120, .02114, .03696, EXT 400 6 .02955, .07500, .5241, .05237, .0343, .03114, .03666, EXT 400 6 .02955, .07500, .5241, .05237, .0343, .03114, .03666, EXT 510 CATA (RUPABS(1,2), I=1, 401/ 1 .6252, .01316, .01662, .02665, .04614, EXT 520 1 .62958, .01501, .3241, .055380, .04684, .055335, .04614, EXT 520 2 .01829, .0189, .01377, .01672, .02827, .03433, .03114, .03696, EXT 520 1 .62955, .07500, .5241, .05525, .06816, .01652, .006644, EXT 520 2 .01829, .01849, .01377, .01672, .02827, .02838, .03943, .03144, .03696, EXT 520 2 .01829, .01849, .01962, .02827, .02843, .03144, .05535, .04614, EXT 520 3 .01546, .01377, .01672, .02822, .02829, .02532, .03487, EXT 540 3 .01546, .01377, .01674, .02852, .02879, .04032, .03487, EXT 540 3 .01546, .01377, .01674, .02852, .028616, .016522, .03487, EXT 540 3 .01346, .01377, .01674, .02852, .02863, .03997, .03247, EXT 540 4 .07835, .03854, .06844, .07575, .04382, .04634, EXT 550 4 .07734, .03456, .03601, .03741, .037570, .04158, .03600, EXT 590 1 .51889, .02876, .03601, .03575, .035637	1 1.66076, 1.47886, 1.40139, 1.00000, .80652	5059532259.	EXT	350
3 .16139, .15424, .14557, .16215, .16766, .14954, .14032, EXT 410 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .16139, .15949, .15778, EXT 436 6 .15184, .13848, .12563, .11076, .09601/ DATA (RUMAPS(I,1),I=1, 40)/ 1 .67196, .11977, .08305, .05930, .05152, .05816, .05006, EXT 450 2 .01968, .02270, .02101, .05652, .02785, .01316, .00867, EXT 470 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 450 4 .02823, .03952, .06779, .07265, .003402, .03114, .03696, EXT 450 CATA (RUMAPS(I,2),I=1, 40)/ 1 .62955, .02360, .5241, .63297, .03380/ CATA (RUMAPS(I,2),I=1, 40)/ 1 .62955, .01316, .01677, .02852, .06816, .01652, .00867, EXT 540 3 .011546, .01373, .01677, .02852, .06816, .01652, .00867, EXT 540 3 .01354, .03774, .07971, .02852, .06816, .01652, .03487, EXT 540 3 .013546, .01373, .01677, .02852, .02816, .03967, .03247, EXT 540 3 .013546, .02816, .93101, .03741, .04829, .04032, .04399, EXT 570 6 .02916, .02816, .93101, .03741, .04829, .04032, .04399, EXT 570 1 .078734, .03956, .03601, .03575, .035637 0 ATA (RUPAPS(I,3), I=1, 40)/ 1 .51899, .02816, .03601, .03575, .035637 0 ATA (RUPAPS(I,3), I=1, 40)/ 1 .51899, .02876, .05614, .03575, .035637 0 ATA (RUPAPS(I,3), I=1, 40)/ 1 .51899, .02876, .05604, .03577, .04158, .03602, EXT 590	2 .23468 .20772 .18532 .17348 .35114	2000617386.	EXT	400
 4 .12968, .12601, .13551, .13582, .13228, .11070, .09994, EXT 420 5 .09873, .10418, .13241, .15924, .16139, .15949, .15778, EXT 420 6 .15184, .13648, .12563, .1076, .09601/ DATA (RUPAPS(I,1), I=1, 401/ 1 .67196, .11937, .08505, .05930, .05152, .05816, .05006, EXT 460 2 .01968, .02270, .02101, .05652, .02785, .01316, .00867, EXT 470 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 480 4 .02823, .03952, .06779, .07265, .00343, .03114, .03696, EXT 460 5 .02557, .02342, .0277, .02627, .03380/ 5 .02557, .02342, .02717, .02627, .03380, .03114, .03696, EXT 510 EXT 510 CATA (RUPAPS(I,2), I=1, 40)/ 1 .01546, .01373, .01677, .02852, .02829, .02632, .03467, EXT 520 1 .01546, .01373, .01671, .02852, .02829, .02532, .03487, EXT 540 3 .01546, .01373, .01677, .02852, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .01671, .02852, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .0167, .02852, .02829, .02632, .03487, EXT 540 3 .01354, .03856, .03601, .03575, .035637 0 .0734, .03956, .03601, .03575, .035637 0 .0734, .03956, .03601, .03575, .035637 0 .0734, .03956, .03601, .03575, .035637 0 .0738, .03620, EXT 570 1 .51899, .02676, .05815, .04682, .03570, .04158, .03620, EXT 570 	3 .16139, .15424, .14557, .16215, .16766	1495414032.	EXT	410
5 .09873, .10418, .13241, .15924, .15139, .15949, .15778, EXT 430 6 .15184, .13048, .12563, .11076, .09601/ DATA (RURAPS(T,1), J=1, 40)/ 1 .67196, .119377, .08505, .05930, .05152, .05816, .05006, EXT 440 2 .01968, .02070, .02101, .06652, .02785, .01316, .00867, EXT 470 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 480 4 .02823, .03962, .06775, .017285, .08120, .04032, .03177, EXT 490 5 .02557, .02342, .02177, .02627, .03943, .03114, .03696, EXT 500 EATA (RURAPS(I,2), I=1, 40)/ 1 .62955, .10811, .07671, .05380, .04684, .0533E, .04614, EXT 510 CATA (RURAPS(I,2), I=1, 40)/ 1 .62955, .01811, .07671, .02852, .08464, .0533E, .04614, EXT 520 2 .01829, .01877, .01962, .15525, .06816, .01652, .00867, EXT 540 3 .01546, .01373, .01677, .02852, .02899, .02432, .03487, EXT 540 3 .01546, .02816, .93101, .03741, .04829, .03967, .03247, EXT 560 5 .02816, .02816, .03601, .03741, .04829, .04032, .04399, EXT 570 6 .03734, .03956, .03601, .03575, .03563/ DATA (RUPAPS(I,3), I=1, 40)/ 1 .51879, .07854, .06634, .03575, .04158, .03620, EXT 590 1 .51879, .07867, .03601, .03757, .04158, .03600, EXT 590 0 ATA (RUPAPS(I,3), I=1, 40)/	4 .1296812601135511358213728	1107009994.	EXT	420
6 15184, 1784A, 12563, 11076, 09601/ DATA (RUMAPS(I,1)) J = 1, 40)/ 1 67196, 11977, 08505, a05930, 05152, 05816, 05006, EXT 460 2 01968, 02070, 02101, 05652, a02785, 01316, 00867, EXT 470 3 01462, 01310, 01627, 02013, 02165, 02367, 03538, EXT 480 4 02823, 03952, 06779, 07285, 08120, 04032, 03177, EXT 450 5 02557, 007342, 0777, 02627, 03943, 03114, 03696, EXT 503 6 102955, 07500, 07671, 05380, 04684, 05335, 04614, EXT 510 DATA (RUPAPS(I,2)) J = 1, 40)/ 1 07873, 01873, 01677, 02852, 08816, 01652, 00867, EXT 540 3 011546, 01373, 01677, 02852, 086816, 01652, 00867, EXT 540 3 01546, 02816, 03774, 02777, 02852, 08038, 03977, 032487, EXT 550 6 07734, 07356, 0864, 07272, 08038, 03977, 032477, EXT 550 5 02816, 02816, 03611, 03741, 04829, 04032, 04399, EXT 570 6 03734, 07356, 0.8601, 03575, 035637 0ATA (RUPAPS(I,3), J = 1, 40)/ 5 02816, 03861, 03977, 04158, 03600, EXT 590 1 51889, 07874, 07856, 04684, 05770, 04158, 03600, EXT 590 1 51889, 07874, 07856, 06614, 07777, 0395637, 04032, 04399, EXT 570 6 007734, 07956, 07861, 03575, 035637 0ATA (RUPAPS(I,3), J = 1, 40)/	5 .09873, .10418, .13241, .15924, .16139	1594915778.	EXT	436
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	6 .15184, .13848, .12563, .11076, .09601	/	EXT	440
1 .67196, .11937, .08505, .05930, .05152, .05616, .05006, EXT 460 2 .01968, .02070, .02101, .05652, .02785, .01316, .00867, EXT 470 3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 480 4 .02823, .03962, .06779, .07285, .08120, .04032, .03177, EXT 450 5 .02557, .07342, .02177, .02627, .03943, .03114, .03696, EXT 500 CATA (RUPABS(1,2), I=1, 40)/ 1 .02856, .10211, .057671, .05380, .04684, .05335, .04614, EXT 520 2 .01829, .01899, .01962, .05825, .08816, .01652, .00867, EXT 540 3 .01544, .01373, .01677, .02852, .02869, .02433, .03947, .03247, EXT 550 4 .07845, .03654, .06684, .07272, .08380, .049432, .03947, EXT 550 5 .02816, .02816, .03654, .036741, .04829, .04032, .04399, EXT 570 6 .03734, .03956, .03601, .03575, .035637 EXT 550 0ATA (RUPABS(1,3), I=1, 40)/ 1 .51899, .02676, .05815, .04682, .03570, .04158, .03620, EXT 500	DATA (RURAPS(1.1) ,[=1, 40)/		EXT	450
2 •01968, •02070, •02101, •05652, •02785, •01316, •00867, EXT 470 3 •01462, •01310, •01627, •02013, •02165, •02367, •03538, EXT 480 4 •02823, •03962, •06779, •07265, •08120, •04032, •03177, EXT 490 5 •02557, •07342, •02177, •02627, •03943, •03114, •03696, EXT 500 CATA (RUPABS(1,2), IT=1, 40)/ 1 •04614, •01373, •01627, •02822, •04614, •05335, •04614, EXT 540 3 •01829, •01809, •01962, •05825, •06816, •01652, •0867, EXT 540 3 •01849, •01373, •01677, •02892, •02899, •02532, •03487, EXT 540 3 •01845, •01873, •01664, •07272, •08380, •04032, •03487, EXT 540 3 •01845, •03973, •0167, •02892, •02899, •02532, •03487, EXT 540 5 •02816, •02816, •03101, •03741, •04829, •04032, •04399, EXT 570 6 •03734, •03956, •08604, •05575, •03563/ 0ATA (RUPABS(1,3), IT=1, 40)/ 1 •51899, •0276, •5815, •04982, •03570, •04158, •03600, EXT 590 1 •51899, •0276, •05815, •04982, •03570, •04158, •03600, EXT 600	1 .67196, .11937, .08505, .05930, .05152	· •05816, •05006,	EXT	460
3 .01462, .01310, .01627, .02013, .02165, .02367, .03538, EXT 480 4 .02823, .03962, .06779, .07285, .08120, .04032, .03177, EXT 450 5 .02557, .02342, .02177, .02627, .03943, .03114, .03696, EXT 503 6 .02955, .03500, .^3241, .63297, .03380/ EXT 510 EXT 61 CATA (RUPABS(1,2), I=1, 40)/ 1 .01829, .01873, .01677, .02852, .02464, .05335, .04614, EXT 540 3 .01546, .01373, .01677, .02852, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .01677, .02852, .02829, .02632, .03487, EXT 550 4 .07835, .03816, .07604, .07272, .08038, .03907, .03247, EXT 550 5 .02816, .038616, .03601, .03741, .04829, .03907, .03247, EXT 550 6 .03734, .03956, .03601, .03575, .035637 CATA (RUPABS(1,3), I=1, 40)/ 1 .51899, .02676, .05815, .04682, .03570, .04158, .03600, EXT 600	2 .01968, .02070, .02101, .05652, .02785	01316, .00867,	EXT	470
4 .02823; .03952; .06775; .07285; .08220; .04032; .03177; EXT 490 5 .02557; .07342; .72177; .02627; .03943; .03114; .03696; EXT 500 6 .02955; .07500; .^3241; .63297; .03360/ EXT 500 CATA (RUPABS(1,2),I=1; 40)/ 1 .02968; .10811; .07671; .05380; .04684; .05335; .04614; EXT 520 2 .01829; .01899; .01962; .05525; .06684; .01652; .00467; EXT 540 3 .01546; .01373; .01677; .02892; .02829; .026322; .03487; EXT 550 4 .07835; .07854; .06684; .07272; .08038; .03907; .03247; EXT 550 5 .02816; .02816; .03601; .03741; .04829; .04032; .04399; EXT 570 6 .03734; .03956; .03601; .03575; .035637 EXT 590 0ATA (RUPAPS(1,3),I=1; 40)/ 1 .51899; .02676; .05815; .04682; .03570; .04158; .03620; EXT 600	3 .01462, .01310, .01627, .0201302165	. 02367, .03538.	ΕXΤ	480
5 .02557, .02342, .02177, .02627, .03943, .03114, .03696, EXT 503 6 .02955, .02500, .23241, .63297, .03360/ EXT 510 EATA (RUPABS(1,2),I=1, 40)/ 1 .62958, .10211, .07671, .05380, .04684, .05335, .04614, EXT 520 2 .01829, .01899, .01962, .05525, .06816, .01652, .00867, EXT 540 3 .01546, .01373, .01677, .02892, .02899, .02532, .03487, EXT 540 3 .01546, .01373, .01667, .02892, .02899, .02532, .03487, EXT 540 5 .02816, .02816, .03601, .03741, .04829, .03967, .03247, EXT 550 6 .03734, .03956, .03601, .03525, .035637 0ATA (RUPABS(1,3),I=1, 40)/ 1 .51899, .02676, .05815, .04982, .03570, .04158, .03620, EXT 600	4 .02823, .03952, .06779, .07285, .08120	, .04032, .03177.	EXT	490
6 .02955, .07500, .^3241, .63297, .03360/ EXT 510 CATA (RUPABS(1,2),I=1, 40)/ 1 .62968, .10681, .07671, .05380, .04684, .05335, .04614, EXT 530 2 .01829, .C1899, .C1962, .C5525, .06816, .01652, .00867, EXT 540 3 .01546, .01373, .01677, .02892, .02829, .02632, .03487, EXT 540 3 .01546, .01373, .01677, .02892, .0289, .029, .03977, .03247, EXT 550 4 .07835, .03854, .06644, .07272, .68038, .03967, .03247, EXT 550 5 .02816, .038616, .03601, .03575, .04632, .04032, .04399, EXT 570 6 .03734, .03956, .03601, .03525, .03563/ 0ATA (RUPABS(1,3),I=1, 40)/ 1 .51899, .02676, .5815, .04982, .03570, .04158, .03620, EXT 600	5 .02557, .02342, .02177, .02627, .03943	03114, .03696,	EXT	503
CATA (RUPABS(1,2) ,T=1, 40)/ EXT 520 1 .62968, .10816, .07671, .05380, .04684, .05335, .04614, EXT 530 2 .01829, .01899, .01962, .05525, .06816, .01652, .00867, EXT 540 3 .01546, .01373, .01677, .02852, .02829, .02532, .03487, EXT 550 4 .07835, .03854, .06684, .07272, .08038, .03987, .03247, EXT 560 5 .02816, .02816, .93101, .03741, .04829, .04032, .04399, EXT 570 6 .03734, .03956, .03601, .03555, .03563/ DATA (RUPABS(1,3), T=1, 40)/ 1 .51899, .02678, .05815, .04082, .03570, .04158, .03620, EXT 600	6 .02955, .03500, .*3241, .63297, .03380	17	EXT	510
1 .62958, .10211, .07671, .05380, .04684, .05335, .04614, EXT 530 2 .01829, .61982, .61952, .15525, .06686, .01652, .00867, EXT 540 3 .01546, .01373, .01677, .02852, .02429, .02532, .03487, EXT 550 4 .07835, .03654, .06684, .07272, .08038, .03987, .03247, EXT 560 5 .02816, .02816, .93101, .03741, .04829, .04032, .04399, EXT 570 6 .03734, .03956, .03601, .03525, .035637 EXT 560 0ATA (RUPAPS(I,3),I=1, 40)7 1 .51899, .02767, .05815, .04082, .03570, .04158, .03620, EXT 600	CATA (RUPAES(1,2) ,1=1, 40)/		EXT	520
2 .01829, .C1899, .C1952, .C5525, .06816, .01652, .00867, EXT 540 3 .01546, .01373, .01677, .02852, .02429, .02532, .03487, EXT 550 4 .07835, .03854, .06684, .07272, .68038, .03967, .03247, EXT 550 5 .02816, .02816, .03101, .03741, .04829, .04032, .04399, EXT 570 6 .03734, .03956, .03601, .03525, .035637 0ATA (RUPAPS(I,3),I=1, 40)7 1 .51899, .08276, .05815, .04082, .03570, .04158, .03620, EXT 600	1 .6295810816076710538004684	., .05335, .04614,	EXT	530
3 .01546, .01373, .01677, .02852, .02429, .02532, .03487, EXT 550 4 .07835, .03854, .06684, .07272, .08038, .03987, .03247, EXT 560 5 .02816, .02816, .03101, .03741, .04829, .04032, .04399, EXT 570 6 .03734, .03956, .03601, .03555, .035637 EXT 570 0ATA (RUPA95(1,74), I=1, 40)7 EXT 590 1 .51899, .08278, .05815, .04382, .03570, .04158, .03620, EXT 600	2 .01829, .01899, .01962, .05525, .06816	01652, .00867.	EXT	540
4 .07835, .03854, .06684, .07272, .08038, .03977, .03247, EXT 560 5 .02816, .02816, .93101, .03741, .04829, .04032, .04399, EXT 570 6 .03734, .03956, .03601, .03525, .035637 0ATA (RUPAPS(I,3),I=1, 40)7 1 .51899, .08278, .05815, .04382, .03570, .04158, .03620, EXT 600	3 .01546, .01377, .01627, .02892, .02829	. 02532, .03487.	EXT	550
5 .02816, .02816, .03101, .03741, .04829, .04032, .04399, EXT 570 6 .03734, .03956, .03601, .03525, .035637 0ATA (RUPAPS(I,3),I=1, 40)7 1 .51899, .08276, .05815, .04382, .03570, .04158, .03620, EXT 600	4 .07875, .07854, .06684, .07272, .08038	039P7, .N3247,	EXT	560
6 .03734, .03956, .03601, .03525, .03563/ EXT 500 DATA (RUPADS(I,3) ,I=1, 40)/ EXT 590 1 .51899, .08276, .^5815, .04082, .03570, .04158, .03620, EXT 600	5 .02816, .02816, .93101, .03741, .04829	. 04032, .04399,	EXT	570
0ATA (RUPA95(I,3) ,I=1, 40)/ EXT 590 1 ,51899, .08278, .º5815, .04382, .03570, .04158, .03620, EXT 600	6 .03734, .03956, .03601, .03525, .03563	37	EXT	580
1 .51899, .08270, .º5815, .04982, .03570, .04158, .03620, EXT 600	DATA (RUPABS(1,3) ,I=1, 40)/		EXT	590
	1 .51899, .08278, .05815, .04982, .03570), .04158, .03620,	EXT	600

Table A1.	Listing of	Fortran	Code	LOWTRAN	5 (Coni.)
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2	.01513.	.01481.	.01633.	.05278.	.13690 .	. 12494.	.00886.	EXT	610
	. 01 804 .	01582	-01677.	.04816.	.04367	.03013.	. 03443 .	FXT	620
ě.	. 0 2 9 3 0.	. 0 1677.	. 1 (209 .	. 16911.	.07475.	. 03862.	.03104	FXT	6.20
ŝ	07517	01068	06452	. 06 24 1 .	06017	.06203	.06215	FYT	640
ź	0000104	053001	• • • • • • • • • • • • • • • • • • • •	36466	060057	• • • • • • • • • •	addet by	EVT	650
° n	+ U7014y	• • • • • • • • • • • • • • • • • • •	304000j	104120)	.040997			EVT	660
	ALA CRUKAD	00010	1-1, 4077	0434.0		041.17	04313	201	670
1	+ 21 94 51	.028461	.01943+	401342,	.011/1,	+ U14 27 y	01:239	E 3 1	670
2	•01152,	.06695,	• 01329 •	.06108,	.24690,	. 05323,	101430	CAL	600
\$	•03351,	.02949,	.02652,	.03437,	.08506,	. 4-348,	+140279		2.00
4	• 04383 •	.64557.	↓ 05383,	,05715,	.05899,	.04861,	.052539	EXI	700
5	.06171,	.07437,	.10152,	.12019,	.12190,	•11734,	.11411,	EXI	/10
6	10766,	.09487,	.08430,	.07348,	.06861/			EXT	720
0	ATA (URUE)	(1(1,1))	,I=1, 40)/					EX1	7.50
1	1.00815, 1	1.63316,	1.51867,	1.00000,	.77785,	.47095,	.30006,	EXT	740
2	•21392 ,	.19405,	.17886,	.18127,	•16133;	•14785,	.14000,	EXT	750
3	•12715,	.11880,	- 11234,	.10601,	.1050 0,	•103ó1,	.10342,	EXT	760
4	.08766.	.08652,	.11937,	.12139,	.12797,	.09797,	.09057,	EXT	770
5	.08595,	.08'96,	.07563,	.06696,	.07209,	.06842,	.07177,	EXT	780
6	.05354,	.0€177,	.05373,	.04728,	•04051/			EXT	790
0	ATA (URBE)	(1(1,()))	J=1. 40)/					£ΧΤ	800
1	1.95582. 1	1.64994.	1.53070.	1.00000.	.77614.	.4č619,	.29487.	EXT	810
2	.21051.	.18943.	.17285.	17209.	.21418.	.15354,	.14051,	EXT	620
3	. 12728 .	.11861.	11183.	. 11329.	. 11 323 .	.10963.	.10247 .	EXT	830
ū.	.08696.	.02361.	.12013.	. 12418 .	. 12 30	. 19514.	. 88842	EXT	840
6	- 08487.	.06285.	.08361	.08430.	.08880.	. 18449.	08601	EXT	850
ĥ	.07835.	. 17323.	. 6367.	.05500.	. 047477	••••	,	EXT	860
Ť٩	ATA (UPRE)	XT(T.3)	T=1. 4037					FXT	870
+	1.96430.	1.641132.	1.52392.	1.00000.	. 77709.	. 46253.	20690.	FXT	880
5	. 20310.	.17981.	-16101.	15614.	26475	.15456.	13563	EXT	89.
2	12215.	11361.	. 10500	11715	11757.	10392.	19766	FYT	900
		08067.	100007	11342.	11063.	. 08701.	.08025.	FYT	910
ē	07865	000077	100401	10070	10386.	. 10061	09885.	E YT	620
2	40/0001	.00032;	• 71017	- AUU (11)	• • • • • • • • • • • • • • • • • • • •		a 2 500 C 9	5 4 4	670
°.	* US194,		+ 57152 g	.000099	. 09 29 37			E V T	010
<u>ر</u>	ATA TURBES	XILL947 -	•1 = 1 • 40 / Z				75769	EAI	250
1	1.41200, 1	1,00010;	1.29114,	1.000000	*03545;	+ 3 3 9 6 3 9		5 V T	550
2	• 25285,	.215/6,	.18319,	.16215,	. 37 854 ,	.20494.	.16665,	* X 1 F V T	900
3	+147/5,	1.847,	•129439	+15575+	.15/09,	.13513,	.12401,	F, X 1	510
4	.11759,	.11494.	.11487,	•11329•	.11108,	,09911,	.09209,	621	980
5	,09342,	,10120,	•13177,	.15596,	•15/56•	•15513,	.15203.	EXE	0,00
6	.14532,	.1 *0 3 8,	-11785,	.10411,	*09101/			EXI	1000
0	ATA (URPA	PS(1,1)	,I=1, 40)/					EXI	1010
1	.78437,	.589/5,	.54285,	.36184,	. 29222,	.20886,	15658,	EXT	1020
2	.12329,	•11462,	.10747,	. 11797,	.10025,	.08759,	.00184,	EXT	630
3	.07506,	• 0 7 0 0 6 1	• 96741 ,	.06601,	.06544,	.06449,	.06665,	EXT	1040
4	,06278,	.06949,	. 37316,	.07462,	.00101,	.05753,	05272,	EXT	1050
5	.04899,	•04734,	• 84494 ,	.0444*,	.05133,	.04348,	.04443,	EXT	1060
6	.03994,	.13981,	•03633,	.03468,	.03146/			EXT	1070
C	ATA (URSA	:5(1,2)	,I=1, 40)/					EXT	1000
1	,69032 ,	•4936î,	•45165,	,29741,	24070,	.17399,	.13146,	EXT	1090
2	.10754,	.0.589,	• 19025,	.10411,	.15101,	.07880,	.06949,	EXI	1100
3	06 70,	.06095,	.05829,	.07171,	.06797.	.05975,	.06 13,	EXT	1110
4	.05519,	.0E051,	. 07133,	.07454,	.07956,	,05525,	.05184;	EXŤ	1120
5	.05083.	.05291.	. : 5885 .	.16386,	.06880.	.06127,	.06019,	EXT	1130
6	.05525.	.05070.	.04500.	.04076.	.03741/			EXT	1140
_ <u>r</u>	ATA (UPSA	"S(1,7)	,1=1, 43)/					EX1	1150
1	.54848.	. 77101.	. 3.34 .	.21949.	.17785.	.12966.	.09354.	EXT	1150
2	07484	.0716 -	06791 -	.08563	19639	.05722.	.05316.	EXT	1170
3	.05315.	.048 6.	.04620	.07570.	.06899.	.05291.	.05101.	EXT	1180
4	04734.	.05025.	• 061/1 ·	.06570.	.06854.	04892	.04797 .	EXT	1190
5	.05057.	05665	.07127	.08055	.08411	. 07728 .	.07475.	EXT	1200
-									

Table A1, - L	listing of	Fortran	Code	LOWTRAN	5	(Cont.)
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6 .06855, PEU19, 195222, 104576;	+ +041/1/ EXT	1519
DATA (URPARS(I,4) ,T=1, 40)/	EXT	1220
1 .15975, .10090, .09013, .05785,	04671, .03424, .02633, EXT	1230
2 .02525, .01975, .02354, .06241,	.26690, .05810, .02285, EXT	1240
3 .03810	.085570546594576. EXT	1250
4 01302 04674 04671 04701	04864. 04684. 06477. EYT	1260
	, , , , , , , , , , , , , , , , , , ,	4/ 70
5 .06197, .07477, .10342, .12146;	+121/7, +11/34, +11325, EAT	1270
6 .10608, .09171, .38063, .06968,	+064/5/ EXI	1280
CATA (OCNEXT(I,1] ,I=1, 40)/	EXT	1290
1 1.47576, 1.32514, 1.26171, 1.00000,	88133, .70257, .56487, EXT	1300
2 .46076420443831035076.	.472663227828810. EXT	1310
3 24005. 24484. 46734. 46791.	. 21532 15076 12057. EXT	1320
	14.630 16258 08367. EVT	1 3 3 6
4 1100309 1107039 1150703 1150709	, 14039, 10220, 100307, EXT	1000
5 .0/3/3, .01829, .35044, .043/3,	, .04962, .UE158, .UF702, EXE	1340
-6 .07234, .0F297, .º5481, .D5329,	, .08741/ EXT	1350
DATA (OCNEXT(T,2) ,1=1, 40)/	EXT	1360
1 1.36924. 1.25443. 1.20835. 1.00000.	91367, .77089, .64987, EXT	1370
2 .54885502474503838209.	.505894376638076. EXT	1380
3 31658 27675 22215 21019	27570 24057 44944. FYT	1390
		10,00
4 .14/09, .14/17, .16975; .1/Udr;	, 16025; 11005; 109759; EAT	1400
5 .09215, .093**, .10532, .12570,	• •13000, •13623, •14291, EXT	1410
-6 .13506, .11475, .º9658, .08291,	10348/ EXT	1420
CATA (OCNEXT(1,3) ,1=1, 40)/	EXT	1430
1 1.22259. 1.14627. 1.11842. 1.00000.	94766 £753880418. EXT	1440
7 . 72930 68592 62165 49962.	. 67949 FF4F8 59253. FXT	1450
T LOCEL LLC74 77486 30056	47767 37010 30867 EXT	41.60
- 3 (4-3)1; (440-1; (-7000) (-7030);	, .4350/, .3/019,	46.30
4 +2E417, +75776, +24905, +23975,	, .2270E; +17CU4; +1931b; EAT	1470
5 •15373, •16791, •22361, •28348,	, 20577, 29082, 29038, EXI	1480
6 .27811, .23867, .20209, .16430,	, .14943/ EXT	1490
CATA (OCNEXT(1,4) ,1=1, 40)/	5.X.T	1500
1 1.09133. 1.06011. 1.05620. 1.00000.	975069479194203. EXT	1510
2 .07671078679041180253.	. 89727. 94467. 92146. EXT	1520
1 85701 97505 76767 68656	78200. 76266. 68658. 697	1570
	5 102039 1172009 1700009 EKT	15.0
4 + 62/24, +69226, +96300, +76260	1 471001; 440444; 407190; EAV	1940
5 .35899, .7316, .46854, .582.4,	, +58690, +6(348, +60%63, FX1	1550
6 .60000, .55392, .50367, .43576,	, .359497 EXT	1560
CATA (OCNABS(1,1) ,I=1, 40)/	EXT	1570
1 .30987043540283001797.	01468, .01766, .01582, EXT	1580
2 .00816011460167707310.	833800071500443. FXT	1590
3 00500 00601 00753 04595	.02963. 00994. 01367. EYT	16.00
	07504 04508 04740 EVT	4640
4 .0157 , .(25.6, .03401) .03405		1010
5 .011-2, .01082, .1070, .01563,	, .U2063, .U31/1, .U3819, EXI	1950
6 .03741, .03804, .03753, .04209,	, .U7892/ EXT	1 C 30
DATA (OCNARS(I,?) ,I=1, 4))/	EXT	1640
1 .23367, .03127, .92070, .01297,	01063, .01285, .01193. EXT	1650
2 .00037009110157505576.	. 234870394900905. FXT	1 6 80
3 92057018160166506025.		1670
4 2021904 203704 2044323 204944	, •04/13) (03407) •030(4) 2X1	1000
5 .04329;	, .1005/, .1024/, .14222, EXT	1690
6 .09551, .02241, .07158, .0650A,	, .09203/ EXT	1700
EATA (CCNAPS(1,3) ,T=1, 40)/	EXT	1710
1 .13025, .01557, .01013, .00646,	, 100532, .00665, .00722, EXT	1720
2 .01335007280181009835.		1730
3 .06110003021170917666.	15458. 08785. 06800. EYT	1740
- 0 + C 2 + 1 + 0 + 2 + 1 + 0 + 2 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1	, 120100, 10000, 100000, EAL 07660, 07055, 07069, EAL	1760
- 9 (1000) (00/01) (.7647) (70/07)	+ U(1777) + U(UC2) + 3(702) EXI - 20200 - 20206 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 24200 - 2420 - 2420 - 2420 - 2420 - 2420 - 2420 - 242 - 242 - 242 - 242 - 242 - 242 - 242 - 242 - 242 - 242 - 242 - 242 - 242 - 242 - 242 - 24 - 2	1720
5 .04049, .12481, .17667, .22019,	• • • • • • • • • • • • • • • • • • •	1100
6 ·20536, ·17278, ·14677, ·12171,	• •12430/ EXT	1770
CATA (OCNA95(1,4) ,I=1, 40)/	EXT	1780
1 .03504, .00323, .00215, .00139,	00114, .00171, .00932, EXT	1790
2 .03082, .01101, .0374120101.	. 47608, .21165, .05234. EXT	1800

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and the second
7 45887 44245 8058L 7	3840	74 77 0	20543	46664	
J .12005, .11215, .99004, .3		21//09	.20513,	.10050,	EXT 1030
4 •15975; •15842; •17907; •15	, other	16051,	.10700,	.18323,	EXT 1020
5 -21/09, -25652, -3222, -3		39654,	• • • • 2 • 7 •	,400299	EAT 1030
6 .39025, .35458, .32605, .20	/15, .	253407			221 1040
UATA (TROEXT(1,1),1=1,43)/					EXI 1850
1 2.21222, 1.82753, 1.67032, 1.9	1000,	72424 -	• 35272,	.15234 ,	EXI 1860
2 .05165, .03861, ."2994, .0	671, .	02467,	.01538,	•01145g	EXT 18:J
3 .01032, .00816, .00861, .00)994, 4	01057,	.01139,	.01747,	EXT 1880
4 .01494, .02418, .03165, .0	3386, 4	04247,	.01601,	.01215,	EXT 1890
5 ,00977, ,00861, ,90823, ,0	Lil9, .	01924,	.01234,	a01348,	EXT 1900
6 .01114, .01297, .01266, .0	1418, d	01487/			EXT 1910
DATA (T90EXT(I,2) ,I=1, 40)/					EXT 1920
1 2.21519, 1.82256, 1.66557, 1.0	0000, ,	72525,	.35481,	.15449,	EXT 1930
2 .05475, .04044, .03082, .0	+620, <i>•</i>	05272,	.01867,	.01266,	EXT 1940
3 .01127, .00886, .00885, .0	L 4 49, .	01399,	.0122 8 ,	.01728,	EXT 1950
4 .01475, .02285, .03215, .03	3494, .	04285,	.01652,	.01304,	EXT 1960
5 .01101, .01120, .01297, .0	1753, .	02468,	.01741,	.01766,	EXT 1970
6 .01513, .01557, .01456, .0	1532, 4	01582/			EXT 1980
DATA (TROEXT(1,3) ,1=1, 40)/					EXT 1990
1 2.19082. 1.79452. 1.64456. 1.0	0000, ,	73297 .	. 36443,	.16278,	EXT 2000
2 .0646804650P37990	4538.	11892.	.02835.	.01646	EXT 2010
3 .0138601076009680	2551	02222.	.01468.	01690	EXT 2020
4 .0143701994031270	3513.	04076	.01722.	01513	EXT 20 30
5 .01519 .01791 .02538 .0	3272.	03816	.03038.	02866	EXT 2040
6 .02551 .02228 .01937 .0	18 14 .	017917	,	,	EXT 2050
DATA (TROFYT(1.4) _7=1.40)/					EXT 2060
1 1. 75696. 1.54829. 1.45962. 1.0	1000.	77816 .	.47129.	.21778.	EXT 2070
2 11 120. 08101. 055050		26201	.06816.	.03703.	EXT 2080
T 02604 04059. 0468. 0	.0.6.2.		02234	1707	EXT 2050
A DIEZO CICZO AUDON AU	77629 1	02505	01758	. 81893.	EYT 2400
E 03700 07957 8022373 80	6462	06609	NE030	.05525.	EXT 2110
2 + UC 3749 + UC C479 + UC C079 + UC C 0/964 02757 09060 0	37/6	071657	1092309	•097295	EVT 2420
	23469 0	021097			ENT 5120
UAIA (IR(UABE(1,1),1=1,40))			076 57	0.244.0	EAT 2130
1 .690/1, .8990*, .40903, .0	*101,	03354,	. 0.2027,	+020109	EXT 2140
2 .008/3, .00910, .00930, .0	3215, (,01287,	.00513,	+00316	EXI 2100
3 .00557, .00444, .00645, .0	08°/, (,00937,	.01025,	.01040,	EXI 2100
4 .01481, .02418, .02885, .0	2070, .	. 04032,	.61454,	• 1139,	EXT 2170
5 .00873, .00816, .00797, .0	1134, ,	01911,	.01215,	.01329,	EXI 2168
6 .01101, .01291, .01266, .0	1418, .	0148//			EXI 2190
DATA (TROABS(1,2) ,1=1, 40)/					EX1 5500
1 .65099, .08791, .05816, .0	3652,	.02994,	.03278,	.02557,	EXT 2210
2 .00810, .00842, .00867, .0	3139,	03949,	.00646,	.00316,	EXT 2220
3 .00595, .00519, .00646, .0	1304, .	01247,	.01095,	.01620,	EXT 2230
4 .01449, .02278, .02930, .0	3184, .	.04063,	.01544,	.01234,	EXT 2240
5 .01044, .01076, .01272, .0	1741, .	,02462,	.01722,	.01747,	EXT 2250
6 .01506, .01551, .91456, .0	1532, .	01582/			EXT 2260
CATA (TROARS(1,3) ,I=1, 40)/					EXT 22/0
1 .52804, .06367, .04155, .0	2633,	02164,	.02443,	,01937,	EX1 5560
2 .00650, .00646, .00709, .0	2949,	10013.	.00968,	.00310,	EXT 2290
3 .00677, .0(582, .10646, .0	2361,	01994,	01266	.01544 ,	EX1 5300
4 .0138601968020480	3203.	03854	.01620	.01449,	EXT 2:10
5 .0146?	3253.	03797	.03019.	.028€1.	EXT 2320
6 .0253802215	1797.	017917			EXT 2338
	,				EXT 2340
1 .1982901842012150	9791.	. 00665.	.00778-	.00652.	EXT 2350
2 _003610025300393 _ 0	2570	20690	.01716	.00316-	EXT 2360
3 0087300728. 00650 0	L . A 1 .	.01525.	. 01646	-01405-	EXT 2170
-3 +010 39 +007759 +100269 +0 -6 01310, 01668 01065 0	2181	02367	01608	.01816.	EXT 2380
	6 7 0 0	06538	05847	.05466.	E YT 2100
-2 (COMP) (VOCUD) (VOCUD) (VOCUD) (VOCUD)	0377×	07150	1 1 20 5 1 3	• • • • • • • • •	EXT 31.00
0 e0+071e e05475F e16948e e0	E-9-3-24 A	VE170/			LAI (400

Table A1. Li	sting of Fortran	Code L	OWTRAN	5	(Cont.)
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DATA(FG1EXT(I),T=1, 40)/				EXT 2410
1 .985199615899189.	1.00000.	1 .00576. 1 01747	. 1.03177.	EXT 2420
2 1.06166 1.06696 1.05723.	1.05886.	4.04.800 4.04.873	1 07004	EVT 2430
7 4 00222 4 10167 4 44686	4 40420	1 11367 4 13000	1 14047	EXT 34.60
	1 21 266	1.11.001.1.1200	4 1414307#	E X 1 2 4 4 U
4 141(2194 14162(8, 142013))	1.012004	1.21949, 1.22677	+ 1e10509;	EX1 2450
5 1.05684, .98241, 1.1120g	1.10911,	1.11452, 1.14671	1.16247,	EX1 2460
6 1.18544, 1.21582, 1.24614,	1.26842,	1.20500/		EXT 2470
DATA(FG1A85(I),I=1, 40)/				EXT 2480
1 .00013, 0.00000, 0.00000,	8.00000,	0.0000000095	31513,	EXT 2490
2 .10861, .03892, .13272,	.47133,	.49696 .45785	17918.	EXT 2500
3 .373733460131867.	. 55190.	. 55025 . 49987	. 46342 .	EXT 2510
4 . 45943 45918 46089.	. 45241.	46386 . 4719F	489.5.	E ¥T 2626
5 .514685710455266.	. 68665.	58899. 60367	61158	EYT 2530
6 C277E 66420. 65C27	• 9 C D C 9 1	667007	, .01190;	
	+ 002.01			EX1 2540
UAIN(FG2EXI(1),1=1, 40)/				EXI 2550
1 .94791, .96215, .9765,	1.90090,	1.00937, 1.05177	, 1.12519,	EXT 2560
2 1.29570, 1.39203, 1.41120,	1.04715,	1.10816, 1.43285	, 1.45272,	EXT 2570
3 1,18709, 1,04367, .82354,	•71747,	.92405, .79342	60266.	EXT 2580
4 .476774317176734.	.33259.	. 31184 24139	. 21601.	EXT 2590
5 .24006	.56861.	\$7266 580A9	57165.	EXT 25.00
6 54247. 47981. 34475	. 2/ 005	.10201 /	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	EVT 2640
	• • • • • • • • • •	• * 3 5 3 7 1		CAT 2010
				E XI 2020
1 6.06000, 0.0000, 0.00000,	0.000-0,	0.00000, .00013	, .00247,	EXI 2630
2 .01987, .00620, .02323,	•17209,	.57930, .19810	, .03475,	EXT 2640
3 .09639, .08000, .06582,	.34589,	.32703, .17025	, .12633,	EXT 2650
4 .11316, .116 77, .11513,	·11538,	.11601, .12329	, .14468,	EXT 2660
5 .186332485735411.	44885.	. 45095 45215	44278.	EXT 2670
6 .417793443227823.	.210F3.	.17857/	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	EXT 2FPD
ATA/RSTEVI(T) J=1. 641/				EV1 2600
1 + 1 + 2 + 7 + 3 + (-1) + (7047) 20047	00001	CVT 2000
- I X+HCC/I; I+97402; I+91900;	1.000000	• (0000 g • 200 F /	, ,09994,	EXT ZICU
C +041649 +027779 +110409	•013359	.05910, .00930	, .00532,	EXT 2/10
3 .04/65, .042/8, .05811,	.05367,	• 04 392, • 03342	, .94456,	EXT 2720
4 .11867, .14719, .17734;	.09291,	•08778, •U501;	04070,	EXT 2730
5 .05734, .03576, .01975,	.01892,	.01956, .03665	, .04152,	EXT 2740
6 .01715, .01620, .00835,	.00633,	.00589/	•	EXT 2750
CATA (BSTABS (I) . I=1 . 40)/				EXT 2760
1 8.00000. 0.00000. 0.00000.	0.0000.0.	0.00000.0.00000		FXT 2770
2 .001270015800291.		05888	06010	EYT 2780
7 04C40 0 177 0C707	00407		y e00013y	C X T 27 CU
	.052003		, .04437,	EAT 7790
4 •1101h; •14653; •12639;	.09217,		, .04044.	EXT 2800
5 .05709, .P3551, .51952,	.01892,	.01949, .03655	, .04146,	EX1 2810
6 .01709, .01520, .40835,	,OQ633,	.00589/		EXT 2650
DATA(AVDEXT(I),I=1, 40)/				EXT 2830
1 1.14880, 1.19171, 1.18013,	1.00000,	.84873, .57019	, ,27968,	EXT 2840
2 .14551, .11070, .^8633.	. (7184.	.0607604586	03399.	EXT 2850
3 .020950153801266.	.01019.	.00994	01361 -	EXT 28FO
4 .017910227802618.		.03234	0 3 . 44 -	EYT 2870
6 n2772 0267K n1715	.01567	04666 0+645	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	CVT 2000
	• 0 1 4 7 7	A41307 4 UIC4C	,	EAT 2400
U BUI/// BUIV/by BUIV/D	•01134,	.01559/		EX1 55.40
UAIALAVOAUS (1),[=1, 40)/			_	EX1 2500
1 .44816, .11259, .08500,	.05272,	.04082, .02449	61487.	EXT 2910
2 .01019, .00857, .J0842,	.(0842,	.00949, .0(741	, .00487,	EXT 2920
3 .00314, .00335, .00339,	.08449.	.00525, .80665	, .01114.	EXT 2930
4 .01652 .0217792437 .	. D24UF.	.0265807006	02861 -	FX1 2940
5 .0251 X02285	.01572-	.016330:420	11769	EXT 2950
6 01761, 01057, 01038.	.01127		,	EVT 2540
DATAIDUDENTITY 1-4 4012	• 0 × 1 < / 3	4 U A GC 3 K		LAI 2780 577 3030
		4 03043 4 6711		1.84 2170
1 +00717+ +97532+ +94025+	1 + U U U U U U y	1.03013, 1.05575	, 1×U11/1,	EXI 2980
2 .00677, .82918, .76361,	+715€3;	.E7424, .E0589	, .55057,	EXT 2990
3 45222, .37645, .32316,	,25519,	.22728, .20525	, .17810,	EXT 3000

Table A1.	Listing of Fort	ran Code LOWI	RAN 5 (Cont.)
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<pre>4 .14481, .14152, .77633, .44551, .44405, .42222, .35462, EXT 3310 5 .32551, .27519, .16728, .10627, .10661, .10820, .11655, EXT 3620 0 ATA(FV0APS(II),T=1, 40)/ 1 .41582, .22092, .19108, .14468, .12475, .09158, .06123, .02629, EXT 3050 2 .04947, .04367, .04362, .04399, .05076, .04123, .02629, EXT 3050 2 .04947, .04367, .04362, .04399, .05076, .04123, .02629, EXT 3050 2 .04947, .04367, .04362, .04399, .05076, .04123, .02629, EXT 3050 2 .04947, .04367, .04362, .04399, .05076, .04123, .02629, EXT 3050 2 .04947, .04367, .04362, .04399, .05076, .04123, .02629, EXT 3060 5 .01924, .01981, .02297, .02475, .02774, .03411, .05335, EXT 3060 6 .08765, .04032, .5747, .5133, .055123/ DATA(DMEEXT(I),T=1, 4^1/ 1 .05019, 1.05680, 1.05759, 1.00000, .94949, .81466, .66051, EXT 3120 2 .54380, .45133, .44677, .41671, .3063, .24778, .32804, EXT 3120 2 .54380, .45133, .44677, .41671, .30633, .24778, .32804, EXT 3120 5 .27791, .27506, .22620, .21652, .2253, .12266, EXT 3140 6 .18348, .12153, .12924, .08538, .04108/ EXT 3120 0ATA(DMEAUS(1),I=1, 40)/ 1 .00053, .00152, .00151, .11124, .10793, .14376, EXT 3150 5 .22444, .01364, .10956, .00791, .01225, .03728, EXT 3160 3 .14523, .12726, .122462, .11124, .10791, .1076, .09006, EXT 3278 2 .66158, .77536, .09235, .06655, .00791, .01225, .03728, EXT 3120 3 .16237, .10784, .10934, .00506, .00791, .01225, .03728, EXT 3120 5 .22444, .08433, .10944, .01506, .00731, .01225, .03728, EXT 3120 5 .22444, .08435, .10542, .06759, .03247/ EXT 3220 6 .11244, .09235, .06657, .00233, .12329, .10551, EXT 3220 6 .11244, .09235, .06759, .03247/ EXT 3220 CCC C C2M CC C C CM CC C C2M CC C C4M CC C C2M CC C C4M CC C C2M CC C C2M</pre>																
<pre>S 12551, 127519, 14728, 10677, 10661, 10741/ EXT 3060 G 13127, 10108, 08557, 06411, 05741/ EXT 3060 DATA(FV)APS(I),T=1,401/ 1 44562, 22022, 19108, 14468, 12(75, 09158, 06601, EXT 3060 2 04947, 01981, 02207, 02475, 02778, 04133, 02629, EXT 3060 G 04947, 019816, 15742, 16506, 19754, 20741, 16449, EXT 3060 G 06705, 09816, 15742, 16506, 19754, 20741, 16449, EXT 3060 G 06705, 09816, 15742, 16506, 07778, 07367, 07956, EXT 3060 G 06705, 09032, 05747, 15133, 05223/ DATA(DMEFXT(I),T=1,40)/ I 1.05019, 1.05040, 1.05259, 1.00000, 94949, 81466, 06051, EXT 3120 CATA(DMEFXT(I),T=1,40)/ I 1.05019, 1.05400, 1.05259, 1.00000, 94949, 81466, 06051, EXT 3120 CATA(DMEFXT(I),T=1,40)/ I 1.05019, 1.05400, 1.05259, 1.00000, 94949, 81466, 06051, EXT 3120 CATA(DMEFXT(I),T=1,40)/ I 1.05019, 1.05400, 1.05259, 1.00000, 94949, 81466, 06051, 12734, 12804, EXT 3120 C 054580, 045133, 04667, 06550, 004100/ EXT 3100 G 0.18748, 01526, 01527, 00561, 09456, 14576, 12373, EXT 3160 G 0.18748, 01572, 01543, 00561, 09456, 14576, 12373, EXT 3160 G 0.18748, 12150, 12924, 06530, 04100/ EXT 3100 G 0.1152, 03152, 01524, 01543, 10051, 014576, 12373, EXT 3150 G 0.11543, 01572, 01643, 10056, 00791, 01825, 03728, EXT 3190 C 00055, 00157, 01643, 10056, 00791, 01825, 03728, EXT 3190 G 0.14523, 13728, 12462, 11184, 1079, 17076, 19006, EXT 326 G 0.15148, 09355, 06655, 06623, 12329, 10351, EXT 320 G 0.1514, 09355, 006655, 06623, 12329, 10351, EXT 320 G 0.1514, 09355, 06655, 06623, 12329, 10351, EXT 320 G 0.1514, 09355, 005657, 003247/ EXT 320 CC 0004541=482110710N URABS=RURAL AESORPTION EXT 320 CC 0004541=482110CTION URABS=RURAL AESORPTION EXT 320 CC 0004541=482110CTION URABS=RURAL AESORPTION EXT 320 CC 0004541=482110CTION URABS=RURAL AESORPTION EXT 320 CC 0004541=6780, SXM VIS EXTINCTION F61A85+F061 ABSORPTION EXT 320 CC 0004541=6780, SXM VIS EXTINCTION F62A85+F061 ABSORPTION EXT 320 CC 0004541=6780, SXM VIS EXTINCTION F63A85+F061 ABSORPTION EXT 320 CC 0004541=6780, SXM VIS EXTINCTION F63A85+F061 ABSORPTION EXT 320 CC 0004541=6780, SXM VIS EXTINCTION F63A85+F061</pre>		4 .14481	14 1	52.	. 7637		44551		440	5.	. 4723	2.	.364	2.	EXI	3010
6 .13127, .10108, .08557, .06411, .057417 DATA(FV0PS(I),I=1, 40)7 EXT 3640 1 .41582, .22092, .19108, .14468, .12775, .09158, .06601, EXT 3650 2 .04437, .04357, .04342, .04399, .05076, .04432, .02289, EXT 3070 3 .01924, .01981, .02297, .02475, .02778, .04312, .023629, EXT 3070 4 .07337, .08316, .15742, .18506, .07784, .07367, .07966, EXT 3090 5 .16101, .17759, .00455, .00475, .07784, .07367, .07966, EXT 3090 CDATA(OMEFXT(T),F12, 40)7 1 .05019, 1.05600, 1.05299, 1.00000, .94049, .61466, .66011, EXT 3120 2 .54380, .46133, .44677, .41671, .30633, .44778, .22053, .17266, EXT 3140 2 .54380, .14234, .14082, .15057, .16399, .23608, .24481, EXT 3150 5 .27791, .75076, .15722, .09601, .09455, .00456, .02778, .14576, .2404, EXT 3150 CATA(OMEFXT(1),F12, 1.09247, .00545, .14576, .12373, EXT 3160 6 .12348, .12150, .12324, .08538, .041087 CAT3(MEAPS, .1250, .12324, .08538, .041087 CAT3(MEAPS, .13728, .12424, .08538, .041087 C .64158, .7738, .00943, .10051, .11614, .13310, .41436, EXT 3160 2 .64158, .7738, .00935, .00665, .00791, .01225, .03728, EXT 3160 2 .64158, .09000, .10304, .11905, .13357, .104348, EXT 3200 3 .14523, .13728, .12462, .11184, .10799, .17951, .2095, EXT 320 6 .16184, .09875, .10582, .06759, .032477 EXT 3240 CCC ALTITUDE REGIONS FOR AEROSOL EXTINCTION CCEFFICIENTS CCC C C-2KM CCC C C-2KM CCC C C-2KM CCC C C-2KM CCC C C C C C C C C C C C C C C C C C		5 .32551	.275	19.	.16728		10677		1086		104	E.	.1169	5.	EXT	3020
DATA (FUNDAS (T), T=1, 4, 4) EXT 3640 1 41582, 22892, 19108, 14468, 12/75, 09158, 06601, EXT 3050 2 04943, 20457, 00432, 02439, 05076, 04432, 02029, EXT 3060 3 01924, 01981, 92297, 02475, 02778, 03411, 05335, EXT 3050 5 16101, 12759, 08455, 06886, 07278, 07367, 07956, EXT 3060 6 06785, 06032, 05747, 055133, 056237 EXT 3100 EXT 3120 DATA (OVEFXT(1), 7=1, 4^)/ .51333, 051237 1 1.05019, 1.05800, 1.05259, 1.00000, .94949, .81456, .6051, EXT 3120 2 54360, .45133, .44677, .41671, .38063, .24778, .32804, EXT 3120 2 .54380, .42133, .44677, .41671, .38063, .24778, .32804, EXT 3120 3 .27721, .27506, .25002, .22620, .21652, .20253, .47266, EXT 3140 4 .44905, .14724, .12934, .006518, .10071, .01425, .03728, EXT 3150 5 .27791, .20076, .15272, .09601, .09456, .14576, .12373, EXT 3160 011 .00053, .01152, .01184, .00506, .00791, .01425, .03728, EXT 3120 2 .66158, .07384, .10951, .111614, .13310, .14346, EXT 320 2 .61584, .09835, .00562, .00579, .03247 EXT 3220 3 .14533, .13728, .10582, .06565, .06923, .12329, .10551, EXT 3220 5 .22444		6 .13127	101		.0.8557		06411		0574	1		,			EXT	3020
<pre>1 * 41582, * 226927 * 19108, * 14468, * 12775, * 09158, * 06601, EXT 3050 2 * 04947, * 04357, * 04342, * 04399, * 05076, * 04333, * 02829, EXT 3070 3 * 01924, * 01981, * 02297, * 05475, * 03411, * 05335, EXT 3070 5 * 16101, * 17759, * 06455, * 06886, * 07778, * 07367, * 07367, * 07367, * 0737 6 * 06735, * 06032, * 55747, * 25133, * 052237 COATA (DWEFXT(T), T=1, 4°)7 1 * 05019, * 1.05680, * 1.05299, * 1.00000, * 94949, * 01466, * 06051, EXT 3120 2 * 54380, * 06132, * 55747, * 25133, * 052237 COATA (DWEFXT(T), T=1, 4°)7 1 * 0.05019, * 0.0580, * 1.05299, * 1.00000, * 94949, * 01466, * 06051, EXT 3120 2 * 54380, * 06132, * 05769, * 1.00000, * 94949, * 01466, * 06051, EXT 3120 2 * 54380, * 06133, * 04677, * 16517, * 16399, * 23508, * 24778, * 24045, EXT 3120 2 * 54380, * 05133, * 04677, * 015057, * 16399, * 23508, * 24461, EXT 3150 5 * 27791, * 25076, * 15272, * 09901, * 09456, * 14576, * 12373, EXT 3160 6 * 18348, * 121504, * 12324, * 06530, * 041007 COATA (OMEAPSTL), 1=1, * 0077 1 * 00053, * 001527, * 001644, * 00506, * 00791, * 01625, * 03728, EXT 3160 2 * 06458, * 07738, * 124622, * 11164, * 10709, * 10706, * 09006, EXT 3210 2 * 06458, * 09000, * 10304, * 11905, * 10951, * 01625, * 03728, EXT 3200 3 * 14523, * 13728, * 12462, * 11184, * 10709, * 10767, * 09950, EXT 320 5 * 22464, * 18418, * 09335, * 06665, * 06623, * 12329, * 10551, EXT 320 6 * 16184, * 09875, * 10582, * 06759, * 032677 CCC CC C C * 2KM CCC C * 2</pre>		DATACEVO	APS (T).	T=1.	401/	<i>,</i>		, .							EXT	3640
2 104917, 104377, 10432, 104391, 10278, 10333, 102229, EXT 3060 3 01924, 01981, 02297, 102475, 02778, 003411, 05335, EXT 3070 4 -07137, 02816, 15342, 118306, 119354, 20711, 10449, EXT 3080 5 16101, 11779, 00455, 1006866, 07778, 07367, 07956, EXT 3090 DATA(DMEFXT(1), 71, 40)/ 1 105019, 105800, 107259, 1,00000, 94949, 41456, 66051, EXT 3100 2 54380, 45133, 44677, 41671, 30063, 24778, 32804, EXT 3130 3 .70722, 27506, 25082, 22620, 21652, 20253, 17266, EXT 3140 4 .14905, 14274, 14082, 15057, 16399, 23608, 24481, EXT 3150 5 .27791, 27507, 15272, 09601, 09456, 14576, 12373, EXT 3160 0 0ATA(DMEARS(1), 113, 40)/ 1 0.0053, 00152, 00536, 00791, 01825, 03728, EXT 3160 2 .66158, .77538, 40843, 10051, 11614, 13310, 114348, EXT 3200 2 .66158, .77538, 12462, 11184, 10799, 10766, 00791, 14348, EXT 3200 2 .66158, .77538, 12462, 11184, 10799, 10766, 00791, 14348, EXT 3200 2 .66158, .75538, 12462, 11184, 10779, 15751, 20956, EXT 3200 2 .66158, .75538, 12662, .06665, .06623, .12378, 11320, 113448, EXT 3200 2 .66158, .75538, 12662, .06665, .06623, .12329, 10551, EXT 3200 2 .66158, .75538, 12662, .06665, .06623, .12329, 10551, EXT 3200 2 .66158, .75538, 12662, .06665, .06623, .12329, 10551, EXT 3200 2 .66158, .75738, 10582, .06665, .06623, .12329, 10551, EXT 3200 3 .14633, .05900, .10304, .11905, .13437, 19551, 20095, EXT 3200 5 .22440, .18414, .05235, .06665, .06623, .12329, .10551, EXT 3230 6 .16184, .05973, .10582, .06559, .03247/ EXT 3200 CCC C _2KM CCC C _2KM CCC		1 4158		92.	19108		14468	• •	1247	5.	.0919	58.	.0660	1.	EXT	3050
3 0.0224, 0.0198, 0.02207, 0.02475, 0.02778, 0.0011, 0.05335, EXT 3070 4 0.07133, 0.0816, 1.0342, 1.0506, 0.07278, 0.07367, 0.07956, EXT 3080 5 0.6101, 1.1759, 0.0455, 0.06865, 0.07278, 0.07367, 0.07956, EXT 3160 DATACOMEFRY[1], 7:1, 401/ EXT 3110 1 1.05019, 1.05080, 1.00759, 1.00000, 0.94949, 0.41456, 0.66051, EXT 3120 2 0.54380, 0.45133, 0.4677, 0.16000, 0.94949, 0.41456, 0.66051, EXT 3120 2 0.54380, 0.45133, 0.4677, 0.16000, 0.94949, 0.414576, 0.2253, 0.12726, EXT 3140 2 0.54380, 0.140724, 0.15077, 0.1639, 0.23608, 0.24481, EXT 3150 3 0.07722, 0.7506, 0.25082, 0.22620, 0.1653, 0.2053, 0.24576, 0.12373, EXT 3160 4 0.4195, 0.14274, 0.16727, 0.9601, 0.9456, 0.12373, EXT 3150 5 0.27731, 0.0157, 0.9011, 0.9456, 0.01827, 0.24576, 1.2373, EXT 3150 0.0157, 0.0157, 0.0184, 0.0506, 0.0791, 0.01825, 0.3728, EXT 3150 2 0.65180, 0.77538, 0.9943, 0.0666, 0.0791, 0.01825, 0.3728, EXT 3120 2 0.65180, 0.10304, 0.10304, 0.1049, 0.10709, 0.10251, EXT 3220 2 0.6184, 0.9875, 0.0662, 0.0623, 0.03247/ 2 0.11844, 0.9935, 0.0666, 0.0623, 0.0259, 1.0251, EXT 3220 2 0.11844, 0.9935, 0.0666, 0.0294, 0.01825, 0.01845, EXT 3200 2 0.6184, 0.9875, 0.0666, 0.0294, 0.0006, EXT 3220 <td></td> <td>2 0494</td> <td></td> <td>67.</td> <td>04342</td> <td></td> <td>04399</td> <td></td> <td>05070</td> <td>5.</td> <td>.041</td> <td></td> <td>.028</td> <td>9</td> <td>EXT</td> <td>30 F0</td>		2 0494		67.	04342		04399		05070	5.	.041		.028	9	EXT	30 F0
<pre>40713%, .00916, .15342, .18506, .19354, .20751, .18449, EXT 3080 5 .16101, .11759, .00455, .00686, .D7278, .07367, .07959, EXT 3090 6 .08785, .06032, .05747, .25133, .05728, .07367, .07959, EXT 3100 DATA(DWEFXT(1), T=1, 4°)/ 1 1.05019, 1.05808, .107259, 1.00000, .94949, .41456, .66051, EXT 3120 2 .54380, .46133, .44677, .41671, .3003, .24778, .32004, EXT 3130 3 .29722, .27506, .25082, .22620, .21652, .20253, .17266, EXT 3140 4 .14905, .14234, .14082, .15057, .161399, .23608, .24481, EXT 3150 5 .27791, .27076, .18272, .09601, .09456, .14576, .12373, EXT 3160 6 .12348, .21530, .12924, .06538, .04108/ DATA(DWEADS(1), T=1, 40)/ 1 .00053, .00152, .01844, .00506, .00791, .01425, .03728, EXT 3160 2 .66178, .27538, .40944, .10051, .11414, .13310, .14348, EXT 3160 3 .14633, .13728, .12462, .11184, .1079, .10765, .00006, EXT 3216 4 .06734, .09015, .00355, .06665, .06823, .12329, .00006, EXT 3216 5 .22444, .18418, .09235, .06665, .06823, .12329, .10551, EXT 3230 6 .16184, .09835, .10582, .06759, .03247/ EXT 3200 5 .22444, .18418, .09235, .06665, .06823, .12329, .10551, EXT 3230 6 .216184, .09835, .10582, .06759, .03247/ EXT 3200 CCC C _2KM CCC ALTITUDE REGIONS FOR AEROSOL EXTINCTION COMBAS=MURAL AESORPTION EXT 3310 CCC MUREXT=UP3AN EXTINCTION URBABS=WARATITHE AESORPTION EXT 3330 CCC OCNEXT=MARTITME EXTINCTION TP0A25=TR0F055HEF ABSOPTION EXT 3330 CCC FGLEYT=FOG' .5KM VIS EXTINCTION FGLABS=FOGI ABSORPTION EXT 3330 CCC FGLEYT=FOG' .5KM VIS EXTINCTION FGLABS=FORDOSPHER ABSORPTION EXT 3320 CCC FGLEYT=FOG' .5KM VIS EXTINCTION FGLABS=FORDOSPHER ASSORPTION EXT 3340 CCC S2-0KM EXTINCTION TROABS=TR0F0SPHER ASSORPTION EXT 3340 CCC GSTAT=FOFDSPHER EXTINCTION TROABS=TR0F0SPHER ASSORPTION EXT 3340 CCC GVORT=AGFD VOLCANIC ASTORPHERIC EXTINCTION EXT 3400 CCC AVOAT=AGFD VOLCANIC EXTINCTION EXT 3450 CCC AVOAT=AGFD VOLCANIC EXTINCTION EXT 3450 CCC AVOAT=AGFD VOLCANIC CASTORPHERIC EXTINCTION EXT 3400 CCC AVOAT=AGFD VOLCANIC CASTORPHERIC EXTINCTION EXT 3450 CCC CYONET=FRESH VOLGANIC EXTINCTION EXT 3450 CCC AVOAT=AGFD VOLCANIC EXTINCTI</pre>		3 01924	019	81.	. 1 2 2 97		02475		2778		.0341	1	.053	5.	EXT	3970
6 16101, 11750, 00005, 00707, 007067, 007067, 007066, EXT 3000 6 00705, 00002, 00747, 00000, 04440, 007067, 007056, EXT 3100 0ATALOMEEXITI, 7=1, 4077 100000, 04440, 00106, 00004, 04446, 00001, 04470, 00000, 0000, 0000, 0000, 000000		4 .0713	083	16.	15342		18506		1935		.207	1.	.1844	9.	EXT	3080
6 .06785, .06032, .6747, .05133, .05123/ DATA(DWFFXT(T),T=1, 4)/ 1 1.05019, 1.05800, 1.0529, 1.00000, .94949, .81456, .66051, EXT 3120 2 .55380, .45133, .44677, .41671, .38063, .34778, .32804, EXT 3120 3 .27722, .27506, .25062, .226262, .21653, .17266, EXT 3140 4 .14905, .14274, .14682, .15057, .16399, .23608, .24461, EXT 3150 5 .27791, .26076, .15272, .09011, .09456, .14576, .12373, EXT 3160 6 .12348, .12150, .12924, .08538, .044104/ EXT 3170 DATA(DWFAPS(1),I=1, 40)/ 1 .00053, .00157, .00184, .00506, .00791, .01225, .03726, EXT 3190 2 .66158, .07538, .0943, .10051, .111614, .13310, .14348, EXT 3120 2 .66158, .07538, .09434, .10051, .111614, .10791, .00006, EXT 320 3 .14633, .13728, .12462, .11184, .1079, .1076, .09006, EXT 320 5 .22444, .18418, .09235, .06665, .06633, .12329, .10551, EXT 320 6 .16184, .09875, .10582, .06759, .03267/ RETURN CCC CCC CCC CCC CCC CCC CCC C		5 .16101	1 77	- 9	.08455	1 1	05886		0727	8.	.073	57.	.079	56.	FXT	30 00
DATA (DMEFXT (T), T=1, 4)/ EXT 3110 1 1.05019, 1.05080, 1.05259, 1.00000, .94949, .81456, .66051, EXT 3120 2 5.54300, .45133, .44677, .41671, .36063, .34778, .32004, EXT 3130 3 .20722, .27506, .25082, .22620, .16522, .20233, .17266, EXT 3140 4 .14905, .14274, .14082, .15057, .16399, .23608, .24441, EXT 3150 5 .27791, .25076, .15272, .09601, .09456, .14576, .12373, EXT 3160 6 .12348, .12150, .12924, .06538, .04108/ 00ATA (DMEADS(1), 1=1, 40)/ 00ATA (DMEADS(1), 1.407) 2 .66158, .07538, .08943, .10051, .11614, .13310, .14348, EXT 3200 2 .66158, .07538, .08943, .10051, .11614, .13310, .14348, EXT 3200 2 .66158, .07538, .08943, .10051, .11644, .1076, .09006, EXT 3260 5 .22404, .18418, .09235, .06665, .06033, .12329, .10551, EXT 3230 6 .16184, .09875, .10582, .06759, .03247/ RETURN CCC CCC CCC C.2KM CCC C.2KM CCC CVMPEXTUP9AN FXTINCTION RURABS=RURAL AESORPTION EXT 3220 CCC CVMPEXTUP9AN FXTINCTION RURABS=RURAL AESORPTION EXT 3240 CCC C.2KM CCC CCC CCC C2KM CCC C2KM CCC C2KM <td< td=""><td></td><td>6 .08785</td><td></td><td>132</td><td>. 5747</td><td></td><td>25133</td><td></td><td>0512</td><td>3/</td><td></td><td></td><td></td><td></td><td>EXT</td><td>3160</td></td<>		6 .08785		132	. 5747		25133		0512	3/					EXT	3160
1 1.05019, 1.05600, 1.05259, 1.00000, .94949, .81456, .66051, EXT 3120 2 .54380, .46137, .44677, .41671, .38063, .34778, .32804, EXT 3140 4 .14905, .14234, .14062, .15057, .16399, .23608, .24481, EXT 3140 4 .14905, .14234, .14062, .15057, .16399, .23608, .24481, EXT 3150 5 .27791, .75076, .15272, .09601, .09456, .14576, .12373, EXT 3160 6 .18348, .12150, .12924, .08538, .04108/ EXT 3170 DATA(DMEARS(1),1=1, 40)/ 1 .00053, .00157, .01044, .00506, .00791, .01825, .03728, EXT 3190 2 .66158, .7538, .08943, .10051, .11614, .13310, .14348, EXT 3200 3 .14523, .13728, .12492, .11184, .1079, .14576, .00066, EXT 3216 4 .04734, .09000, .10304, .11905, .13437, .19551, .2095, EXT 3220 5 .22444, .18414, .09035, .06665, .06823, .12329, .10551, EXT 3220 5 .22444, .18414, .09035, .06665, .06823, .12329, .10551, EXT 3220 CCC CCC CCC CCC CCC CCC CCC		DATACOM	FXT(I).	T=1 .	411/	, -		•							EXT	3110
2 54380, .44677, .41671, 38063, .34778, .32804, EXT 3120 3 .29722, .27506, .25002, .22620, .21652, .20253, .17266, EXT 3120 4 .14905, .14274, .14062, .1507, .16399, .23608, .24464, EXT 3150 5 .27791, .276076, .15272, .09601, .09456, .14576, .12373, EXT 3150 6 .18348, .12150, 12924, .06536, .04108/ EXT 3130 0DATA (DMEARS (L), T=1, 40)/ EXT 3180 01438, EXT 3180 1 .00053, .00157, .01144, .10310, .14343, EXT 3180 2 .66153, .12728, .12462, .11144, .10709, .10706, .09006, EXT 3220 3 .14523, .12728, .12625, .0655, .06623, .12329, EXT 3220 5 .22494, .18418, .09205, .06655, .06623, .12329, EXT 3220 6 .15124, <t< td=""><td></td><td>1 1.0501</td><td>1.1.058</td><td>80.</td><td>1.05259</td><td>. 1.</td><td>00000</td><td></td><td>94949</td><td>э.</td><td>. 8149</td><td></td><td>. 560</td><td>1.</td><td>EXT</td><td>3120</td></t<>		1 1.0501	1.1.058	80.	1.05259	. 1.	00000		94949	э.	. 8149		. 560	1.	EXT	3120
3 .29722, .27506, .25082, .22626, .21652, .20253, .17266, EXT 3140 4 .14905, .14234, .14082, .15057, .16399, .22608, .24481, EXT 3150 5 .27791, .75076, .15272, .09601, .09456, .14576, .12373, EXT 3160 0ATA(DMEA0S(1),1=1, 40)/ 1 .00053, .00157, .00164, .00506, .00791, .01825, .03728, EXT 3180 2 .66158, .07538, .08943, .10051, .11614, .13310, .14348, EXT 3200 3 .14523, .11728, .12462, .11184, .10709, .1076, .09006, EXT 3220 5 .22444, .18418, .09235, .06665, .06823, .12329, .10551, EXT 3220 6 .16184, .09875, .10582, .06759, .03247/ RETURN CCC ALTITUDE REGIONS FOR AEROSOL EXTINCTION CCEFFICIENTS CCC CC C C-2KM CCC CC C C-2KM CCC CC C C C-2KM CCC CC C C C C C C C C C C C C C C C		2 .54380		33.	.44677		41671		3896	3.	. 3477	18.	.3281	14.	EXT	3130
4 .14905, .14234, .14082, .12057, .16399, .23608, .24481, EXT 3150 5 .27791, .25076, .15772, .09601, .09456, .14576, .12373, EXT 3160 0ATA (DMEAUSIL),TE1, 40)/ 1 .00053, .00152, .00184, .00506, .00791, .01225, .03728, EXT 3190 2 .66158, .07538, .08943, .10051, .11614, .13310, .14348, EXT 3200 3 .14633, .13728, .12462, .11184, .10709, .17076, .09006, EXT 3210 5 .22494, .18418, .09235, .06665, .06823, .12329, .10551, EXT 3230 6 .16184, .09875, .10582, .06759, .03247/ RETURN CCC CCC ALTITUDE REGIONS FOR AEROSOL EXTINCTION CCEFFICIENTS CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC C C C C C -2KH CCC C C C C C C -2KH CCC C C C C C -2KH CCC C C C C C C C C C C C C C C C C C		3 .29722		n 6.	. 25082		27620		2165		.2029	53.	.1720	56.	ĒXT	3140
5 27791, .20076, .10272, .00601, .00456, .14576, .12373, EXT 3160 6 .12348, .12150, .12324, .00538, .00108/ EXT 3170 DATA (DMEADS(1), 1:1, 40)/ EXT 3170 1 .00053, .00152, .00184, .00506, .00791, .01825, .03728, EXT 3190 2 .66158, .07538, .00943, .10051, .11614, .13310, .14348, EXT 3200 2 .66158, .07538, .00943, .10051, .11614, .10769, .0006, EXT 3210 4 .04734, .09000, .10304, .11905, .13437, .19551, .20095, EXT 3200 5 .22404, .18418, .09235, .06655, .06823, .12329, .10551, EXT 3230 6 .16184, .09235, .06655, .06823, .12329, .10551, EXT 3200 7 RETURN CCC ALTITUDE REGIONS FOR AEROSOL EXTINCTION COEFFICIENTS CCC C-2KH CCC COMEXT=RURAL EXTINCTION URBABS=RURAL AESORPTION CCC COMEXT=RUPAN EXTINCTION URBABS=RURAL AESORPTION CCC COMEXT=RUPAN FXTINCTION TROABS=RURAL AESORPTION CCC COMEXT=RUPAN FXTINCTION TROABS=RURAL AESORPTION CCC COMEXT=RUPAN FXTINCTION TROABS=RUBALTIME ABSORPTION EXT 3330 <td></td> <td>4 .14909</td> <td> 142</td> <td>34.</td> <td>.14 082</td> <td></td> <td>15057</td> <td></td> <td>1639</td> <td>9.</td> <td>.2360</td> <td></td> <td>2448</td> <td></td> <td>EXT</td> <td>3150</td>		4 .14909	142	34.	.14 082		15057		1639	9.	.2360		2448		EXT	3150
6 18348, 12150, 12924, 00538, 0041087 EXT 3170 0ATA (DMEADS (1), 1=1, 40)7 EXT 3190 EXT 3190 1 00053, 00157, 00184, 00506, 00791, 01625, 03728, EXT 3190 EXT 3190 2 66158, 07538, 00843, 10051, 11614, 13310, 14348, EXT 3200 3 3 14633, 13728, 12462, 11184, 10709, 1076, 09006, EXT 3210 EXT 3200 4 04734, 06000, 10304, 11905, 13437, 19551, 20095, EXT 3230 6 5 22494, 18418, 09235, 06665, 06623, 12329, 10551, EXT 3230 6 6 16184, 09875, 10582, 06659, 032477 EXT 3260 CCC RETURN EXT 3270 EXT 3260 CCC C CXM EXT 3260 CCC C EXT 3270 EXT 3270 CCC C EXT 3270 EXT 3270 CCC C C EXT 3270 CCC C C EXT 3270 CCC C C EXT 3270 CCC C		5 .27791	250	76.	15272		09601		0945	5.	.145	76	.1237	3.	EXT	3160
OATA (DMEARS (1), 1=1, 40)/ EXT 3180 1 .00053, 00157, 00184, .00506, .00791, 01625, 03728, EXT 3190 2 .66158, .07538, .09943, .10051, .11614, .13310, .14340, EXT 3200 3 .14633, .13728, .12462, .11184, .10709, .1076, .09006, EXT 3216 4 .08734, .09000, .10304, .11905, .13437, .19551, .20095, EXT 3220 5 .22494, .18414, .09255, .06665, .06423, .12329, .10551, EXT 3230 6 .16184, .09835, .10582, .06759, .03247/ RETURN CCC		6 .18348	121	50.	12924		08538	• •	04108	sź.					EXT	3170
1 .00063, .00152, .00184, .00506, .00791, .01825, .03728, EXT 3190 2 .66158, .07538, .08943, .10051, .11614, .13310, .14348, EXT 3200 3 .14633, .13728, .12462, .11184, .10709, .1076, .09006, EXT 3210 4 .04734, .09000, .10304, .11905, .13437, .19551, .20095, EXT 3220 5 .22404, .18418, .09235, .06665, .06823, .12329, .10551, EXT 3220 6 .16184, .09835, .10582, .06759, .03247/ RETURN CCC CCC ALTITUDE REGIONS FOR AEROSOL EXTINCTION COEFFICIENTS CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC CCC C -2KH CCC C C -2KH		DATA (DME	A85(1).	I=1.	40)/			, ·							EXT	3180
2 .66158, .77538, .08943, .10051, .11614, .13310, .14348, EXT 3200 3 .14633, .13728, .12462, .11184, .10709, .17076, .09006, EXT 3210 4 .08734, .09000, .10304, .11905, .13437, .19551, .20095, EXT 3220 5 .22494, .18418, .69235, .06665, .06823, .12329, .10551, EXT 3230 6 .16184, .09875, .10582, .u6759, .03247/ RETURN CCC CCC C _2KM CCC CCC C _2KM CCC C _ C _2KM CCC CCC C _ C _2KM CCC CCC C _ C _2KM CCC CCC C _ C _2KM CCC CCC C _ C _ C _ C _ C _ C _ C _ C _ C _ C _		1 .0005	001	52	.00184		00506		0079	1.	.0182	29.	.0372	28.	EXT	3190
3 14633, 13728, 12462, 11184, 10709, 117076, 199006, EXT 3216 4 .04734, 0.9000, 10304, 11905, 13437, 19551, 20095, EXT 3230 5 .22494, 18448, 09235, 06665, 06623, 12329, 10551, EXT 3230 6 .16184, 09875, 10582, 06759, 032477 RETURN EXT 3230 CCC EXT 3270 CCC C-2KM CCC		2 .66158	075	38.	.08943		10051		1161	4.	.133	10.	.143		EXT	3200
4 .08734, .09000, .10304, .11905, .13437, .19551, .20095, EXT 3220 5 .22494, .18418, .09235, .06665, .06823, .12329, .10551, EXT 3240 6 .16184, .09875, .10582, .06759, .03247/ RETURN EXT 3240 CCC EXT 3250 CCC EXT 3240 CCC CC CCC RURFXT=RURAL FXTINCTION CCC CC		3 .14633	3137	28.	.1246?		11184		10709	з.́.	.1007	6.	.090	16.	EXT	3210
5 22494, .1841A, .09235, .06665, .066823, .12329, .10551, EXT 3230 6 .16184, .09RT5, .10582, .06759, .03247/ EXT 3240 RETURN EXT 3240 CCC C-2KM CCC RUREXT=RURAL EXTINCTION RURABS=RURAL AESORPTION EXT 3310 CCC CCC CCC RUREXT=RUBAN FXTINCTION URBABS=URBAN ABSORPTION EXT 3320 CCC CCC CCC CTARST=TENPSPHER EXTINCTION TROABS=RURAL AESORPTION EXT 3340 CCC FG1EXT=F0G1 .2KH VIS EXTINCTION FG1ABS=FOG1 ABSORPTION EXT 3340 CCC FG1EXT=F0G1 .2KH VIS EXTINCTION FG2ABS=FOG2 ABSORPTION EXT 3340 CCC FG1EXT=TOFOSPHER EXTINCTION TROABS=TROPOSPHER ABSORPTION EXT 3340 CCC STEXT=ABCKGPOUND S RATOSPHERIC EXTINCTION EXT 3400 CCC STEXT=ABCKGPOUND S RATOSPHERIC EXTINCTION EXT 3400 CCC STEXT=ABCKGROUND S RATOSPHERIC ABSORPTION EXT 3400		4 .08734	000	100.	.10304		11905		1343	7.	.1955	51.	.2004	35	EXT	3220
6 16184, 09875, 10982, .06759, .03247/ RETURN CCC CCC ALTITUDE REGIONS FOR AEROSOL EXTINCTION CCEFFICIENTS CCC CCC CCC CCC CCC CCC CCC C		5 .22494	184	14,	.09239		06665		0682	3.	.123	29.	.105	51.	ĒXT	3230
RETURNEXT 32:0CCCALTITUDE REGIONS FOR AEROSOL EXTINCTION CCEFFICIENTSEXT 32:0CCCEXT 32:0EXT 32:0CCCC-2KHEXT 33:00CCCC-2KHEXT 33:00CCCCCXRURFXT=RURAL FXTINCTIONRURABS=RURAL AESORPTIONEXT 33:10CCCCOMEXT=POBAN FXTINCTIONRURABS=RURAL AESORPTIONEXT 33:10CCCCOMEXT=POBAN FXTINCTIONRURABS=RURAL AESORPTIONEXT 33:10CCCCOMEXT=POPSPHER EXTINCTIONCOMABS=MARITHE AESORPTIONEXT 33:20CCCFGIEXT=FOG1 .2KM VIS EXTINCTIONFGIADS=FOG1 ABSORPTIONEXT 33:00CCCFGIEXT=FOG2 .5KM VIS EXTINCTIONFGIADS=FOG1 ABSORPTIONEXT 33:00CCCFGIEXT=FOG2 .5KM VIS EXTINCTIONFGIADS=FOG2 ABSORPTIONEXT 33:00CCCFGIEXT=FOGS .5KM VIS EXTINCTIONTROBS=FOG2 ABSORPTIONEXT 33:00CCCFGIEXT=FOGS .5KM VIS EXTINCTIONFGIADS=FOG2 ABSORPTIONEXT 33:00CCCFGIEXT=FGOSPHER EXTINCTIONFGIADS=FOG2 ABSORPTIONEXT 33:00CCCSTEXT=FGOSPHER EXTINCTIONTROBS=FOG2 ABSORPTIONEXT 33:00CCCSGIEXT=FGOSPHER EXTINCTIONTROBES=FOG2 ABSORPTIONEXT 34:00CCCSGIEXT=FGOSPHER EXTINCTIONTROBES=FOG2 ABSORPTIONEXT 34:00CCCSGIEXT=FGOSPHER EXTINCTIONCXT 34:00EXT 34:00CCCCCCSGIEXT=FGOSPHER EXTINCTIONEXT 34:00CCCAVOEXT=AGED VOLCANIC EXTINCTIONEXT 34:00EXT 34:00CCCAVOEXT=AGED VOLCANIC EXTINCTIONEXT 34		6 .16184	nce	175.	.10582		6759		0324	11					EXT	3240
CCC CCCEXT 3260CCC CCCALTITUDE REGIONS FOR AEROSOL EXTINCTION CCEFFICIENTSEXT 3260CCC CCC CCCEXT 3290CCC CCCC-2KMEXT 3210CCC CCC CCCRURFXT=RURAL FXTINCTION RURABS=RURAL AESORPTIONEXT 3320CCC C		RETURN				•		, .							ĒXT	32 . 0
CCCALTITUDE REGIONS FOR AEROSOL EXTINCTION CCEFFICIENTSEXT 3270CCCEXT 3290EXT 3290CCCC-2KHEXT 3300CCCC-2KHEXT 3300CCCC-2KHEXT 3300CCCURFEXT=RURAL FXTINCTIONRURABS=RURAL AESORPTIONEXT 3310CCCURFEXT=UPBAN FXTINCTIONURBABS=URBAN ABSORPTIONEXT 3320CCCOCNEXT=PDBANEXTINCTIONURBABS=URBAN ABSORPTIONEXT 3320CCCTROEXT=FDDSPHER EXTINCTIONOCNABS=HARITIME ABSORPTIONEXT 3320CCCFG1EXT=FDG1 .2KH VIS EXTINCTIONFG2ABS=FGG1 ABSORPTIONEXT 3350CCCFG1EXT=FDG2 .5KM VIS EXTINCTIONFG2ABS=FGG2 ABSORPTIONEXT 3320CCCS2=9KMEXTINCTIONTROABS=TROFOSPHER ABSORPTIONEXT 3320CCCS9=30KMEXT 33400EXT 33400CCCS9=30KMEXT 1000 S RATOSPHERIC EXTINCTIONEXT 3400CCCAVCAPS=ABCKGROUND S RATOSPHERIC EXTINCTIONEXT 3400CCCAVCAPS=ABCKGROUND S RATOSPHERIC ABSORPTIONEXT 3400CCCAVCAPS=ABCH VOLCANIC EXTINCTIONEXT 3400CCCAVCAPS=ABCH VOLCANIC ABSORPTIONEXT 3420CCCFVOEXT=RESH VOLCANIC EXTINCTIONEXT 3420CCCFVOEXT=RESH VOLCANIC EXTINCTIONEXT 3420CCCFVOEXT=RESH VOLCANIC EXTINCTIONEXT 3420CCCFVOEXT=RESH VOLCANIC ABSORPTIONEXT 3420CCCFVOEXT=RESH VOLCANIC ABSORPTIONEXT 3450CCCFVOEXT=RESH VOLCANIC ABSORPTIONEXT 3450CCC<	000														EXT	3260
CCC EXT 3280 CCC EXT 3290 CCC C-2KH CCC RURFXT=RURAL EXTINCTION RURABS=RURAL AESORPTION CCC URFEXT=RURAL EXTINCTION RURABS=RURAL AESORPTION EXT 3310 CCC URFEXT=RURAL EXTINCTION RURABS=RURAL AESORPTION EXT 3320 CCC URFEXT=RUPBAN FXINCTION URBABS=RURAL AESORPTION EXT 3320 CCC OCKEXT=TPOPSPHER EXTINCTION URBABS=RURAL AESORPTION EXT 3320 CCC OCKEXT=TPOPSPHER EXTINCTION TPOASS=TROFOSPHER ABSORPTION EXT 3340 CCC FGIEXT=FOG2 .SKM VIS EXTINCTION FGIASS=FOG2 ABSORPTION EXT 3320 CCC FGIEXT=ROFOSPHER EXTINCTION FGA2AES=FOG2 ABSORPTION EXT 3340 CCC FGIEXT=ROFOSPHER EXTINCTION FGA2AES=FOG2 ABSORPTION EXT 3320 CCC FGIEXT=ROFOSPHER EXTINCTION FGA2AES=FOG2 ABSORPTION EXT 3320 CCC FGIEXT=ROFOSPHER EXTINCTION FGA3330 EXT 3320 CCC PGEXT=TROFOSPHER EXTINCTION TROFX13300 EXT 3400 CCC PGEXT=TROFOSPHER EXTINCTION </td <td>CCC</td> <td>ALTITUDA</td> <td>REGICN</td> <td>IS FO</td> <td>R AEROS</td> <td>OL E</td> <td>XTINC</td> <td>TICN</td> <td>CCE</td> <td>FFIG</td> <td>DIENT</td> <td>5</td> <td></td> <td></td> <td>EXT</td> <td>3270</td>	CCC	ALTITUDA	REGICN	IS FO	R AEROS	OL E	XTINC	TICN	CCE	FFIG	DIENT	5			EXT	3270
CCC EXT 3290 CCC C-2KM EXT 3300 CCC RURFXT=RURAL FXTINCTION RURABS=RURAL AESORPTION EXT 3310 CCC RURFXT=RURAL FXTINCTION RURABS=RURAL AESORPTION EXT 3320 CCC URPEXT=UPBAN FXTINCTION URBABS=URBAN ABSORPTION EXT 3320 CCC OCNEXT=POPSPHER EXTINCTION DRABS=RUBAN ABSORPTION EXT 3320 CCC TRIST=TPOPSPHER EXTINCTION POABS=FROGSFHER ABSORPTION EXT 3340 CCC FG1EXT=F0G1 .2KM VIS EXTINCTION FG1ABS=FOG1 ABSORPTION EXT 3340 CCC FG2EXT=F0G1 .2KM VIS EXTINCTION FG2ABS=FOG2 ABSORPTION EXT 3340 CCC FG2EXT=F0F0SPHER EXTINCTION FG2ABS=FOG3 ABSORPTION EXT 3340 CCC FG2EXT=F0F0SPHER EXTINCTION FG2ABS=FOG3 ABSORPTIONEXT 3:80 EXT 3340 CCC FG2FXT=F0F0SPHER EXTINCTION TROFXT=T3:70 EXT 3340 CCC STEXT=ABCKGPOUND S:RATOSPHERIC EXTINCTION EXT 3400 EXT 3400 CCC STEXT=ABCKGPOUND S:RATOSPHERIC EXTINCTION EXT 3400 EXT 3400 CCC STABS=ABCKGROUND S:RATOSPHERIC EXTIN	CCC														EXT	3280
CCC C-2KM EXT 3300 CCC RURFXT=RURAL EXTINCTION RURABS=RURAL AESORPTION EXT 3310 CCC URPEXT=UPBAN FXTINCTION URBABS=URBAN ABSORPTION EXT 3320 CCC OCNEXT=MARITIME EXTINCTION URBABS=URBAN ABSORPTION EXT 3320 CCC OCNEXT=MARITIME EXTINCTION OCNABS=MARITIME ABSORPTION EXT 3320 CCC TROEXT=TPOPSPHER EXTINCTION TOOABS=TROEOSPHER ABSORPTION EXT 3340 CCC FGIEXT=FOG1 .2KM VIS EXTINCTION FG1APS=FOG1 ABSORPTION EXT 3350 CCC FGIEXT=FOG2 .5KM VIS EXTINCTION FG2APS=FOG2 ABSORPTION EXT 3350 CCC FGIEXT=FOG2 .5KM VIS EXTINCTION FG2APS=FOG2 ABSORPTION EXT 3350 CCC FGIEXT=FOG2 .5KM VIS EXTINCTION FG2APS=FOG2 ABSORPTION EXT 3350 CCC FGIEXT=FGG2 .5KM VIS EXTINCTION FG2APS=FOG2 ABSORPTION EXT 3350 CCC FGIEXT=FGG2 .5KM VIS EXTINCTION FG2APS=FOG2 ABSORPTION EXT 3350 CCC STOFXT=FGE0SPHER EXTINCTION TROEXT=TSOF0SPHER EXTINCTION EXT 3400 CCC BSTEXT=ABCKGROUND S RATOSPHERIC EXTINCTION EXT 3400	CCC														EXT	3290
CCCRURFXT=RURAL FXTINCTIONRURABS=RURAL AESORPTIONEXT 3210CCCURPEXT=UPBAN FXTINCTIONURBABS=URBAN ABSORPTIONEXT 3210CCCOCHEXT=HARITINE EXTINCTIONURBABS=URBAN ABSORPTIONEXT 3330CCCTROEXT=TPDPSPHER EXTINCTIONTPOADS=TROFOSPHER ABSORPTIONEXT 3340CCCFGIEXT=FOG2.2KM VIS EXTINCTIONFGIADS=FOG1 ABSORPTIONEXT 3340CCCFGIEXT=FOG2.2KM VIS EXTINCTIONFGIADS=FOG2 ABSORPTIONEXT 3340CCCFGIEXT=FOG2.5KM VIS EXTINCTIONFG2ADS=FOG2 ABSORPTIONEXT 3340CCCZ=9KMEXT 100 TROADS=TROFOSPHER ABSORPTIONEXT 3340CCCTROFXI=TROFOSPHER EXTINCTIONTROADS=TROFOSPHER ABSORPTIONEXT 3340CCCSGIEXT=9ACKGROUND S RATOSPHERIC EXTINCTIONEXT 3400CCCAVOEXT=AGED VOLCANIC ABSORPTIONEXT 3400CCCAVOEXT=AGED VOLCANIC ABSORPTIONEXT 3420CCCFVCANS=AGED VOLCANIC ABSORPTIONEXT 3420CCCFVCANS=RESH VOLCANIC CASORPTIONEXT 3420CCCFVCANS=RESH VOLCANIC CASORPTIONEXT 3420CCCFVCANS=RESH VOLCANIC ABSORPTIONEXT 3420CCCCMCADS==AGED VOLCANIC ABSORPTIONEXT 3450CCCFVCANS=RESH VOLCANIC ABSORPTIONEXT 3450CCCCMCADS==AGEN VOLCANIC ABSORPTIONEXT 3450CCCFVCANS=RESH VOLCANIC ABSORPTIONEXT 3450CCCSUCANS=AGEN VOLCANIC ABSORPTIONEXT 3450CCCFVCANS=RESH VOLCANIC ABSORPTIONEXT 3450CCCFVCANS=RESH	CCC	ġ.	-2KH												EXT	3300
CCCURPEXT=UPBAN FXTINCTIONURBABS=URBAN ABSORPTIONEXT 3320CCCOCNEXT=HARITIME EXTINCTIONOCNABS=HARITIME ABSORPTIONEXT 3340CCCTRASXT=TPOPSPHER EXTINCTIONFOABS=TROFOSFHER ABSORPTIONEXT 3340CCCFGIEXT=FOG1 .2KH VIS EXTINCTIONFG1ABS=FOG1 ABSORPTIONEXT 3350CCCFGIEXT=FOG2 .5KM VIS EXTINCTIONFG2ABS=FOG2 ABSORPTIONEXT 3350CCCSZ=KMEXT 1000FG2ABS=FOG2 ABSORPTIONEXT 3370CCCYG=XKHVIS EXTINCTIONTROABS=TROFOSPHER ABSORPTIONEXT 3380CCCSG1EXT=ACKGPOUND S:RATOSPHERIC EXTINCTIONEXT 3400CCCGSTABS=ACKGROUND S:RATOSPHERIC ABSORPTIONEXT 3410CCCAVOEXT=AGED VOLCANIC ABSORPTIONEXT 3420CCCAVOEXT=AGED VOLCANIC ABSORPTIONEXT 3420CCCFVCAPS=FRESH VOLCANIC EXTINCTIONEXT 3440CCCFVCAPS=FRESH VOLCANIC ABSORPTIONEXT 3440CCCSJ=1100KHEXTINCTIONEXT 3440CCCCMFEXT=METEORIC DUST EXTINCTION 'EXT 3440CCCCMFEXT=METEORIC DUST ABSORPTIONEXT 3440CCCCMEABS=METEORIC DUST ABSORPTIONEXT 3440CCCCMEABS=	CCC	-	RUREXT	RURA	L EXTE	OTTO	N R	URAB	S=RUI	RAL	AESOR	RPTI	ON		ĒXT	3310
CCCOCNEXT=MARITIME EXTINCTIONOCNABS=MARITIME ABSORPTIONEXT 3330CCCTRAGXT=TPOPSPHER EXTINCTIONTPOABS=TROGOSFHER ABSORPTIONEXT 3340CCCFGIEXT=FOG1.2KH VIS EXTINCTIONFGIADS=FOG1 ABSORPTIONEXT 3350CCCFGIEXT=FOG2.5KM VIS EXTINCTIONFG2ADS=FOG2 ABSORPTIONEXT 3350CCC>2-9KMEXTINCTIONFG2ADS=FOG2 ABSORPTIONEXT 3370CCC>2-9KMEXTINCTIONTROADS=TROPOSPHER ABSORPTIONEXT 3380CCC>3-30KMEXTINCTIONTROADS=TROPOSPHER ABSORPTIONEXT 3390CCCBSTEXT=AGCKGROUND S:RATOSPHERIC EXTINCTIONEXT 3400CCCQSTABS=9ACKGROUND S:RATOSPHERIC ABSORPTIONEXT 3400CCCAVCAPS=AGCKGROUND S:RATOSPHERIC ABSORPTIONEXT 3400CCCAVCAPS=AGCKGROUND S:RATOSPHERIC ABSORPTIONEXT 3400CCCAVCAPS=AGCKGROUND S:RATOSPHERIC ABSORPTIONEXT 3400CCCAVCAPS=AGCKGROUND S:RATOSPHERIC ABSORPTIONEXT 3400CCCAVCAPS=AGCN VOLCANIC EXTINCTIONEXT 3420CCCFVOEXT=FRESH VOLCANIC EXTINCTIONEXT 3420CCCFVCARS=FRESH VOLCANIC ABSORPTIONEXT 3450CCC>3G-11^NKHEXT 3450CCC>3G-11^NCHEXT 3450CCC>3G-11^NCHEXT 3450CCCCMEADS=METEORIC DUST ABSORPTIONEXT 3450CCCCMEADS=METEORIC DUST ABSORPTIONEXT 3450CCCCMEADS=METEORIC DUST ABSORPTIONEXT 3450CCCCMEADS=METEORIC DUST ABSORPTIONEXT 3450CCCCMEADS=METEORIC DUST ABSOR	000		URPEXT	UPRA	N EXTIN	OTTO	N U	RBAB	S= UR	BAN	ABSO	RFTI	ON		EXT	3320
CCCTROEXT=TEMPSEMER EXTINCTIONTPOADS=TROFOSEMER ABSORPTIONEXT3340CCCFGIEXT=FOG1.2KM VISEXTINCTIONFGIADS=FOG1 ABSORPTIONEXT3340CCCFGIEXT=FOG2.5KM VISEXTINCTIONFGIADS=FOG2 ABSORPTIONEXT3340CCC>2-9KMEXTEXTINCTIONFGIADS=FOG2 ABSORPTIONEXT3370CCCTROFXI=TROFOSPHEREXTINCTIONTROADS=TROFOSPHER ABSORPTIONEXT3340CCC9-30KMEXTSATOSPHERIC EXTINCTIONEXT3400CCC@STEXT=9ACKGROUND S.RATOSPHERIC EXTINCTIONEXT3400CCC@STEXT=9ACKGROUND S.RATOSPHERIC ABSORPTIONEXT3400CCC@STEXT=9ACKGROUND S.RATOSPHERIC ABSORPTIONEXT3400CCC@STEXT=9ACKGROUND S.RATOSPHERIC ABSORPTIONEXT3400CCC@STEXT=9ACKGROUND S.RATOSPHERIC ABSORPTIONEXT3400CCC@STEXT=9ACKGROUND S.RATOSPHERIC ABSORPTIONEXT3420CCC@STEXT=9ACKGROUND S.RATOSPHERIC ABSORPTIONEXT3450CCC@STEXT=9ACKGPUCANIC ABSORPTIONEXT </td <td>CCC</td> <td></td> <td>OCNEXT=</td> <td>MARI</td> <td>TINE E</td> <td>TINC</td> <td>TION</td> <td>OCN</td> <td>ABS=1</td> <td>MARI</td> <td>TIME</td> <td>Aes</td> <td>ORPTI</td> <td>CN</td> <td>ĒXT</td> <td>3330</td>	CCC		OCNEXT=	MARI	TINE E	TINC	TION	OCN	ABS=1	MARI	TIME	Aes	ORPTI	CN	ĒXT	3330
CCCFG1EXT=FOG1.2KH VIS EXTINCTIONFG1APS=FOG1 ABSORPTIONEXT 3350CCCFG2EXT=FOG2.5KM VIS EXTINCTIONFG2APS=FOG2 ABSORPTIONEXT 3350CCC>2-9KMEXTINCTIONFG2APS=FOG2 ABSORPTIONEXT 3380CCCTROFX1=TROPOSPHER EXTINCTIONTROABS=TROPOSPHER ABSORPTIONEXT 3380CCC>9-30KMEXT 3400CCC@STEX1=9ACKGPOUND S:RATOSPHERIC EXTINCTIONEXT 3400CCC@STEX1=9ACKGROUND S:RATOSPHERIC ABSORPTIONEXT 3410CCC@STAPS=9ACKGROUND S:RATOSPHERIC ABSORPTIONEXT 3410CCCAVOEXT=AGED VOLCANIC ABSORPTIONEXT 3420CCCAVOEXT=AGED VOLCANIC ABSORPTIONEXT 3420CCCFVOEXT=FRESH VOLCANIC ABSORPTIONEXT 3440CCCFVOEXT=FRESH VOLCANIC ABSORPTIONEXT 3440CCCSG-110KHEXT 3440CCCCMFEXT=METEORIC DUST EXTINCTIONEXT 3460CCCCMFEXT=METEORIC DUST ABSORPTIONEXT 3470CCCCMEAPS=METEORIC DUST ABSORPTIONEXT 3470 <td>003</td> <td></td> <td>TROSXT</td> <td>TPNP</td> <td>SPHER</td> <td>XTIN</td> <td>CTION</td> <td>ΤP</td> <td>OARS</td> <td>= T R(</td> <td>DFOSFI</td> <td>FER</td> <td>ABSOR</td> <td>PTION</td> <td>ΕXΪ</td> <td>3340</td>	003		TROSXT	TPNP	SPHER	XTIN	CTION	ΤP	OARS	= T R(DFOSFI	FER	ABSOR	PTION	ΕXΪ	3340
CCCFG2FXT=FDG2SKM VISEXTINCTIONFG2AES=FDG2ASSORPTIONEXT3340CCC>2-9KMEXT3770EXT3770CCCTROFXT=TROPOSPHEREXTINCTIONTROADS=TROPOSPHERABSORPTIONEXT3390CCC9-30KMEXT3390EXT3390CCCESTEXT=9ACKGROUNDSTRATOSPHERICEXTINCTIONEXT3400CCCQSTADS=9ACKGROUNDSTRATOSPHERICASSORPTIONEXT3410CCCAV0EXT=AGEDVOLCANICEXTINCTIONEXT3420CCCAV0EXT=AGEDVOLCANICABSORPTIONEXT3420CCCFVOEXT=FRESHVOLCANICABSORPTIONEXT3460CCCFVCARS=FRESHVOLGANICABSORPTIONEXT3460CCCCMFEXT=METEORICDUSTABSORPTIONEXT3460CCCCMFEXT=METEORICDUSTABSORPTIONEXT3460CCCCMEABS=METEORICDUSTABSORPTIONEXT3490CCCCMEABS=METEORICDUSTABSORPTIONEXT3490CCCCMEABS=METEORICDUSTABSORPTIONEXT3490CCCCMEABS=METEORICDUSTABSORPTIONEXT3490	CCC		FS1EXT:	F 0G 1	.2KH \	ISE	XTINC	TION	FG	1 A E	S=FOG	1 48	SORPT	ION	EXT	3350
CCC >2-9KH EXT 370 CCC TROFXI=TROPOSPHER EXTINCTION TROADS=TROPOSPHER ADSORPTIONEXT 3100 CCC >9-30KH CCC BSTEXT=9ACKGPOUND S RATOSPHERIC EXTINCTION CCC BSTEXT=9ACKGROUND S RATOSPHERIC EXTINCTION CCC QSTADS=9ACKGROUND S RATOSPHERIC EXTINCTION CCC QSTADS=9ACKGROUND S RATOSPHERIC ADSORPTION CCC AVCATS=AGED VOLCANIC EXTINCTICN CCC AVCATS=AGED VOLCANIC ADSOFTION CCC FVOEXT=RESH VOLCANIC ADSOFTION CCC FVCARS=FRESH VOLCANIC ADSORPTION EXT 3450 EXT 3450 CCC <	CCC		FG2EXT:	F DG 2	.5KM	IS E	XTINC	TION	FG	2 48	S=FOG	2 A 9	SORPT	ION	EXT	3360
CCC TROFXI=TROPOSPHER EXTINCTION TROADS=TROPOSPHER ADSORPTIONEXT 3:00 CCC >9-30KM EXT 3300 CCC BIEXI=AACKGPOUND S:RATOSPHERIC EXTINCTION EXT 3400 CCC QSTADS=AACKGROUND S:RATOSPHERIC EXTINCTION EXT 3410 CCC AVOEXT=AGED VOLCANIC EXTINCTION EXT 3420 CCC AVOEXT=AGED VOLCANIC ADSORPTION EXT 3420 CCC AVOEXT=RESH VOLCANIC EXTINCTION EXT 3440 CCC FVCENT=RESH VOLCANIC ADSORPTION EXT 3440 CCC >355-110 KM EXT 3450 CCC CMEADS=METEORIC DUST ADSORPTION * EXT 3470 CCC CMEADS=METEORIC DUST ADSORPTION EXT 3470 CCC CMEADS=METEORIC DUST ADSORPTION EXT 3470 CCO CMEADS=METEORIC DUST ADSORPTION <t< td=""><td>000</td><td>></td><td>2-9KM</td><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td><td></td><td></td><td></td><td></td><td>EXT</td><td>3770</td></t<>	000	>	2-9KM							-					EXT	3770
CCC >9-30XM EXT 3390 CCC BSTEXT=9ACKGPOUND SIRATOSPHERIC EXTINCTION EXT 3400 CCC BSTEXT=9ACKGROUND SIRATOSPHERIC ABSORPTION EXT 3400 CCC BYDS=9ACKGROUND SIRATOSPHERIC ABSORPTION EXT 3400 CCC AV0EXT=AGED VOLCANIC EXTINCTION EXT 3420 CCC AV0EXT=AGED VOLCANIC ABSORPTION EXT 3430 CCC FVOEXT=FRESH VOLCANIC ABSORPTION EXT 3450 CCC FVCAPS=FRESH VOLCANIC ABSORPTION EXT 3450 CCC FVCAPS=FRESH VOLCANIC ABSORPTION EXT 3460 CCC SG-110 KM EXT 3450 CCC CMFEXT=METEORIC DUST EXTINCTION * EXT 3460 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3460 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3460 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3490 END EXT 3490 EXT 3490	000		TROFXI:	TROF	OSPHER	EXTI	NCTIC	N T	ROAS	S = TF	ROPOSI	PHER	ABSO	RPTIC	NEXT	3380
CCC BSTEXT=GACKGPOUND S RATOSPHERIC EXTINCTION EXT 3400 CCC QSTABS=GACKGROUND S RATOSPHERIC ABSORPTION EXT 3410 CCC QSTABS=GACKGROUND S RATOSPHERIC ABSORPTION EXT 3410 CCC AVCAPS=ACKGROUND S RATOSPHERIC ABSORPTION EXT 3420 CCC AVCAPS=ACKGROUND S RATOSPHERIC ABSORPTION EXT 3420 CCC AVCAPS=ACKGROUND S RATOSPHERIC ABSORPTION EXT 3420 CCC FVOEXT=FRESH VOLCANIC ABSORPTION EXT 3450 CCC FVCARS=FRESH VOLCANIC ABSORPTION EXT 3460 CCC SG-110KH EXT 3460 CCC CMFEXT=METEORIC DUST EXINCTION * EXT 3460 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3420 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3420 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3420 END EXT 3490 EXT 3490	000	>	3-30KM												EXT	3390
CCCQSTADS=DACKGROUND S RATOSPHERIC ABSORPTIONEXT 3410CCCAV0EXT=AGED VOLCANIC EXTINCTICNEXT 3420CCCAV0APS=AGED VOLCANIC ABSORPTIONEXT 3420CCCFV0EXT=RESH VOLCANIC EXTINCTIONEXT 3440CCCFVCAPS=FRESH VOLCANIC ABSORPTIONEXT 3450CCCCCCFVCAPS=FRESH VOLCANIC ABSORPTIONEXT 3450CCCCMFEXT=METEORIC DUST EXTINCTION *EXT 3460CCCCMFEXT=METEORIC DUST EXTINCTION *EXT 3470CCCCMFEXT=METEORIC DUST ABSORPTIONEXT 3490CCCCMEABS=METEORIC DUST ABSORPTIONEXT 3490	CCC		BSTEXT =	ACK	OND OC	SIRA	TOSPH	ERIC	EXT	I NĈ	TION				EXT	3400
CCC AVOEXT=AGED VOLCANIC EXTINCTION EXT 3420 CCC AVOEXT=FRESH VOLCANIC ABSORPTION EXT 34400 CCC FVOEXT=FRESH VOLCANIC EXTINCTION EXT 34400 CCC FVCARS=FRESH VOLCANIC ABSORPTION EXT 3450 CCC FVCARS=FRESH VOLCANIC ABSORPTION EXT 3460 CCC CCC FVCARS=FRESH VOLCANIC ABSORPTION EXT 3460 CCC CCC FVCARS=FRESH VOLCANIC ABSORPTION EXT 3460 CCC CMEEXT=METEORIC DUST EXTINCTION * EXT 3460 CCC CMEEXT=METEORIC DUST ABSORPTION EXT 3460 CCC CMEEXT=METEORIC DUST ABSORPTION EXT 3460 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3460 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3490	000		estaes=	BACK	GROUND	S RA	TOSPH	ERIC	ABS		TION				EXT	3410
CCC AVCAPS=AGED_VOLCANIC ABSOFPTION EXT 3430 CCC FVOEXT=FRESH VOLCANIC EXTINCTION EXT 3450 CCC FVCARS=FRESH VOLCANIC ABSORPTION EXT 3450 CCC >3G-110KM EXT 3460 CCC CMEFXT=METEORIC DUST EXTINCTION * EXT 3460 CCC CMEFXT=METEORIC DUST EXTINCTION * EXT 3470 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3470 END EXT 3490 EXT 3490	000		AVOEXT=	AGED	VOLCAN	ιιίε	XTINC	TICN		-					EXT	3420
CCC FVOEXT=FRESH VOLCANIC EXTINCTION EXT 3440 CCC FVCARS=FRESH VOLCANIC ABSORPTION EXT 3450 CCC >3G-11°KM EXT 3460 CCC CMFFXT=METFORIC DUST EXTINCTION * EXT 3470 CCC CMFFXT=METFORIC DUST EXTINCTION * EXT 3470 CCC CMFFXT=METFORIC DUST ABSORPTION EXT 3470 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3490 END EXT 3490 EXT 3490	000		AVCADE	AGEN	VOLCAN	IIC A	BSOFP	TION							EXT	3430
CCC FVCARS=FRESH VOLCANIC ABSORPTION EXT 3450 CCC >3G-11°KM EXT 3460 CCC CMFFXT=METFORIC DUST EXTINCTION * EXT 3460 CCC CMFFXT=METFORIC DUST EXTINCTION * EXT 3470 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3490 END EXT 3490	CCC		FVOEXT	FRES	H VOLC	NIC	EXTIN	CTIO	N						EXT	3440
CCC >3G-110KM EXT 3460 CCG CMEEXT=METEORIC DUST EXTINCTION * EXT 3470 CCC CMEABS=METEORIC DUST ABSORPTION EXT 3480 END EXT 3430	000		FV CARS:	FRES	H VOLC	NIC	ABSOR	PTIO	N						EXT	3450
CCC CMEEXT=METEORIC DUST EXTINCTION * EXT 3470 CCC CMEARS=METEORIC DUST ARSORPTION EXT 3480 END EXT 3490	CCC	> 3	30-1 - 11	1											EXT	3460
CCC CMEABS=METEORIC DUST ABSORPTION EXT 3480 END EXT 3490	000		CHEEXT:	METE	ORIC DU	ST E	XTINC	TION	•						EXT	3470
END EXT 3490	cċc		CMEABS=	METE	ORIC D	JST Å	BSORP	TION							EXT	3480
		END					-	-							EXT	3490

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		SUBROUTINE FATH	PAT	10
С		REVISER 12 CFC 79	PAT	20
c		LOADS CUMULATIVE ABSORBER AMOUNTS INTO THE MATRIX NEATH FROM WLAY	PAT	30
C		FOR THE ATMOSPHERIC SLANT PATH	PAT	40
Ç		USED FOR RAPIANCE CALCULATIONS	PAT	50
C			PAT	60
		COMMON /CARE1/ MONFL, IMAZE, ITYPE, LEN, JP, IM, M1, M2, M3, ML, IEMISS, NU	PAI	70
	1	COMMON ACADERA MA MR ANGLE DANCE RETA MARA DE	DAT	03 03
		COMMON /CARL2/ H1/H2/HN0L//HANDS/DEIA/HFIN/RE Common /CARL2/ H1/H2 DN AVE CO.C	DAT	100
		COMMON PERCENT A 1992 STATATORY CONTRACTORY CLOSED AND A COMMON PERCENT A COMPACTATO PERCENTA PERCENTA COMPACTATO PERCENTA PERCENTA PERCENTA COMPACTATO PERCENTA COMPACTATO PERCENTA PERC	PAT	110
	4	TENDENT FUNCTION OF THE O	PAT	120
		CONMON /HDATA/ 7(34) .P (7.34) .T (7.34) .NH(7.34) .HC (7.34)	PAT	130
	1	, SEA SN (2), VULCN (5), VSP (9), HZ (15), HMIX (24)	PAT	140
		COMMON RELHUH(34), HSTOR(34), EH(15,34), ICH(4), VP(15), TX(15)	PAT	150
		COMMON WLAY(74,15),HPATH(58,15),T00Y(68)	PA.	160
		COMMON ABSC (4,40),EXTC (4,40),VX2(40)	PAT	178
		IF (ITYPE,E0,1) GD TO 60	PAT	180
		IF (J1.FG.J2.AND.J1.E9.JMIN) GO TO 60	PAT	1 50
		IF (ITYPE0.2. AND. H1. E0. H2) J2=J1	PAT	200
		IF (H2.GT.H1.AND.ANGL5.GT.SCAND.NP1.EC.1) J1=J1-1	PAT	210
		1F (JEX PB, EQ. I) J2=J2+1	PPI	220
		1F ([117PE,EU.2])ANU: (H1.3],H2/ANU.(LENSI-EG.1)/ J2=J2=1	DAT	200
		IF (LITPE:EG.) JZ=NL	DAT	240
		IF LUFAEMANT FFIN, 'UF ULFUE TECLUE EN AN DOTHET ZE	PAT	260
		$\frac{1}{1} + \frac{1}{1} + \frac{1}$	PAT	270
			PAT	280
			PAT	290
		HPATH(1K,K)=0.	PAT	300
	5	CONTINUE	PAT	310
		LEN=P	PAT	320
		NLL=NL-1	PAT	330
		IL=U1+1	PAT	340
		IJ=IL+NLL	PAT	350
		CO 10 K=1,KMAX	PAT	360
		E(K)=0.	PAT	370
	10	CONTINUE	PAT	3.60
		IF (ANGLE.GT. CO. 7) GC TO 15	PAT	390
		LEN=1.	PAI	400
			PAI	410
			DAT	420
	15		DAT	400
	19		PAT	450
		TE (IEN.EO.L. TURIL-1	PAT	460
		TF (LEN. FG.1) TI=TI+1	PAT	470
			PAT	4.80
		IF (IL.EQ.0) GD TO 40	PAT	490
		00 20 K=1, KWAX	PAT	500
		$H(K) = E(K) + HLAY(1L_FK)$	PAĨ	510
		HPATH(IK,K)=H(K)	PAT	520
	20	CONTINUE	PAT	530
		IF (IL.LE.C.OF.IL.GF.NL) GO TO 25	PAT	540
		TBAR=(T[H,]L)+T(H,]L+1))+0.5	PAT	550
		IF(M1.GT.O.ANC.M.LT.7) T9AR=(T()'1,IL)+T(M1,IL+1);*0.5	PAT	560
ç		TO A DEVENT OF A STRATE STATE STATE STATE STATE	PAT	570
Ç	15	1F (JEX:KA.CH.1) [BAR=((M,J1)+1(M,J1+1))70.5	PAT	ングレーチャック
	25		P # 1	540
		184711212 908	PA (ະ ປປ

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		PAI	610
	E(K)=H(K)	PAT	620
	30 CONTINUE	PAT	630
	IF (ANGLE-LE-90-0-ANC.IL-EQ-NLL) GO TO 50	PAT	64D
	IF (ITYPE.EC. ³ ,ANJ.ANCLE.LE.90.0) GO TC 35	PAT	650
	IF (ITYPE.EC. JAND LEN.ED. 1. AND TL.ED. J2) GO TO 50	PAT	660
	IF (ITYPE FO.2 AND LENST FO.0 AND TL FO.12) GO TO 50	PAT	670
	TE (IL.EQ. JETN. AND. HETN.GT. P. () EN=1	PAT	E R.O.
	TE (11-E0-1-AND-WEIN-1E-8-0) 60 TC 50	DAT	600
		DAT.	200
		0.1	746
	$\frac{1}{1} \left(\frac{1}{1}, \frac{1}{2}, \frac{1}{2},$	PAI	710
	IF (ITTPE, EU. Z. AND IL. EU. JZ) GU (U 50	PAI	720
	35 CONTINUE	PAT	730
	IF(JP.EQ.0)FRINT 90, IK,(APATH(IK:K),K=1,8),WPATH(IK:10),	PAT	740
	1HPATH(IK,11),TBPY(IK)	PAT	750
	40 CONTINUE	PAT	760
	IKHAX=69	PAT	770
	LEN=LENST	PAT	7.80
	IF (JP.NE.D) RETURN	PAT	700
	PPINT AS	PAT	8 0 0
		DAT	
	DU 92 IN-IIJNEA2 Se do tut an the indetinity by bails 465	0 4 1	670
	40 FRINI DUS INSTAFALITIES SAS		020
	RETURN	PAI	830
	50 CONTINUE	PAT	840
	IS(JP.EQ.C) PRINT 8", IK,(WPATH(IK,K),K=1,8),WPATH(IK,10)	PAT	850
	1 ,HPATH(TK,11),TRRY(IK)	PAT	860
	IKN4X=IK	PAT	870
	LEN=LENST	PAT	880
	IF (JP NE - 1) PETURN	PAT	800
	PDINT 85	DAT	9.80
		DAT	940
	= 5 - 2 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 +	DAT	C 20
	22 FRINE 20, INJER ALDEIN, NJER 20, 14/		220
		PAI	930
	50 DO 55 RAINAA	PAI	940
	WPATH(1,K) = W(K)	PAT	9 50
	65 CONTINUE	PAT	960
	IF (M+EQ+C) J1=1	PAT	570
	J2=J1	PAT	980
	T88Y(1) = T(4, J1)	PAT	990
	IF(M1.GT.0.ANT.M.LT.7) TBBY(1)=T(M1.J1)	PAT	1000
	TICHAX=1	PAT	1010
	TE/ 16 EQ 113 DETNIT 70 (4 12	 	1020
		DAT	1020
	አጠንወጠቀር ጊዜ የግሩ		1030
	1K=1	PAI	1640
	IKWAX=IK	PAT	1050
	IF(JP.EQ.0) PRINT 80, IK,(WPATH(IK,K),K=1,8),WPATH(IK,10),	PAT	1060
	1 WPATH(IK,11),TBRY(IK)	PAT	1070
	HMIN=1.0E-5	PAT	1080
	IF(JP.NE.0) RETURN	PAT	1090
	PRINT AS	PAT	1100
	FRINT 8°. TK. (WPATH(TX.K).K=12.14)	PAT	1110
	RETIEN	Ϋ́Α.Υ	1120
~	er i vra		1130
C	TR FORMAT (OT3)	PA	1110
		PA I Baarat	1140
	75 FORMAL (77,20X,534 CUMULATIVE ABSCRBER AMOUNTS FOR THE ATMOSPHE	RICPAT	1150
	1 PATH;//10X;3HH20;6X;4HC02+;8X;2HC3;9X;2HN2;8X;5HH20 C;6X;5HH0L	S,PAT	1160
	27X;4HA5P1;6X;5HD3_UV;7X;54H20_C;7X;4HHN03;5X;4HTAVE)	FAT	1170
	80 FORMAT (IF,1P10E11.3,0PF10.3)	PA T	1188
	85 FORMAT (//,7X,2HI9,4X,4 HAER2,7X,4HAER3,7X,4HAER4)	PAT	1190
	END	PAT	1200

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Table A1.	Listing of F	ortran Code	LOWTRA	AN 5	(Cont.)
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	SUBROUTINE TRANS	TRA	10
с	REVISED 14 JAN 1990	TRA	20
Ċ	CALCULATES TRANSMITTANCE AND RADIANCE VALUES BETHEEN VI AND V2	TRA	30
С	FOR A GIVEN ATMOSPHERID SLANT PATH	TRA	40
С		TRA	60
	COMMON /CARC1/ MODEL.THAZE.ITYPE.LEN.JP.IM.M1.M2.M3.ML.IEMISS.RO	TRA	60
	1 TBOUND, ISEASN, IVULCN, VIS	TRA	70
	COMMON /CARC2/ H1.H2. ANGLE. RANGE. BETA. HMIN. RE	TRA	80
	COMMON /CAPC3/ V1. V2. 0V. AVW. CO. CH. H(15) . C (15) . CA. FI	TRA	90
	COMMON /CNTRL/ LENST, KMAX, M, IJ, J1, J2, JMIN, JEXTRA, IL, IKMAX, NLL, NP1	TRA	100
	1, IFIND, NL, IKLO	TRA	110
	COMMON /MDATA/ Z (34),P(7,34),T(7,34),HH(7,34),HO(7,34)	TRA	120
	1 ,SEASN(2),VULCN(5),VSP(9),HŽ(15),HMŽX(34)	TRA	1 30
	COMMON RFLHLM(34),HSTOR(34),EN(15,34),ICH(4),VH(15),TX(15)	1 R A	140
	COMMON WLAY (34,15), HFATH (38,15), T89Y(68)	TRA	150
	COMMON ABSC(4,40),EXTC(4,40),VX2(40)	1 R A	160
	COMMON /TREWED/ TR(67),FH(67),FO(67)	TRA	170
	COMMON /C4C5C2/ C4(133),C5(15),C8(102)	TRA	180
	COMMON /AER/ XX2 +XX2 +XX3+XX4+ YY1+ YY2+ YY3+ YY4	TRA	1 90
	DIMENSION APS(15)	TRA	200
	FF (T + V) = 1 + 190956F-16+(V**5)/(EXP(1+43079*V/T)-1+)	TRA	210
С	WATTS. CM-2 ST-1 MICRON-1	TRA	220
	RADHIN=1.CE+300	TRA	230
	RADMAX=9.	TRA	240
	VRHIN=0.	TRA	250
	VRMAX=0.	TRA	260
	SUMA=0.	TRA	270
		TOA	200
		TOP	100
	CALL GADINA CALL TADIN	TDA	340
		TEA	328
	TVI-VI/2* TVI-VI/2*	TPA	110
	1927927007070 TV/=TV/=FG	TRA	340
	1 V 2 × V 2	TRA	350
	TE (TV1.1T.350) (V1#350	TRO	768
	IF (IV2.GT.50000) IV2=50000	TRA	370
	IF (DV.11.5) DV=5	TRA	380
	IDV≠DV	TRA	3 50
	IV = IV 1 - IP V	TRA	400
	ICOUNT= 9	TRA	410
С	BEGINING OF TRANSMITTANCE CALCULATIONS	TRA	420
	5 IV=IV+ICV	TRA	430
	SUM V= 0.	TRA	440
	TLOLC=1.	TPA	450
	TSOLD=1.	TRA	460
	IKL0=1	TRA	470
	IF (IEMISS.EG.D) IKMAX=IKLO	TRA	4 6 0
	$10 \ 10 \ JK = 1, 11$	IRA	490
	ABS (JK) = 0.	TOA	500
		TOP	510
	10 LUNI1NUT 15 CID NE 03 CO TO 20	15A 15A	520
	17 NOTINE 107 10 10 20 VE (TEOUNY 20 0) EO TO 15	TPA	520
	TE CLOURT SUPPORT OF 17 12	TRA	560
		TRA	560
	15 TCOUNT= 1	TRA	570
	IF (IENISS.FO.D) PRINT 255	TRA	580
	20 00 25 K=1,KMAX	TRA	590
	TX(K) = 0, 0	TRA	600

		IF (K.LT.4) TX(K)=1.0	TRA	611
	25	CONTTRUE	TRA	£ 20
		ICOUNT - ICOUNT + 1	TRA	630
		SUM=0.0	TRA	E 40
		V=IV	TRA	650
		I=(IV-350)/5+1	TRA	€ € 0
C		######################################	TRA	670
С		HNO3 ABSORPTION CALCULATION	TRA	680
		CALL HNOT (V, APS(11))	TRA	690
		IF (IV.LT.670) 60 TO 80	TRA	700
		IF (IV+LE+3000) 60 TO 45	TRA	710
С		*** HOLECULAR SCATTERING	TRA	720
		ABS(6)=V##4/(9.26799E+18-1.07123E+09#V##2)	TRA	730
		IF (IV.(1.929C) GD TO 80	TRA	740
_		IF (IV.LT.13^C0) SO TO 65	TRA	750
С		*** UV OZONE	TRA	7 E O
		IF (IV.LE.23400) GO TO 30	TRA	770
		IF (IV.GE.27500) 30 TO 35	TRA	780
		60 10 110	TRA	790
	30	X1=(V-1 <000.0)/200.0+1.	TRA	800
			TRA	810
	35	X1=(V+2/5)00,07/5000+57.	TRA	950
	40	N=X1+1.001	IRA	e 30
			TRA	840
		405(0)=00(N)+20*(00(N)+00(N-1))	IKA	850
		GO TO 65	AY1 TOA	820
c		444 HATER VAROR CONTINUIN 15 MICRON RECTON		880
v	45	TE (TV-GT.1350) GT TO 60		800
		ABS (5)=14.18+6578.0#FYP(=7.67F=3#V))	104	0.00
		60 TO 55	TO	G10
	50	IE (TV-17-2350) 60 TO 60	TRA	920
С		*** WATER VAPOR CONTINUUM 4 NICRON REGION	TPA	930
-		XI= (V-2350.0)/50.0+1.0	TRA	C 4 8
		NH=XI+1.0/1	TRA	6 6 0
		XH=XI-FLOAT (NH)	TRA	960
		485(10)=C5(NH)+XH*(C5(NH)-C5(NH-1))	TRA	\$70
	55	CONTINUE	TRA	980
		IF (IV.LF.1350.OR.IV.GT.2740) GO TO 80	TRA	e eo
С		*** NITPOGEN CONTINUUM	TRA	1000
	60	IF (IV.LT.2(80) GD TO 80	TRA	1010
		K4=I-346	TRA	1020
		ABS (4)=C4(K4)	TRA	1030
		GQ TO 89	TRA	1249
С		*** WATER VAPOUP	TRA	1050
	65	IF (IV.LT.12800.AND.IV.GE.9875) GC TO 70	TRA	1060
		IF (IV.LE,14520.AND.IV.GE.13400) GO TO 75	TRA	1070
		GD TO 85	TRA	1020
	70	I=I-135	TRA	1090
		GO 10 00	TRA	1160
	75		TRA	1110
	50	UALL UIUTA (AMS(1),1)	TRA	1120
~	85	ARA INTEODERY MAYER CAREE	TRA	1130
ι.		TTT UNIFURBLE BIXED GASES	TRA	1140
		TE (THIT 17400 AND TH CT 40070) CO TO OC	IRA	1150
		CU TU 400 16 JUANE (4101704 POL4 1840)410701 00 10 30	I RA	1100
	o n	00 TO 100 127-30		11/0
	74			1100
	95	J= (TV+12960)/5+1516	188	1200
	23	カーメアル・アピニンバトレン・アンドル	IKA	†¢0 0

Table A1. Listing of Fortran Code LOWTRAN 5 (Cont.)

Fairing a state of the state of

			4540
100	UALL 0201A (AMS(2),3)	IRA	1210
105	CONTINUE	TRA	1220
	*** 070NE	TRA	1230
	TE (19.17.575.0R.TV.67.3270) GO TC 110	TRA	1240
		TDA	1250
		TRA	1250
	CALL C3DIA (ARS(R),L)	I R A	1260
110	CONTINUE	TRA	1270
	CALL AFREXT (V)	TRA	1280
	DO 210 THEIVIO, THAY	TRA	1290
		TEA	4 1 0 0
	17 (1EH155,EG.0) 60 10 120	TRA	1300
	00 115 K=1, KMAX	IRA	1310
	H(K)=WP&TH(IK,K)	TRA	1320
115	CONTINUE	TRA	1330
120	CONTINUE	TPA	1 * 6 0
400		TDA	4750
	30 4 = (,)	(RA	1250
	CO 125 J×=4,11	INA	1360
	TX(JK)=&@S(JK)=N(JK)	TRA	1370
125	SUN=SUN+TX(JK)	TRA	1380
	TY(5) = TY(5) + TY(10)	TRA	1390
		104	1.000
		1 87	1400
	K1=1	TRA	1410
	IF (H(1)+LT+1+9E-20) GO TO 145	TRA	1420
	IE (ABS(1), LE5.0) GO TO 145	TRA	1430
		TOA	1.4.0
		104	1440
	IF (HS1.L), -2.3468) [X(1)=1UB//0/TEXP(1.855595*HS1)	IKA	1450
	IF (WS1.LT2.3468) GO TO 145	TRA	1460
	IF (WS1+GT+3+56P2) 30 TO 140	TRA	1470
	TF (WS1.GT.2.0) K1=40	TRA	1480
	DO 130 K=K1.67	TPA	1 4 9 0
	DU 130 NEXTIC		1430
	1F (NS1.(E.FN(R)) (0 10 155	IKA	1200
130	CONTINUE	TRA	1510
135	TX(1)=}R(K)+(TR(K-1)+TR(K))+(FW(K)-WS1)/(FH(K)-FW(K-1))	TRA	1520
	60 TO 145	TRA	1530
1 4 0		TEA	3540
140		704	1540
145	CONTINGE	184	1550
	TX (2)=1.0	TRA	1560
	K1≈1	TRA	1570
	TE (W(2), (T, 1, 0) -20) GO TO 165	TRA	1580
	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	TEA	1 5 0 0
	IF (A A(2)+LE+79+0) 50 TO 102	TRA	1970
	WS2=AL0G10(W(2))+4 HS(2)	IRA	1600
	IF (WS2,LT,-2,T468) TX(2)=1,-,087787*EXP(1,855555*WS2)	TRA	1610
	IF (WS2.LTZ.346A) GO TO 165	TRA	1620
	TE (W\$2,67,3,4682) 30 TO 160	TRA	1630
		TDA	1640
			1040
	UU 150 K=K1+57	1 6 4	1620
	IF (WS2+LF+FW(K)) GO TO 155	TRA	1660
150	CONTINUE	TRA	1670
155	TX(2)=TR(K)+(TR(K-1)-TR(K))*(FH(X)-WS2)/(FW(K)-FW(K-1))	T₩A	1 6 60
• • • •		TOA	1500
		1 1 1 1	1200
160	(x(z)=0.0	I KA	1700
165	CONTINUE	TRA	1710
	TX(3)=1.	TRA	1720
	Ki=1	TRA	1730
	TE (44(3))(T,4)PE=20) GO TO 145	TPA	1740
		164	4 7 5 6
	11 14 10 107 + 11 101 101 10 300	I NA	3750
	WS3=ALOG1C(W(3))+4PS(7)	TRA	1760
	IF (WS3 LT,~1.6778) TX(3)=1.~.0551944EXP(2.3678534WS3)	TRA	1770
	TE (WS3.1T1.6778) 60 TO 185	TRA	1780
	TE (WS3.61.3.9365) 50 TO 180	TDA	1700
	AL ANGLIGATION ALGOVIA DO LO AND NY ANGRES ALGOVIA DA	10.4	4 4 6 6
	17 INS16861619 KI730	I KA	1000

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	DO 170 K=K1.67	TRA 1	810
	IE (WST-LE-EQ(K)) 60 TO 175	TRA 1	820
170	CONTINUE	TRA 1	830
175	TX(3) = TR(K) - (TR(K) - TR(K-1)) + (FO(K) - NS3) / (FO(K) - FO(K-1))	TRA 1	840
	GO TO 185	TRA 1	850
180	7 X (3) =0. C	TRA 1	86C
185	CONTINUE	TRA 1	870
	TX(10)= YY1* +(7) +YY2* H(12) + YY3* H(13) + YY4* H(14)	TRA 1	880
	¥X(7)=XX1*H(7)+XX2*H(12)+XX3*H(13)+XX4*H(14)	TRA 1	e 90
	SUH=SUH+TX(7)	TRA 1	9009
	TX(9)=SUM	TRA 1	910
	00 205 K=×,KMAX	TRA 1	920
	IF (TX(K).EG.0.0) GO TO 135	TRA 1	930
	IF (TX(K).LE.0.1) GO TO 190	TRA 1	940
	IF (TX(K).67.20.) 63 TO 200	TRA 1	950
	TX(K)=EXP(-TX(K))	TRA 1	960
	GO TO 205	TRA 1	970
190	TX(K)=1.0-TX(K)+0.5+TX(K)+TX(K)	TRA 1	980
	GO TO 205	TRA 1	990
195	T × (K) = 1 , 0	TRA 2	000
	GO TO 205	TRA 2	010
200	TX(K)=0.	TRA 2	1020
205	CONTINUE	TRA 2	030
	TX(9)=TX(1)+TX(7)+TX(3)+TX(9)	TRA 2	1040
	IF (IV.65.13000) TX(3)=TX(8)	TRA 2	050
	ALAH=1.7E+04/V	TRA 2	060
	IF (IEMISS-EQ.0) 30 TO 220	TRA 2	0 70
	BBIK=FF(TBBY(IK),V)	TRA 2	080
	TLNEW=(TX(9)*TX(10))/(TX(7)*TX(6))	TRA 2	090
	TSNEW=(1X(7)+TX(6))/TX(10)	TRA 2	100
	OTAU=TLOLD-TLNEW	TRA 2	110
	IF (DTAU.LT.1.0E-5.AND.TLNEN.LT.1.0E-5) GC TO 215	TRA 2	120
	SUHV=SUHV+0.5+BRIK+DTAU+(TSOLD+TSNEW)	TRA 2	130
	TLOLDETLNEW	IRA 2	140
	1 SOLUE I SNEH	IRA Z	150
210	CONTINUE	TRA 2	160
215	CONTINUE	TRA 2	170
	TAUG=0	IRA 2	180
	1F (HMIN.LE.D. 0. AND. 1L.EU.1) (AUG=1x(9)	TRA 2	140
	11=TROUND	TRA 2	2200
	99G=++(11,9)+1AUG	TOP 2	2210
	IF (HEIN.LE.U.D) SUNVESURVEBUG		220
		TRA 4	230
	$[F ([V, G(\cdot, V)]) + F ((V, F) + G)]$	TDA C	240
	IF (IV.GC.1V/) FACIURE())		2250
	SUMY=(1,0++04/V++2)+SUMV	1704 2	2250
	RAUSOM-RALSCH+DUTFAGIORTSUMV	T T T T	270
	IF (JP.EU.U) FRINI 205, V, ALAN, SUNV, SUNVA, RAUSUN, 12(3)	TO 5	2200
	IF (SUNV, FF, REDNAX) VRIPX-V	TDA C	2230
	1F LOUNT + CE ARAUMERT RAUMANENDURY	TOA 2	1000
	TE LOURVALEARAURINI VKRINAV TE LOURVALEARAURINI VKRINAV	1 KA 2	010
	TE ASOMAAFEARANDIN' KANAFANA SUMAN DADSIM IA'OV Te asomaafeearandin' kanafimi suman	1 R.A. 4	7776
2	WRLIC (1923) VINLMNISUNVISUNVISUNVIKUUUFJIKVJI TV1403-4 -TV1403	TDA S	2366
<i>~</i> 20	FA(10)-1+	15.8 4 Top 3	2360
	MO-1TV.CT TC /TV CO TV4 OD TV CO TV31 AD-0.5440	TDA 3	2160
	TL STAGENATADEDN TL STAGENATADEDN	TOP	2176
	ЭЧПИ-ЭЧЛИЧИИТЦИ ТЕ ИТЕМТЕЕ, КО 18 СО ТО 225		2340
	- 15 - 15 50 50 51 257 53 10 557 - 75 - 16 50 51 25775 75 - 2601 - 79,8184,77759, 17778,-24+1 71,77461,4	TRA 4	2100
	- II. 1019-04907 PRIIC 1096007 ATPAGRIDIA107511AIN7584497751A160733 4. TV/443	TOA 3	10.00
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c	IF (JP.50.0) WPITE (6.403) IV.ALAM.EXTING.ABSORE	TR	2410
	WRITE (7.240) IV, ALAM, TX(3), (TX(K), K=1,7), TX(10), TX(1	1) TRA	2420
	225 CONTINUE	TRA	2430
	1F (IV.GE.IV2) GO TO 230	TRA	2440
	GO TO 5	TRA	2450
	230 A8=1.0-SUMA/FLOAT(IV-TV1)	TRA	2460
	PRINT 245, IV1,TV,SUM4,AB	TRA	2470
	IF (IEMISS.EQ.1) PRINT 250, RADSUM, VRMIN, RADMIN, VRMAX	"RADMAX TRA	2480
	RETURN	TRA	2490
С		TRA	2500
	235 FORMAT (F8.1,F13.5,3E13.5,F13.6)	ŤRA	2510
	240 FORMAT(I6,11F9,4,5X,F9.4)	TRA	2520
	245 FORMAT (27H INTEGRATED ABSORPTION FROM, 15, 3H TO, 15, 7H	CM-1 =,F10.2TRA	253O
	1,23HAVERAGE TRANSMITTANCE =,F6.4)	TRA	2540
	250 FORMAT (22H INTEGRATED RADIANCE ≈,E12.5,13HWATT CH +2	SR,/7H RADMITRA	2550
	1N, F12.3, E12.5, /, EN RADHAX , F12.3, E12.5)	TRA	2560
	255 FORMAT (1+1,/10×,32H FREQ WAVELENGTH TOTAL H2C,	5X,4HCO2+,5X,TRA	2570
	164H07ONE NZ CONT 420 CONT MOL SCAT AEROSOL AEROSO	IL INTEGRATETRA	2580
	2D,12H NITRIC ACIO/11X,14H CH-1 MICRONS,8(4X,5HTRANS)	,4X,20H ABS TRA	2250
	3 ABSORPTION ,4X,5HTRANS)	TRA	5600
	260 FORMAT (1CX,16,109,4,F14,4,F9,4)	TPA	2610
	265 FORMAT (30X,F8.1,F13.6,3E13.5,F13.6)	TRA	5650
	END	TRA	2630

SUBROUTINE TREN	TRF 10
LONTRAN TRANSMITTANCE FUNCTIONS	TRF 20
COMMON /TREWFO/ TR(67), FW(67), FO(67)	TRF 30
DATA(TR(I), 1=1, 67)/	TRF 40
1 .9990, .9980, .9960, .9940, .99	320, •9900, •9800, •9700, TRF 50
2 .06009510, .9430, .9380, .93	200, .9100, .9000, .8800, TRF 60
3 .8600, .8400, .8200, .8000, .78	500, .7600, .7400, .7200, TRF 70
4 .7000, .5800, .5600, .5400, .62	200, .6000, .580C, .5600, TRF 80
5 .5400, .5200, .5000, .4800, .46	50 0, .4400, .4200, .4000, TRF 90
6 .3800, .3600, .3480, .3200, .3	000, .2800, .2600, .2400, TRF 100
7 .2200, .2000, .1890, .1600, .10	400, .1200, .1000, .0000, TRF 110
8 .0600, .0400, .0300, .0200, .03	153, .u100, .CO80, .0060, TRF 120
9 .0040, .0020, .0010/	TRF 130
DATA(FW(I), I=1, 67)/	TRF 140
1-2.3468,-2.0362,-1.6990,-1.4815,-1.3	279,-1.2007,7825,5229, TRF 150
2 3468, 1938, 0655, . 0414, . 19	553, .2430, .3324, .4838, TRF 160
3 .6128, .7?43, .8251, .9191, 1.00	000, 1.0792, 1.1461, 1.2122, TRF 170
4 1.2672, 1.3284, 1.3892, 1.4409, 1.44	955, 1.5441, 1.5966, 1.6435, TRF 180
5 1.6857, 1.7340, 1.7782, 1.8261, 1.86	592, 1,9191, 1,9638, 2,0086, TRF 190
6 2.0607, 2.1038, 2.1461, 2.1875, 2.23	304, 2.2788, 2.3263, 2.3717, TRF 200
7 2.4183, 2.4698, 2.5159, 2.5740, 2.6	284, 2.6902, 2.7559, 2.8261, TRF 210
8 2.9031, 3.0000, 3.0607, 3.1461, 3.20	041, 3.2718, 3.3054, 3.3444, TRF 220
9 3.3979, 3.4914, 3.5682/	TRF 230
DATA(FO(I), I=1, 67)/	TRF 240
1-1.6778,-1.3380,-1.1192,9508,8	239,7258,4318,2366, TRF 250
2 1074, (. 0000, .)969, .1761, .2	304, .3010, .3522, .4624, TRF 260
3 .5563, .6435, .7243, .7924, .84	573, .9191, .9731, 1.0253, TRF 270
4 1.0719, 1.1173, 1.1614, 1.2095, 1.24	480, 1.2900, 1.3263, 1.3617, TRF 280
5 1,3979, 1,4393, 1,4698, 1,4983, 1,5	314, 1,5682, 1,6021, 1,6335, TRF 290
6 1.6721, 1.7076, 1.F482, 1.7924, 1.8	325, 1.8865, 1.9395, Z.0000, TRF 300
7 2.0607, 2.1206, 2.1993, 2.2552, 2.3	185, 2.4313, 2.5185, 2.6435, TRF 310
8 2.7853, 2.9777, 3.1072, 3.2553, 3.3	617, 3.4771, 3.5563, 3.6233, TRF 320
9 3.7076, 3.8325, 3.9345/	TRF 330
RETURN	TRF 240
END	TRF 350

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	SUPROUTING AFREXT (V)	ATR	10
С		ATR	20
ř	INTERPOLATES AFROSOL EXITNETION AND ABSORFTICN COEFFICIENT	ATK	30
č	FOR THE WALENUMBER, V.	ATR	40
è.		ATR	50
•	COMMON /CARC1/ MODEL . IMAZE, ITYPE .LEN, JP. IM. M1.M2.M3.ML, IEMISS.R0	ATR	60
	1 . IBOUNF. ISEASN. TVULCN. VIS	ATR	70
	COMMON / ARE2/ H1. H2. A NGLE. RANGE. BETA. HMIN. RE	ATR	60
	COMMON /CARC3/ V1. V2. DV. AV H.CO. CH. H(15) .E (15) .CA.FI	ATR	90
	COMMUN /CNTRL/ LENST KHAX, H, IJ , J 1, J2, JHIN, JE XTRA, IL, IKHAX, NLL, NP1	ATR	\$ 0 0
	1, IFIND, NL, IKLC	ATR	110
	CONHON /HPATA/ 7 (34) .P (7.34) .T (7.34) .HH (7.34) .HC (7.34)	ATR	120
	1 SEASH (2), VULCH (5), VSB (9), HZ (15), HMIX (34)	ATR	130
	COMMON RELHUH (34), HSTOR (34), EH (15, 34), ICH (4), VH (15), TX(15)	ATR	140
	COMMON WLAY (34,15) . WPATH (58,15) . TBBY (68)	ATR	1 50
	COMMON ABSC (4,42), FXTC (4,40), VX2 (40)	ATR	160
	COMMON ZAERZ EXTV(4) + ABSV(4)	ATR	170
	CO 5 T=1.4	ATR	180
	$E \times T \times (T) = 0$.	ATR	1 90
	$A = S \times (I) = 0$	ATR	206
	5 CONTINUE	ATR	210
	IF (IHA7E.ED.0) RETURN	ATR	220
	ALAH=1.0E+4/V	ATR	230
	00 10 N=1,40	ATR	240
	XD=ALAM-VX2 (N)	ATR	250
	IF (X0) 15,10,10	A'R	260
	10 CONTINUE	ATR	270
	N= 4 D	ATR	280
	15 VXD = VX2(N) - VX2(N + 1)	ATR	290
	$00 \ 20 \ I = 1, 4$	ATR	300
	EXTY(I) = (EXTC(I,N) - EXTC(I,N-1)) * X0/VX0 + EXTC(I,N)	ATR	310
	$\Delta PSV(I) = (\Delta BSC(I,N) - \Delta ESC(I,N-1)) * X0/VX0 + \Delta BSC(I,N)$	ATR	320
	20 CONTINUE	ATR	330
	RETURN	ATR	340
	END	ATR	3 50

ě:

	SUBROUTINE HNC3 (V,HARS)	10 10
С	HI	10 20
C	HNO3 STATISTICAL BAND PARAMETERS H	NC 30
С	H	NO 40
	OIMENSTON H1(15), H2(16), H3(13)	NO 50
С	ARRAY HI CONTAINS HNOR ABS, COEF(CH-IATH-I) FROM 850 TO 920 CH-I H	NC 60
	DATA H1/2.197, 3.911, 6.154, 8.150, 9.217, 9.461, 11. 56, 11.10, 11.17, 12.4H	NO 70
	10,10,49,7.509,6.136,4.899,2.866/ N	08 OF
С	ARRAY HO CONTAINS HNCE ASS, COEF(CH-1ATH-1) FROM 1275 TO1350 CH-1 H	NQ 90
	DATA H2/2,828,4.611,6.755,8.759,10.51,13.74,18.00.21,51,23.09,21.6H	10 100
	18,21,32,16.82,16.42,17,87,14.86,8,716/	NO 110
C	ARRAY HE CONTAINS HNOT ARS, COEF (CH-1ATH-1) FROM 1675 TO 1735 CH-1 H	120
	DATA H3/5.003,8.803,14,12,19,83,23,31,23,58,23,22,21,09,26,99,25,8H	10 130
	14,24.79,17.68,9.420/ H	NO 140
	HA85 0. H	NO 150
	IF (V.GE.850, (.AND, V.LE.920.0) GO TO 5	10 160
	IF (V.GE.1275.0.AND.V.LE.1350.0) GO TO 10 H	NO 170
	IF (V.GE.1675.0. AND.V.LE.1735.0) GO TO 15 H	NO 180
	RETURN	NO 190
	5 I=(V-845.)/5. H	NO 200
	HABS=H1(I) H	0 210
	RETURN	NO 720
	10 I=(V-1270.)/5.	10 230
	HABS=HZ(I)	10 240
	RETURN	NO 250
	15 I=(V-1670.)/5. H	NO 260
	HABS=H3(I)	NO 270
	RETURN	NO 280
	END	NO 250

	010 1
UATED VACAD	(10 5
$C1 \ LOCATION \ 1 \qquad V = 350 \ CH^{-1}$	616 3
$C1 \ LOCATION \ 1770 \ V = \ 9195 \ CH=1$	C10 4
C1 LOCATION 1771 V = 9875 CM-1	C1C 5
C1 LOCATION 2355 V = 12795 CM-1	C10 6
$C1 \ LOCATION \ 2356 \ V = 12350 \ CM-1$	C10 7
C1 LOCATION 2580 W = 14520 CN-1	Cin r
	C10 C
	C 4 0 4 4
(A A C 1 I), I = 1, 1907	010 10
1 3.93, 5.72, 3.54, 3.42, 3.37, 3.37, 3.36, 3.38, 3.25, 3.13,	610 11
2 3.02, 2.96, 2.97, 3.00, 3.08, 3.12, 3.08, 3.03, 3.00, 3.01,	C1D 12
3 3.03, 3.07, 3.05, 3.01, 2.94, 2.83, 2.71, 2.62, 2.58, 2.57,	C1D 13
4 2.62. 2.67. 2.72. 2.71. 2.68. 2.46. 2.35. 2.26. 2.22. 2.23.	C10 14
5 2.40. 2.17. 2.17. 2.20. 2.26. 2.34. 2.42. 2.39. 2.20. 2.01.	010 15
2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -	C10 10
0 14769 14039 14769 1479 14619 14049 14049 14049 14719 14719	010 10
(1.39, 1.30, 1.25, 1.18, 1.19, 1.18, 1.21, 1.33, 1.47, 1.53)	U1D 1 7
8 1.54, 1.76, 1.12, .89, .69, .49, .60, .71, .79, .99,	C1D 18
9 .867 .737 .537 .437 .517 .527 .677 .737 .807 .837	C10 19
\$.80534732082129210108.	C10 20
\$.16090371373530313742.	C10 21
\mathbf{f}_{-1} (48, (1.10) (1.10	010 23
	C10 27
5 7 1 7 1 4 1 7 1 1 1 1 1 1 1 1 1 1	010 23
s = -40, -32, -21, -09, -18, -16, -19, -28, -33, -35,	C10 24
s = .26, = .27, = .10, = .05, = .11, = .13, = .27, = .27, = .18, = .06,	C10 25
\$ +119 +239 +269 +199 +119 0+009 -+099 +029 ±089 +129	C10 26
\$.22, .28, .39, .54, .68, .75, .79, .79, .71, .69.	C1D 21
\$.7688. 1.01. 1.16. 1.18. 1.14. 1.05. 1.02. 1.11. 1.23-	C10 21
e 1.61, 1.75, 1.82, 1.80, 2.85, 2.83, 2.80, 1.96, 1.96, 1.85,	C10 20
	010 23
1 1.91, 2.08, 2.24, 2.41, 2.63, 2.60, 2.67, 2.73, 2.79, 2.81,	610 33
$2^{2},91, 2.93, 3.02, 3.16, 3.23, 3.39, 3.34, 3.43, 3.57, 3.59,$	C1D 32
3 3.59, 3.58, 3.57, 3.61, 3.71, 3.71, 3.69, 3.64, 3.60, 3.68,	C1D 33
4 3.80, 3.95, 4.95, 4.95, 4.02, 3.99, 3.96, 4.01, 4.13, 4.22,	C1D 34
5 4.35. 4.49. 4.58. 4.62. 4.63. 4.61. 4.57. 4.56. 4.56. 4.53.	C1D 35
6 4.49 4.46 4.40 4.28 4.14 3.42 3.63 3.35 3.15 3.10	C10 30
7 7 26. 3 67 7 66 7 00. 7 07 6. 60. 6 06. 6 46. 6 7 07 6 7	C10 31
	010 37
8 4.35, 4.31, 4.23, 4.20, 4.24, 4.20, 4.35, 4.42, 4.42, 4.44,	610 38
9 4.46, 4.40, 4.30, 4.22, 4.13, 4.67, 4.12, 4.19, 4.22, 4.23,	C 1D 39
\$ 4.16, 4.04, 3.99, 3.94, 3.93, 3.91, 3.86, 3.83, 3.80, 3.78,	C1D 40
\$ 3.70, 3.54, 3.40, 3.30, 3.31, 3.42, 3.52, 3.52, 3.49, 3.41,	C1D 41
\$ 3.21. 3.14. 3.10. 3.08. 3.11. 2.98. 2.88. 2.78. 2.74. 2.75.	C1D 43
\$ 2.72. 2.76. 2.82. 2.85. 2.86. 2.75. 2.64. 2.60. 2.61. 2.64.	C1D 4
$ \begin{array}{c} \mathbf{a} \\ \mathbf{b} \\ \mathbf{c} \\ \mathbf$	C10 44
3 2+26, 2+49, 2+37, 2+22, 2+14, 2+00, 2+11, 2+20, 2+31, 2+20,	610 44
\$ 2.15, 7.06, 1.98, 2.03, 2.05, 1.96, 1.84, 1.72, 1.64, 1.59,	C1C 45
\$ 1.57, 1.57, 1.60, 1.63, 1.51, 1.38, 1.07, .91, .87, .92,	C1D 46
\$ 1.04, 1.01, .92, .84, .92, .97, 1.01, 1.06, 1.10, 1.06,	C1D 41
\$ 1.01, .91, .79, .55, .47, .41, .39, .38, .34, .33,	G10 4/
8 36 43 48 45 38 27 21 22 29 37/	6111 40
$ \begin{array}{c} \mathbf{D} \mathbf{A} \mathbf{T} \mathbf{A} \left(\mathbf{C} \mathbf{Y} \right) \mathbf{T} \mathbf{A} \mathbf{T} \mathbf{A} \mathbf{A} \mathbf{C} \mathbf{Y} \mathbf{A} \mathbf{U} \mathbf{Y} \mathbf{X} \mathbf{Y} \mathbf{U} \mathbf{Y} \mathbf{Y} \mathbf{Y} \mathbf{Y} \mathbf{Y} \mathbf{Y} \mathbf{Y} Y$	C10 5/
	010 90
1 + 38, + 37, + 29, + 19, + 13, + 11, + 03, - + 05, - + 12, - + 24,	610 53
2 32, 34, 43, 50, 54, 50, 73, 80, 92, -1.06,	Ç10 5
3-1.14,-1,22,-1,27,-1,28,-1,33,-1,32,-1,43,-1,51,-1,63,-1,74,	C1C 5
4-1. 32, -1. 98, -2. 09, -2. 91, -2. 21, -2. 24, -2. 27, -2. 36, -2. 512. 65.	C1D 5/
5-2.702.632.572.562.592.672.692.672.672.672.67.	610 57
f_{-2}, f_{-2}, f_{-	C10 51
U LEVELY - EMEGTATE TO TENENTS' LEUN OF TABULET LETATE LETATE LETATE LETATE LETATE LETATE LETATE LEUN - MARINE	010 51
r = b + 1 c + 1 + 0 1 + - + r 2 + - + (2 + - + -	010 5
826,19,13,11,01, .05, .08, .17, .25, .31,	C1D 50
9 6419 4439 4449 4439 4369 4359 4319 4259 4229	C1D 59
\$.21, .33, .49, .65, .76, .71, .51, .30, .13, .10.	C1D 6/
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Table A1.	Listing of	' Fortran	Code	LOWTRAN	5 (Cont.)
					0 10 0 1 /

• • • • • •							
a c1/, c/4, .31,	• 18 • • • • • •	• 5 1 ,	. 50,	•60, •FJ,	.62,	C10	610
a • b 3, • b 4, • b b ,	.69, ./6,	• () •	. 14 .	•/0, •E2,	. 5 2 ,	C10	E 20
3 40, 19, 30,	. 37, . 38,	. 42,	• 47 •	.50, .5 8 ,	. 59,	C1C	630
5 .67, .62, .64,	•68, •76,	.90, 1	11,	1.13, 1.10,	•97,	CiC	640
5 .98, 1.17, 1.38,	1.52, 1.70,	1.76, 1	. 84 ,	1.92, 1.90,	1:87;	C 1 D	650
\$ 1.91, 2.02, 2.1*,	2.10, 2.10,	2.22, 2	2.25,	2.03, 2.01,	1.77,	C10	660
£ 1.93, 2.19, 2.28,	2.14, 2.15,	2.22, 2	2.01,	2.14, 2.26,	2.36,	C10	£70
\$ 2.51, 2.66, 2.73,	2.68, 2.69,	2.64, 2	2.22,	1.95, 1.61.	1.11.	C10	6 80
£ .88, .83, .89,	1.20, 1.62,	1.82. 1	. 99.	2.01. 2.14.	2.16/	C10	690
DATA(C1(I), I= 571,	760)/	•				C10	7 00
1 2.21. 2.30. 2.3%.	2.42. 2.50.	2.51. 2	2.49.	2.46. 2.42.	2.37.	CID	710
2 2.37. 2.33. 2.31.	2.43. 2.56.	2.61. 2	.63.	2.50. 2.50.	2.34.	CID	7 20
3 2.41. 2.34. 2.31.	2.32.2.40.	2.27. 2	. 12 .	2.22. 2.09.	2.08.	010	710
4 2.17. 2.41. 2.77.	2.68. 2.49.	2.29. 2	. 21	2.42. 2.61.	2.58.	040	740
E 2.49. 2.47 2 30.	2 64 2 60	7 66 7		2 70 2 82	2 87	010	7.0
6 2.82. 2.81. 2.84.	2 86. 2 04.	2 96. 7	1 07	7 68 7 54	7 70	010	750
7 1.60. 1 67 7 60	7 66 7 64	7 6/ 7		7 66 7 67	3.301	010	700
· · · · · · · · · · · · · · · · · · ·	3 00 5 0711	5	2	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3.01,	010	774
0 54719 54009 24929	*****	4.021 4		4.12, 4.20,	4.304	610	780
9 4 22, 4 32, 4 42,	4.73, 4.04;	1.77	1.40,	4.28, 4.32,	4.30;	610	790
3 4+37; 4+24; 4+13;	4.14, 4.20,	4.25, 4	++ 32 ,	4+35, 4+31,	4.279	010	600
. 4.25, 4.27, 4.31,	4.56, 4.41,	4.52, 4		4.71, 4.79,	4.81,	C 10	e 10
\$ 4.73, 4.61, 4.42,	4.28, 4.98,	4.00, 3	3.88.	3.86, 3.92,	3.98,	C10	820
\$ 4.12, 4.18, 4.31,	4.37, 4.42,	4.50, 4	+ 53,	4.58, 4.59,	4.61,	C1C	830
\$ 4.61, 4.59, 4.53,	4.49, 4.44,	4.41, 4	··40,	4.34, 4.30,	4.26,	C10	840
\$ 4.09, 3.98, 3.87,	3,78, 3,77,	3.79, 3	5.75,	3.72, 3.62,	3.56;	C 1 D	620
\$ 3.51, 3.48, 3.32,	3.18, 3.07,	2.96, 2	2.87,	2.80, 2.68,	2.58,	C10	860
\$ 2.59, 2.51, 2.59,	2.57, 2.50,	2.42, 2	2.32,	2.20, 2.12,	2.00,	C10	870
\$ 1.92, 1.79, 1.63,	1,60, 1.69,	1.78, 2	2.04,	2.00, 1.81,	1.70,	C1 D	880
\$ 1.63, 1.61, 1.60,	1.49, 1.14,	1.35, 1	. 64,	1.69, 1.70,	1.59/	C 1 D	890
DATA(C1(I), I= 761,	950)/					C1D	960
1 1.45, 1.29, 1.19,	1.08, 1.02,	1.04, 5	i.10,	1.16, 1.20,	1.23,	C10	910
2 1.22, 1.08, 1.08.	1.0689.	.93	. 73.	.58 54 .	. 77.	C10	920
3 . 81 74 71 .	.5749.	. 43.	. 78 .	. 12 10.	.20.	C 1 D	6.30
4 .413731.	.1113.			36 39 .	33.	Č Î Ď	940
5 - 39 45 50.	5662.	68	. 77 .	64 91	1.00.	010	950
6-1.111.191.28.	-1.311.39.	-1.431		1.521.57.	1.60.	CIP	042
7-1-61-1-60-1-58-	-1.511.42.	-1.321		1.16.=1.00.	63.	010	670
P =.716152.		. 30.	. 21	- 10 - 17.	- 15	C 4 D	0 4 0
a = 13, $= 17$, $= 19$.	- 12 - 06	- 01 0		- 11 - 33	- 77	010	
7 - 4107 - 4177 - 4177 8 - 440 - 51 - 447	- 12 - 12	- 6019 6		- 70 - 77		010	40.00
0 - 49 - 70 - 40;				- + 29 y - + 27 y		010	1000
	-1+50,-1(00)	-1+00,-1	• 52 ;=	1.05, 1.19,	-1.02,	010	1010
a = 100, $a = 100$,		00, -	• 13 •		849	010	1020
a -+(U) -+>9, -+48,				- 19, -16,	64,	010	1030
a -• b2, -• 54, -• 52,	48,48,	-,42, -	• 39 ,	38,33,	29,	C1D	1040
\$75,73,22,	28,37,	50, -	.60,	60,51,	46,	C1D	109 0
5 42, 43, 45,	35 24,	··14, ·	.08,	08, 0.00,	,11,	C10	1060
\$.32, .43, .42,	.32, .23,	.22,	.28,	•45, •55,	.62,	C 1 C	1670
\$.65, .71, .75,	.80, .83,	.85,	• 87,	•90, •93,	1.00,	C1D	1080
\$ 1.04, 1.15, 1.22,	1.72, 1.31,	1.32, 1	L.33,	1.48, 1.78,	1.87/	C 1 D	1090
DATA(C1(1), T= 951,	1140)/					C10	1100
1 2.01, 1.92, 1.85,	1.89, 1.92,	1,98, 2	2.03,	2.39, 2.31,	2.48,	C 1 D	1110
2 2.70, 2.71, 2.76,	2.78, 2.70,	2.77. 3	3. D8,	2.54, 3.05,	2.94,	CID	1120
3 3.23, 3.20, 3.10,	3.32, 3.11,	3.41, 3	3 . 31 .	3.36, 3.46.	3.36,	C10	1130
4 3.39, 3.57, 3.41,	3.22, 3.19.	2.98, 2	.78.	2.98, 3.02.	2.82.	C 10	1140
5 2.98, 2.86, 2.92.	2.92, 3.05.	3.22, 3	5.60.	3.78. 3.81.	3.96.	C 10	1150
6 3.76, 3.62, 3.34.	7,08, 3.31.	3.16. 3	3. 37.	3.41. 3.30.	3.33.	CID	1160
7 3.33. 3.51. 3.48.	3.43. 3.52.	3.31. 3	3.40.	3.58. 3.61.	3.49.	C10	1170
8 3.46. 3.42. 3.19.	3.18. 3.30	3.00. 2	. 99	3.21. 3.11.	3.14.	C1D	1100
9 3.10. 2.72. 2.81.	2.95. 2.64	2.73.	. 12	7.47. 2.51	2.60.	C 1 P	1 1 9 0
\$ 2.42. 2.37. 2.73.	1.91. 1.87.	1.81. 1	.78	1.53. 1.51	1.62.	010	1200
						~ ~ ~	~

\$ 1.59.1.50.1.42.1.82.1.22.1.12.1.04.1.029792.	C 10	1210
		4 5 00
\$ +50, +87, +84, +82, +79, 475, +75, +75, +72, +71,	U10	1220
\$.71, .70, .69, .67, .61, .59, .52, .48, .41, .39,	C 1 D	1230
\$.38333230303029282726.	C 1 D	1240
	C 1 D	1200
3 -25, -23, -22, -21, -24, -10, -14, -13, -00, -01,	CID	12.70
\$03,07,11,16,21,24,29,32,38,41,	C1D	1260
\$4550546169768490971.01.	C1D	1270
	6.0	4 3 8 0
3 -1,10,1,13,-1,14,-1,22,-1,20,-1,30,-1,30,-1,30,-1,23,-1,43,	010	TCCU
\$-1.48,-1.50,-1.52,-1.67,-1.61,-1.66,-1.70,-1.72,-1.78,-1.81/	C10	1250
DATA(C1(T), T=1151, 1730)/	C10	1300
	C 10	4340
1-1.09, 1.09, 2.00, 2.00, 2.00, 0, 2.00, 2.	010	1010
2-2.61,-2.71,-2.83,-2.95,-3.10,-5.00,	C10	1320
3-5.00,-5.00,-5.90,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,	C1C	1330
A=5, 40, =5, 00, 00, =5, 00, 00, 00, 00, 00, 00, 00, 00, 00, 0	010	1340
ݤ╾ݤᡵᢕ᠐ᡁᢞݤᡵ᠐ᢔᢧᡄᠫᡵ᠐᠘ᡎ᠆ᠫᠷ᠐᠕ᡎ᠆ᠫᠷ᠐᠕ᡁ᠆ᠫᠷ᠐᠔ᡁ᠆ᠫᠷ᠐᠔ᡁ᠆ᠫᠷ᠐᠘ᡁ᠆ᠫᠷ᠐᠘ᡁ᠆ᠫᠷ᠐᠘ᡁ	010	10.00
6-5.00,	C 1 D	1360
7-5-005-00-+5-005-005-005-005-005-005-005-00-	C10	1370
	CAD	4 7 4 3
d-5,00,-5,000,-5,00,-5,000,-5,00,-5,00,-5,0000,-5,0000	010	1200
9-5.00,	C 1 0	1390
x-3,78,-3,33,-3,01,-2,82,-2,68,-2,49,-2,50,-2,13,-2,00,-1,81.	C1C	1400
$ \begin{array}{c} \bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet $	010	4410
P-T+001-T+012 -+001 -+001 -+001 -+001 -+001 -+001 -+001 -+001	010	****
\$ •.05, .08, .20, .28, .41, .54, .69, .80, .92, 1.04,	010	1420
\$ 1.19, 1.19, 1.01, .98, 1.02, 1.19, 1.29, 1.30, 1.29, 1.38,	C 1 D	1430
C + 10 + 70, 1, 62, 1, 63, 1, 70, 1, 62, 1, 66, 1, 65, 1, 63, 1, 86.	C1 D	\$ 6 6 0
	C 4 F	1.00
\$ 1.96, 1.97, 2.02, 2.01, 1.94, 1.94, 1.03, 2.03, 2.21, 2.42,	616	1420
\$ 2.30, 2.16, 2.02, 2.02, 2.02, 2.13, 1.90, 1.71, 2.01, 1.56,	C10	1460
\$ 1.56. 1.51. 1.30. 1.63. 1.64. 1.67. 1.70. 2.22. 2.39. 2.38.	C10	1470
C 3 3h 1.03. 2.79, 2.49, 2.52, 2.57, 2.21, 2.18, 2.40, 2.41.	0.10	1 6 8 0
	010	
\$ 2.45, 2.51, 2.23, 2.49, 2.30, 2.11, 2.72, 2.52, 2.13, 2.96/	610	1420
DATA (C1 (I), I=1331, 1520)/	C1 C	1500
1 2.51, 2.73, 2.62, 2.52, 2.80, 2.74, 2.79, 2.74, 2.70, 2.88,	C10	1510
2 2.81. 2.72. 2.76. 2.84. 2.92. 2.98. 2.88. 2.8H. 3.02. 3.08.	C 1D	1520
	C . D	4630
3 34209 34039 24149 4809 34039 24119 34139 34309 34319 34729	010	1920
4 3,00, 3,00, 2,74, 3,40, 3,37, 3,32, 3,00, 3,09, 3,99, 3,01,	C 1 U	1540
5 3.07, 3.07, 3.31, 3.21, 3.31, 3.67, 3.58, 3.79, 3.70, 3.49,	C 1 D	1550
6 8 86. 3.11. 3.13. 3.01. 3.10. 3.01. 3.18. 3.32. 3.63. 3.35.	C1Ð	1560
7 7 6 7 70 7 70 7 74 7 75 7 7 6 7 47 7 7 6 7 47 3 60 7 6 7	C 1 D	1670
1 3.409 1.077 3.379 3.529 3.549 3.429 3.549 0.009 3.539 3.0039	010	1.774
8 3.66, 3.48, 3.19, 1.79, 3.31, 3.41, 3.23, 3.32, 3.12, 2.91,	CID	1989
9 2.91, 2.75, 2.78, 2.72, 2.62, 2.58, 2.32, 2.22, 2.00, 1.97,	CID	1590
\$ 1.68 1.67 1.64 1.53 1.56 1.51 4.57 1.48 1.47 1.47	C 10	1600
a = 10000 1000 1000 1000 1000 1000 1000	010	4640
\$ 1.40, 1.41, 1.43, 1.50, 1.52, 1.51, 1.52, 1.39, 1.39, 1.39	010	1010
\$ 1.09, 1.16, 1.21, 1.20, 1.22, 1.20, 1.18, 1.20, 1.19, 1.17,	CID	1620
\$ 1.10, 1.10, 1.09, 1.10, 1.11, 1.04, .98, .90, .86, .90.	C10	1630
d 00 00 0c 74 70 70 71 67 57 53	C 1 D	1640
	010	1070
\$ •42, •₹1, •20, •01, -•08, -•17, -•26, -•35, -•44, -•53,	C 1 D	1650
\$63,73,83,93,-1.04,-1.14,-1.24,-1.34,-1.44,-1.54,	CiD	1660
4-1-641.741.841.942.842.142.242.342.442.54.	C1D	1670
ϕ and ϕ the system of the	C • O	1 6 80
3-2.04, -2.14, -2.04, -2.44, -3.04, -2.14, +3.24, -3.34, -3.44, -3.74,	010	1000
\$-3.64,-3.74,-3.84,+3.44,+3.44,-4.04,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-	610	1690
DATA(Ci(I),I⇔1521,1710)/	C 1 D	1700
1-5,00,-5,(0,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,	CID	1710
2 • • • • • • • • • • • • • • • • • • •	C10	1720
	0.0	4 7 3 0
3-5+80,-5-80,	610	1/30
4-5,00,+5,00,-5,00,00,-5	UΙÛ	1740
5-5,00,-5,000,-5,00,-5,000,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,000,-5,00,-5,00,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,	CiC	1750
-5.005.005.005.005.005.005.005.005.005.00.	C10	1760
(-2) (0) (-2) $(-2$	010	4770
/ ~ ? • UU ; = ? • UU ;	010	1110
8=4。15,=4。05,-7。97,=7。88,=7。79,=3。70,=7。61,=3,52,=3。43,=3。34,	C10	1780
9-3.25,-3.15,-1.07,-2.98,-2.89,-2.80,-2.71,-2.52,-2.53,-2.44,	C10	1790
M-2 TE -2 26 -) 10 -2 00 -2 00 -1 01 -1 82 -1 73 -1 66 -1 EE	C10	4.8 0.0

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Table A1.	Listing	of	Fortran	Code	LOWTRAN	5	(Cont.)	
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,	f 1	1.6	- 4	77		4	30			40			+ 0	_		n 4	_				_			-	74		_			C 4 D	48.40
1	P-1*	- 01	, - 1	• <u>• •</u>			6.64	, - 1	1.	17	,-,	1.0	10	, -	1.4	U I	• •	•	76	,	-•	• c		- •			- •	0.9	,	010	1010
1	£ ~.	261	, -	+ 47	,	~ •	38	, -	~ • i	29	, ,	••	20	,	-•	14	, '	۰.	05	,	-•	02		•	63	۶,	•	10	•	010	1020
;	š.	17	,	• 2 5		•	30,	,	•	35	,		41	,		45	,		42	,	•	40			43	,	٠	46	,	C1 C	1830
\$	ι.	50.		. 79			71		. 1	84			93		1.	01	. 1		06		1.	07		1.	02		1.	01		C10	1840
	ŧ 1.	12	. 1	. 21	1	4	ς μ.	. 1		2.8	í r	i.	34	2	Ŧ.	63	1 7		22		Ξ.	56		Ŧ.,	59	1	4.	56		C10	1850
1		E 4			,			, ,	•				2.2			20	' :		÷.	•									,	C. O	1
1		21	, I	+ 61	,	1.	្រប	, 1	•••	C U	,)	i e	02	,	1.	92		1.	94	,	1.	.04	•	1.	01		1.	47	· •	010	TCC
1	£ 1.	30,	, 1	• 2 8	•	1.	43.	, 1	L e ^s	50	, 1	Ŀ٠.	49	,	1.	55	, :	ι.	48	,	1.	. 32		1.	39		1,	53	7	C1D	1670
1	\$ 1.	8 Z -	, 2	.23	,	2.	61	, 2	2•1	51	, í	2.	20	,	1.	86	, :	۱.	61		1.	19	,	1.	32	•	1.	52	,	C1 D	1880
1	£ 1.	70.	. 1	. 90		2.	6 1	. 1	!	۹2	. 1		91		2.	12	. :	• .	10		2.			2.	18		1.	99	2	C 1 0	1890
1	DAT	411		ŤŇ	÷-	47	4.4		 	۰ ۰	γ.	• •		·			, .	•••	•••				'							C 1 D	1900
		220		***		÷.		,			΄.	•				~ •												~ 4		010	1000
	6 20	11	, 2	• 20	•	4 ک	219	, (2.03	13	, ,	< •		,	1,	A 1	,	1.	92	•	1.	31	,	1.	00	•	1,	91	. 7	010	1910
i	2 1.	91,	, 1	•92	,	1.	93.	, 1	L •]	74	1 2	i •	61	1	1.	58	, :	1.	27	,	1.	. 20	,	1.	14	1,	1.	11	,	C1D	1920
	з.	99.	,	. 86	,		71.	•	. (6 0	•		44	,		31	γ.		19			.03	,	-,	07	',		21	. 1	C10	1930
,	4	35.		. 49			64		• • •	7 q	÷ .	• •	94	. -	٩.	11	1	۱.	24		1.	41		•1 •	.57	· -	1.	73	ć,	C 10	1941
		Q 1	7				27	. - 5	۶. i	46	<u>' - 1</u>	зŤ.	63	1	5	A 4			00	<u>′</u> _	7	1.8	<i>.</i> _	. T. I	37	Ľ.,	÷.			C10	1950
1	2 7	7 4 9	,	0.0	2		47	,	- • •	12	,		10	,-	<u>,</u>	22	,-	. •	33	,		20	1	2.			2.	50		CAC	1050
	c- 3 .	12	•= <u>-</u>	• 94	, .		1.39	, -:	**	21	, - ;	••	49	, -	4,	00	1-1	* •	03	• -	<u> </u>	. 44			19		5.	20		010	1 9 01
	7-5.	00	,-5	.00	, 1	5.	00	, - :	5 e I	00	, - 5	5+	CΟ	, -	5.	06	, =:	5.	00	,-	5.	, 00	• *	-4.	εŧ	•,-	4.	26	÷ •	C10	1970
	8-3,	89	, - 3	.57	· • •	·3.	32	, -?	5	11	,-2	2.	91	,-	2.	89	, - :	2.	79	,-	2.	. 74	, -	-2.	6	í , -	2.	47	' ,	C10	1980
,	3-2.	29.	- ?	. 20		· 2 .	17.	2	2.	23	:	2.	27		2.	32	:	2.	12		2.	. 68	÷-	.2.	07	· • -	2.	07		C10	1990
	e-2.	07	1	. 98	í.,	÷ .	77	. —1		7 n	1-1	Ë.	63	í	٩.	6.0	í		59	í		43	ί.	-1.	21	: -	1.	1 5		C1 D	2000
	÷ .		, - ^										~	,	• •	~ •	· ·	• •		,										64.0	2040
	8-1.	09	, -1	•13	, -	. 7 .	<u> </u>	, -1	1	19	, .	••	90	,	- •	33	, ,	•	<u>er</u>	,	- 1	. 91	,		cc	, ,		11	• 7	CIU	2010
	5	65	, ~	• - 9	,	· •	58,	, -	~ + I	5 3	, .	••	50	,	٠.	39	, .	••	22	1	- •	14	1	~ •	0.6	,,		01	1	CIL	2020
1	s	01	, -	• 0 8	,		20	, -	•• :	16	, -	٠.	02	,		18	,	٠	32	,	•	, 42	,	•	37	' # -		23	· .	C10	2030
1	ε.	12		.15	•		28		!	43	,		59			58	,		53			44			39).		. 38		C10	2041
	ġ.	35		. 23	÷.		26.			19			08	÷.		10	1		18	2		27	1		36	1.		43	s.	CID	2051
	a i	30	,	77		Ţ	5.0	,	- 7	ŝí.	,		97	'			'.	. '	0.0	'		0.2			4.1			0.6		C1 0	2060
	: . ·	00	,	• 37	,	_*	- 0	۰.	. • '	3.0	'	. *	21	,	.*	70	'		20	*	1.4	, 02							,	010	2000
	\$ 1,	ue	, 1	+10	•	1.	16	, 1	L + -	30	,	• 1	41	,	1.	40	,	1.	32	,	1.	. 32	*	1.	. 51	•	1.	42		CID	2071
	51.	50,	, 1	• 42	•	1.	38	, 1	L e Ì	36	, 1	L e	38	,	1.	49	, 1	L.	63	1	1.	62	,	1.	62	.,	1.	,70	,	G1D	2080
	£ 1.	68	, 1	. 60	,	1.	56	, 1	۰. ۱	56	, 1	1.	63	,	1.	64	, :	۱.	56		2.	. 49	,	1.	49	1.	1.	52	27	Ç10	209
	DAT	A ((Ci (I).	Ì=	:19	01	. 20	99	0)	1																			C10	210
	4 4.	5.8	4	62	Ξ.	4.	62		i .	64	2.7	٩.	64		۹.	62		٩.	63		4.	71		۰.	7 :		1.	71	۱.	010	211
		20	' î				27			22			20	,	-		· .		54	,		1.0								C 4 0	24.94
	2 1 4	70	• -	+ 07	,	1.	50	• 1	1		,	1.4	2.0	,	1.	C (,	1.4	20	•	1.	. 43		1.4		•	1.	. 30	· •	010	616
	31.	26	, 1	• 50	,	1.	13	, 1	۰ ۱	14	, 3	1.	19	,	1.	29	,	1.	50	•	1.	12		1.	. 66	y .	1.	78	,	010	213
1	4 1 .	82 ;	, 1	• 88	,	1.	82	, 1	L e C	39	, 」	1.	99	,	2.	00	, ;	2.	14	1	2.	,04	•	2.	02	.,	Ζ,	02	,	C10	214
	51.	98	, 1	+90		1.	83	, 1	۱.,	81	, 1	۱.	72	,	1.	69		١.	59		1.	50		1.	36	5,	1.	20	, ا	C 1 D	215
,	ь.	98.		.63			43.			29			16			05			02			. 03			03	ι.		01		CIE	2160
	7	0.8	. -	.18	1		20	ί.		11		<u> </u>	06	<u> </u>		n 7	1	• .	14			21	1	-	. 0.6	1		0.6		010	2471
		40	,	4 0			4.4			÷-			1.5	· ·		1.1.	,		2.	7				•						C . D	240
	с •	10	,	• 10		•	11	,	•	ΞĔ	1	•	24	,	•	44	,	•	20	,		20	1				•	. 4 .		010	610
	9.	41	,	• 5 5	•	•	35	,	•	41	1	٠	5U	1	•	4 E	,	٠	31	,		10			. 0 (,		120),	C1C	219
	s.	21	,	. 34	,	•	36	,	•	28	,		35	,		39	,	٠	42	,		. 38	۰,	•	- 32	2,		. 30),	C10	2201
	\$.	16	, -	.01	,		23	, -	i	41		-,	52	,	۰.	48	•		58	,		61		ч,	. 48	5,	۰.	23	5,	C10	2211
3	s	03		. 21	•		36			39			47			44			40			-51			. 59			53	5.	CID	2221
	¢ .	60		. 57	1		6.4	<u>.</u>		52	1		62	1		69	<u>.</u>	1	55	2		. 61	Ľ.					26		C10	223
		11	'			•	4.0	,	. •	20	,		1.3		•	6.7	. ·	. *	66	۰.	. '		Ζ.	'			'			C + D	250
	•	11	, [• 00	,	7.	10	1	•	10	1	- 1	43		7.	52	•	٠.	00	,-		• 03		-+-	11	•		. 31	,	010	224
	₹ -1.	45	,-1	• • 9	· , •	-1.	78	, ~1	1	91	17	Ζ.	01	, -	1.	97	,-	1.	97	,-	1.	• Ç7		-1.	97	',-	· 2 (, 26	و ز	CID	22.5
	\$-2.	20	,-2	.01	•	•1 •	99.	, −ê	2	00	, −¢	2.	04	, -	2.	37	,-	2.	49	,⊸	2.	. 44	•	2	.36	5 ,-	2.	32		C10	226
1	\$ - 2 .	19	2	.10		·2.	25	2	Ζ.	16		2.	36		2.	44		2.	40		2.	. 49	۰. ۱	2.	.48		2.	. 43	5.	C10	227
	\$-2.	41	2	. 36		· 2 .	6 N		2	4 Q	i	2.	59	-	2.	68		2.	89		Ξ.	. 28		-3.	. 51	1	3.	. 7 (C10	228
	0 L.	07	, ,		· * .	5.		,	- • ·		,	. •	60	· .	2.	00	,	-•	0.0	"					í á l	Υ.				C + 0	250
	-3	31	, - 4	* 2 U			- ·		**'	-20	1,-1	֥	09	, -	2.		,-	9 e		,-	21			. 2 (e e t		3			010	667
	UAI	AL	U1 (1,1	1=	- Z 0	91	÷ 53	28	U)	1																			U10	230
	1-5.	ε0	,-9	• 00	· • -	- 5+	00	•	ž•	0 0	, -!	5.	00	,-	5.	00	, -	5.	0 Q	,-	• 5	• 00	,,	• 5	• E I	۰,	• 5	• 0 (3,	C10	231
	2-5.	00	, - 9	.00	••	· 5 •	00	• = °	5.	00	1 - 1	5.	00	,-	5	00	,-	5.	00	,-	•5 (.00	• • •	-5	. 81],-	• 5 ,	.00),	C 1 D	232
	3-5.	00	, - 5	. 20		· 5 ·	00	• - •	5.	rр		5.	00		5.	0.0		5.	00	,-	5.	. 00		- 5	. 0 (),-	-5	0),	C1C	233
	4-5-	0.0	5	. 60		- 6	nn		5.	٩ņ	العالي ا	5	0.0	í	5.	0.0	í	5.	0.0		5	. 00	1.	- 5	. c	i	5		1.	CID	234
		0.0	'_E		1		ñ ñ	1	c .	<u>.</u>		: "	n /	1	É.	0.0	'-	ć		1	ΞÉ'		٢.			· / -				C 10	276
	2724	00	,- "	+ 4 4	· * "		0.0	• - :		00	, _	7 *	00		2.	00	, -	2.	00	,-	21	• • •		21			2.	100		C 10	607
	0-2.	03	,-5	• • • •	,-		ήÛ	, - !	2.0	10	, -	• د	00	,-	5,	(1	,-	5.	20	,-	5.	• 4 (•		- 21	.,-	5.	• U f) p	010	236
1	1-2.	90	1-5	.74	· ,-	-3*	бŊ	• = i	Ζ.	46	,-	۶.	32	,-	2.	17	,-	ς.	03	,-	1.	. 87	, -	-1.	,7{	i,-	1.	74	8.9	C1 D	237
	8-1.	83	, - 1	• A2	۰, -	-1.	71	, - 1	1 🖬	59	,-	1.	49	,-	1.	46	,-	1.	46	,-	1	• 49	۱,۰	-1	. 41	3,-	1	. 2 !	5,	C1D	238
	9-1-	24	1	.06		•••	90	'	1.	ŋr.			91		•	91		1.	01		• .	. 99	÷.		. 8 7	7.	-	.92	2.	C 1 D	239
	\$ -	79		. 47			54			3 A			42			4.4			34			. 27		- 1	. 1 2	÷.	-	21	3.	010	240
					-	· · •				~ ~ ~ ~		_		-	-		-									~					

Table A1.	Listing o	f Fortran	Code	LOWTRA	AN 5	(Cont.)
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£38223008012006100614.	C10 2410
\$ -12, -02, -02, -13, -11, -10, -06, -05, -06, -10,	C1D 2420
$\mathbf{T} = 100$, $\mathbf{r} = 0.0$,	C1D 2430
a = a + a + y = -a + b + y + a + b + y = -a + b + a + b + y = -a + b + a + b + y = -a + b + y	
a = -249 = -249 = -119 = -179 = -179 = -029 = -209 = -219 = -219 = -20	010 2440
3 + .00,78,50,39,10, .09, .07, .08, .16, .21,	C1C 2490
\$ 13, 52, 15, 151, 160, 151, 140, 140, 143,	C10 2460
\$.42; .73; .43; .34; .22; .13;11;31;31;41;	C10 2470
\$ -+41,39, -+53, -+69, -+84, -+88,-1+01,+1,10,-1,19,-1,29,	C1D 2480
\$-1.45,-1.49,-1.67,-1.67,-1.51,-1.66,-1.60,-1.69,-1.83,-1.51/	C1D 2490
ΠΑ ΤΑ (C1 (I), I=228 1, 2470)/	C10 2500
1-1.42,-1.40,-1.24,-1.38,-1.31,-1.30,-1.30,-1.28,-1.39,-1.33,	C1D 2510
2-1.40,-1.35,-1.37,-1.37,-1.41,-1.49,-1.46,-1.56,-1.47,-1.46,	C10 2520
3-1, 41, -1, 42, -1, 48, -1, 41, -1, 31, -1, 15, -1, 13, -1, 20, -1, 41, -1, 88,	C1C 2930
4-2.082.082.222.352.351.981.921.781.571.69.	C1C 2540
5-1,70,*1,70, -1,66, -1,94, -1,50, -1,56, -1,42, -1,29, -1,34, -1,28,	010 2550
f = 1, 48, -1, 58, -1, 44, -1, 53, -1, 48, -1, 48, -1, 58, -1, 58, -1, 59, -1, 79	C1D 2560
$7 = 2 \cdot 10^{-1} = 2 \cdot 16^{-1} = 1 \cdot 90^{-1} = 2 \cdot 23^{-1} = 2 \cdot 10^{-1} = 2 \cdot 10^{-1$	C1D 2570
= 3 for -2	CID 2540
0 - 3, 7 - 9, 7 - 9, 14, 7 - 4, 43, -4, 7 - 9, 13, -2, 40, -2, 20, -1, 33, -2, 01, -2, 14, 0, -2, 44, -2, -2, -4, -2, -4, -2, -4, -2, -4, -4, -2, -4, -4, -4, -4, -4, -4, -4, -4, -4, -4	010 2900
9=2, 31, **, 19, -2, 01, -1, 99, -2, 14, -2, 41, -2, 12, -1, 99, -1, 84, -1, 79,	010 2590
\$-1,71,-1,78,-1,72,-1,58,-1,78,-1,52,-1,38,-1,29,-1,22,91,	C10 2600
x = -, 90, -1, 01,76,90,90,90, -1, 19, -1, 00,79,68,	C10 2610
s = .68, 73 , 85 , 85 , 61 , 61 , 48 , 51 , 92 , 83 ,	C1D 2620
\$61,41,29,29,61,74,19,18, 0.00, .19,	C1D 2630
\$10, .20, .20, .02, .20,01, .18, .28, .11, 0.00,	C1C 2640
\$ -,37, -,10, .02, .16, .20, 0.00, .09, .09, .09, .07,	210 2650
\$.22, .11, .11, .21, .09, .21, .20, .37, .28, .07,	010 2660
\$.09,79,69,69,74,88,-1.01,86,54,19,	C10 2678
\$,19, ,27, ,21, ,29, ,28, ,29, ,52, ,54, ,51, ,60,	C1C 2680
£ .40, .49, .48, .46, .49, .27, .06,33,61, -1.17/	010 2690
PATA(C1(1), T=2471, 2580)/	C10 2700
1-1.111.371.521.541.942.152.862.141.562.08.	C10 2710
2-2, $00 = -2$, $08 = -2$, $23 = -2$, $31 = -2$, 31	C1D 2720
2 = 2 = 34, $a = 2 = 1$, $a = 1$, $a = 1$, $a = 2 = 1$, $a =$	
-2 + 3 + j - 2 + 3 + j - 1 + 3 + j + 1 + 0 + j - 1 + 0 + j - 1 + 3 + j - 1 + 1 + j + 1 + 1 + 3 + 3	
	010 2740
1-1+ (0; -1+44; -1+40; -3+40; -3+40; -1; 36; -1; 36; -1; 49; -1; 35; -1; 39;	610 2750
t = 1, 23, -1, 12, -1, 12, -1, 14, -1, 30, -1, 23, -1, 23, -1, 37, -1, 30, -1, 40,	C10 27E0
(-1, 20, -1, 27, -1, 37, -1, 32, -1, 32, -1, 22, -1, 28, -1, 38, -1, 69, -2, 07,	C10 2770
8-2-42,-7-58,-2.58,-2.80,-2.58,-2.47,-1.88,-1.60,-1.26,-1.16,	C1C 2780
9-1+23,-1+10,-1+23,-1+10, -+83, -+80, -+80, -+80, -+80, -+97,	C10 2790
\$ -•97; -•91; -•92;-1•13;-1•24;-1•50;-1•89;-2•18;-2•32;-2•63;	C1D 2800
\$-3.91,-4.20,-4.49,-k.78,-5.07,-5.07,-5.07,-5.07,-5.07,-5.07,-5.07	C1D 2810
C1L=C1(L)	C1C 2820
RETURN	C1D 2830
END	C1C 2860

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Table A1.	Listing of Fortran C	Code LOWTRAN 5 (Cont.)
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	SUBROUTINE CODIA (COL,L)	020	10
С	UNIFORHLY MIXED SASES	C 5 D	20
с	C2 LOCATION 1 V = 503 CM-1	C 2 D	30
С	C2 LOCATION 1515 V = 8070 CM-1	020	40
С	C2 LOCATION 1516 V = 12950 CM-1	CZD	50
¢	C2 LDCATION 1575 V = 13245 CM-1	C 2 D	€0
	CONHON/C2/ C2 (1575)	C 2 D	70
	DATA(C2(1),1= 1, 190)/	CSU	60
	1-4, 25 , -3 , 70 , -3 , 20 , -2 , 75 , -1 , 90 , -1 , 73 , -1 , 51 , -1 , 29 , -1 , 11 , $-$, 91 ,	C 2 D	ġΠ
	2 11, 51, 30, 36, . 22, . 49, . 76, 1.00, 1.29, 1.56,	626	100
	3 1.76, 1.91, 2.68, 2.23, 2.36, 2.51, 2.72, 2.90, 3.12, 3.37,	020	110
	• 3.555, 3.559, 3.74, 3.755, 3.685, 3.655, 3.735, 3.555, 3.38, 3.17,	620	120
	7 < c < c < f < c < f < f < f < c < f < f	C20	120
	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	020	140
	/ - 1 • 00 / - 1 • 30 / - 1 • 42 / -1 • 03 / -1 • 00 / -2 • 10 / -2 • 27 / -2 • 71 / -2 • 72 / -2 • 91 /	620	150
	0 = 3 + 14 + 7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 + 10 + 7 + 00 + 00 + 00 + 00 + 00 + 00 + 00 + 00 + 00 + 00 + 00 + 00 + 00 + 00 + 00	620	170
	2 - 2 + 10 + -2 + -0 + -2 + -4 + -1 + -2 + -2 + -2 + -2 + -2 + -2 + -2	620	1 8 0
	$e^{-1}e^{-$	620	400
	$\mathbf{x} = 26 + -91 + -290 + -27$	620	200
	$s = 2 \cdot 11 + 2 \cdot 74 = 3 \cdot 104 = 3 \cdot 131 = 2 \cdot 581 = 2 \cdot 581 = 3 \cdot 121 = 2 \cdot 581 = 3 \cdot 121 = 3 $	020	210
	\$-1,13,-1,11,-1,16,-1,20,-1,23,-1,21,-1,17,-1,12,-1,15,-1,19,	čžň	220
	\$-1,20,-1,17,-1,02, -, 49, -, 65, -, 42, -, 24, -, 01, , 18, , 40,	C 2D	230
	\$.97, .77, .96, 1.07, 1.13, 1.11, 1.08, 1.15, 1.27, 1.33,	C 2 D	240
	\$ 1.449, 1.40, 1.13, .89, .63, .54, .65, .78, .81, .86.	020	250
	\$.87, .68, .47, .14,12,48,92, -1.43, -1.89, -2.32,	020	260
	\$-2.81,-5.00,-5.00,-5.00,-3.14,-2.47,-2.00,-1.71,-1.59,-1.61/	CZD	270
	DATA(C?(I), I= 191, 380)/	C 2 D	280
	1-1.f9,-1.82,-1.87,-1.90,-1.94,-2.04,-2.10,-2.23,-2.32,-2.48,	C 2 D	590
	2-2.71,-2,89,-7,09,-2.99,-2.43,-2.50,-1.69,-1.42,-*.38,-1.49,	C 5 C	300
	3-1.70,-2.01,-2.41,-2.64,-2.63,-2.49,-2.38,-2.27,-2.16,-2.05,	C2D	310
	4-1.94,-1.83,-1.76,-1.71,-1.70,-1.72,-1.81,-1.92,-2.03,-2.27,	C 2 D	320
	5-2.61;-3.21;-4.01;-5.00;-5.00;-5.00;-5.00;-5.00;-5.00;-5.00;-5.00;-5.00;	C 2 C	330
	6-5,00,-5,00-5,00,-5,00-5,00-5,00-5,00-5,00-5,000,-5,000,-5,00-5,000,-5,00-5,00-5,000,-5,00-5,000,-5,0000,-5,0000,-5,000,-5,000,-5,0000,-5,0000,-5,000,-5,0000,-5,00000000	C 2 C	340
	7-5.00, -5.00,	C 2 D	3 - 0
	8-5.00,-5.00,-5.00,-5.00,-5.00,-4.38,-3.42,-3.17,-2.98,	020	360
	9-2.83,-2.71,-2.17,-2.67,-2.68,-2.33,-2.01,-1.64,-1.32,	020	370
	\$97,75,53,59,50,523,59,89, +100,-1.25, - 4	020	380
	\mathbf{p}^{-1} , p	620	2.90
	a = 3 + 0 = 1 + 2 + 3 + 2 + 1 + 2 + -2 + 3 + 3 + 2 + 1 + 2 + 1 + 2 + 1 + 3 = 1 + 2 + 2 + 1 + 2 + 2 + 2 + 2 + 2 + 2 +	620	400
	a $0_1 0_0 0_1 0_0 0_1 0_1 0_1 0_1 0_1 0_1 $	620	410
	$\mathbf{x} = -5 \mathbf{x}_{1} = -5 \mathbf{x}_{2} = -5 \mathbf{x}_{1} = -5 \mathbf{x}_{2} = -5 \mathbf{x}$	C 2 D	420
	\mathbf{x} 1.51, 1.58, 1.68, 1.71, 1.8 - 1.61, 2.02, 2.18, 2.32, 2.50.	620	440
	\$ 2.61, 2.63, 2.81, 2.89, 2.96, 3.04, 3.14, 3.27, 3.41, 3.55,	C 2 D	450
	\$ 3.77. 3.90. 4.03. 4.72. 4.42. 4.61. 4.71. 4.73. 4.65. 4.63.	CZD	460
	\$ 4.72, 4.78, 4.79, 4.50, 3.62, 3.28, 2.79, 2.30, 1.86, 1.35/	CZD	470
	DATA(C2(1), 1= 381, 570)/	CZD	480
	1 .67,24,-1,69,-2.18,-2.01,-1,79,-1,53,-1,37,-1,20,-1,15,	010	490
	2-1.12,-1.18,-1.75,-1.26,-1.29,-1.17,-1.20,-1.32,-1.54,-1.84,	C 2 0	500
	3-2.16,-2.30,-2.26,-2.01,-1.71,-1.36,-1.06,01,01,45,	C 2 C	510
	445,47,49,46,27,31,34,49,75,-1.11,	C 2 D	520
	5-1.43, -2.01, -2.50, -2.89, -2.87, -2.74, -2.51, -2.42, -2.38, -2.39,	C 2 D	530
	6-2.40,-*.40,-2.40,-2.49,-2.43,-2.43,-2.45,-2.45,-2.53,-2.68,-2.74,	C? C	540
	7-2,82,-1,87,-2,83,-2,82,-2,79,-2,71,-2,66,-2,49,-2,40,-2,32,	C 2 D	550
	8-2,25,-2,23,-2,20,-2,19,+2,62,-1,95,-1,88,-1,84,-1,86,+1,86,	C 50	e e 0
	9-1,87,-1,83,-1,79,-1,73,-1,68,-1,64,-1, 19,-1,74,-1,79,-1.87,	C 2 C	57C
	\$-1.78,-1.63,-1.50,-1.37,-1.21,-1.00,83,69,53,41,	C2C	580
	\$3D,19,0°,04, .02, .10, .16, .18, .23, .20,	C 2 D	590
	\$.279 .269 .249 .229 .179 .129 .079 ~.019079 ~.099	C 2 D	600

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		. 1
\$.32, .72, .01, 1+12, 1+03, .67, .10,11,30,29,	C 2 C	€10
£17,08, 0.99, .09, .13, .18, .24, .27, .29, .30,	C 2 D	£20
\$.29, .26, .23, .21, .13, .09, .02,04,18,32,	C20	630
\$51,72,90,-1.18,-1.50,-1.62,-1.81,-2.04,-2.29,-2.49,	υ2C	640
\$-2.622.73.033.215.005.005.005.005.005.00.	020	650
\$-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-4.0,-3.30,-3.61,-2.63.	050	€€ 0
\$-2, \$2, -2, 09, -1, 98, -1, 94, -2, 00, -2, 14, -2, 26, -2, 20, -2, 02, -1, 82/	C20	£70
DATA(C2(1), 1 = 571, 760)	CZC	F FO
1-1, 59-1, 43-1, 38-1, 46-1, 64-1, 64-1, 60-2, 09-2, 54-2, 61-3, 64	0.2.0	660
2 - 3 + 5 + 5 + 5 + 5 + 5 + 5 + 5 + 5 + 5 +	C20	7 6 0
3 + 2 + 5 + -2 + 2 + 3 + 6 + 6 + 6 + 6 + 2 + -2 + -2 + -2 + -2	626	710
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	C20	720
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	620	770
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	020	7.0
D 3+029 ************************************	0.20	740
7 1 + 85 + 1 + 15 + 1 + 49 + 1 + 10 + 1 + 57 + 1 + 94 + 7 + 72 + 7 + 50 + 7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 +	020	750
8 3-12, 4.18, 3-17, 3-15, 3-21, 3-26, 3-19, 2-98, 2-99, 2-14,	620	760
9 1.70, 1.22, .55,27,-1.042.54,-3.00,-2.94,-2.78,-2.65,	U Z D	770
5-2.61,-2.60,-2.63,-2.60,-2.57,-2.57,-2.57,-2.64,-2.77,	020	76
\$-3,38,-1,98,-5,00-5,00,-5,000	CZO	790
\$-5,00,-5,00,-5,00,-5,50,-5,00-5,00,-5,000,-5,0000,-5,000,-5,000,-5,000,-5,000,-5,0000,-5,0000,-5,00000000	020	800
\$-5+00;+4+00;-3+73;-7+62; 3+59;-3+53;-3+56;=3+57;=3+53;=3+51;	C 2 C	č 10
\$-3+45;-3+77;-3+26;-7+21;-3+18;-3+27;-3+36;-3+60;-3+96;-5+00;	CZD	820
\$-5,00,-5,00-5,00,-5,00-5,00,-5,00-5,00,-5,00-5,00,-5,00-5,00,-5,00-5	C 2 C	8.30
\$-5•00;-5*00;	C 5 D	840
\$-5•00;-5•0;,-5•00;-5•00;-4•62;-4•07;-3•89;-3•76;-3•67;-3•56;	C 50	6=0
8-3.42, 3.35, -3.26, -3.10, -3.14, -3.11, -3.09, -3.10, -3.12, -3.23,	C 2 F	033
\$-3,30,-3,39,-3,37,-3,29,-3,14,-3,08,-3,00,-2,93,-2,89,-2,91/	C 2 D	E70
PATA(CZ(I),I= 761, 950)/	C 2 C	880
1-3,00,-3,08,-3,16,-3,3,48,-3,71,-3,98,-5,00,+5,00,-5,00,	C 2 C	890
2-5.00,-4.52,-3.98,-3.69,-3.42,-3.18,-2.95,-2.77,-2.51,-2.48,	C 2 D	900
3-2-41-2-41-2-40-2-3-80-2-34-2-2-27-2-21-2-31-2-46-2-73-	C2E	910
4-3,21,-4,13,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,	020	920
5-5+00+-5+0+0+-5+00+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+-5+0+0+0+-5+0+0+-5+0+0+-5+0+0+-0+0+-0+0+-0+0+-5+0+0+-0+0+-5+0+0+-0+0+-5+0+0+-0+0+-5+0+0+0+0	C2 D	930
6-5.005.004.134.123.993.963.973.733.513.29.	C 2 D	940
7-3-152-692-842-732-692-682-692-2-692-62-692-692-692-692-692-692-692-62-62-62-62-62-62-62-62-622	C 2 D	950
8-2-57-2-52-2-81-3-04-7-21-3-79-3-42-3-36-3-21-3-03-	620	9 0
9-2, 93, -2, 86, -2, 64, -2, 52, -2, 37, -2, 28, -2, 20, -2, 13, -2, 17, -2, 02,	6 2 D	970
-1, 96, -1, 98, -1, 78, -1, 53, -1, 54, -1, 31, -1, 20, -1, 08, -98, -98, -94,	Č 2D	980
$\mathbf{T} = -86$, $\mathbf{T} = -52$, -31 , -30 , -37 , -36 ,	020	990
\$.35 .35 .30 .462 .403 .23 -674	č20	1000
$\hat{\mathbf{x}} = (\mathbf{x}_1, \mathbf{x}_2, \mathbf{x}_3, \mathbf$	62D	1010
\$ _QA_ 1.11. 1.19. 1.24. 1.25. 1.26. 1.27. 1.51. 1.59. 1.50.	C2D	1020
= -2.07 + 2.07 + 2.07 + 1.0	620	1030
$\mathbf{c} = \mathbf{c}_1, \dots, \mathbf{c}_1, \dots, \mathbf{c}_1, \dots, \mathbf{c}_n, \mathbf{c}$	020	1040
\bullet = 2.5 = .5 = .1 = .0 = .0 = .2 = .2 = .2 = .2 = .2 = .2	C 2D	1050
Ψ = 0.77 = 0.727 A DATA TEUCH SCUT STORE SCUT SCUT SCUT STORE S	C2C	1040
8 -+4/1 - +0/19-140031-140/1702421310-24/09-34049-34039-04-24/9 	020	1000
5-3+3+5-3+21, - 054 - 44/01 / - 24/0	020	1000
UNIA(VC(1))1- 7-11140// 4-7-4/	620	1000
1 + 1 + 1 + 1 + 1 + 2 + 2 + 2 + 3 + - 1 + 1 + 1 + 2 + 2 + 3 + 2 + 2 + 2 + 2 + 2 + 2 + 2	020	1090
(-1, 0, 0, -1, +0, -1,, 1, -1, -2, 0, -1, +0, +1, +0, -1, +0, -2, -2, -2, 0, -2, -2, -2, -2, -2, -2, -2, -2, -2, -2	620	1100
$z = 5_{+} z_{+} + 7_{+} z_{+} z_{+} + 10_{+} = 5_{+} 00_{+} = 5_{+} 00_{+} = 7_{+} z_{+} + 2_{+} z$	0 4 L'	1120
	6.20	1120
$5 - 5 \cdot 00 + 7 \cdot 00 + 5 \cdot 00 + 7 \cdot 00 + 5 \cdot 00$	620	1120
$b = 5 \cdot 0 U_1 + 7 \cdot 0 U_1 + 5 \cdot 0 U_1$	020	1140
/->, UC, ->, U	020	1150
8-5+00,-5+000	020	1160
9-5,00,-5,000,-5,000,-5,0000,-5,000,-5,000,-5,0000,-5,0000,-5,0000,-5,00000000	C2 D	1170
\$-5.00,	C 2 D	1180
\$-5.00,	C 2 D	1190
\$-5+00;-5+00;-5+00;-5+00;-5+00;-5+00;-5+00;-5+00;-5+00;-5+00;	C 2 D	1200

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Table A1,	Listing	of Fortran	Code	LOWT	AN S	5 (Cont.)
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\$-5.00,-5.00,-5.005.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-	C2D 1210
\$-5.00,	C2D 1720
\$-5.005.004.914.744.614.484.404.294.173.90.	C2D 1230
8-4.733.593.623.723.733.693.313.172.612.63.	020 1240
π_{-2} (4) (4) (5) (5) (5) (5) (5) (5) (5) (5) (5) (5	C2D 1260
	020 1220
3-3-31,-3+30,-2+97,-2+04,-2+34,-2+11,-1+03,-1+50,-1+64,-1+22/	C20 12/0
HATA(G ² (1), <u>1=1141,1530</u>)/	621 1280
1-1.00;29;67;54;71;79;78;66;49;54;	C2D 1290
2 -*86,-1, 77,-2,08, -2,44,-3,46,-3,72,-3,74,-3,59,-3,22,-2,98,	C2C 1300
3-2.5/9-2.219-1.649-1.349-1.089869729619709729	CZD 1310
4 67, 57, 38, 51, 97, -1. 36, -1. 89, -2. 74, -3. 18, -4. 21,	C2D 1320
5-4.57,-4.62,-4.78,-4.87,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,	C2D 1330
6-4.934.462.993.452.992.632.302.092.022.12.	C2C 1340
7-2, 18, -2, 13, -2, 04, -1, 78, -1, 83, -2, 08, -2, 28, -2, 81, -3, 01, -3, 15,	20 1350
A = 3, 22, -3, 22, -3, 58, -3, 43, -4, 46, -4, 48, -5, 10, -	020 1360
$\Theta = \Theta$	020 4370
3 - 3 + 0 + 1 - 3 + 0 + 1 + 1 + 1 + 1 + 0 + 0	020 1270
	020 1300
8-3+36,-3+62,-3+64,-3+42,-3+73,-3+37,-3+37,-3+14,-2+14,	020 1390
5-2.52,-2.36,-2.24,-2.19,-2.32,-2.41,-2.29,-2.06,+2.00,-2.18,	CZC 1400
\$-2,47,-2,91,-3,57,-4,*3,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-4,61,	C2D 1410
\$-4.13,-3.89,-3.57,-3.30,-3.02,-2.74,-2.51,-2.20,-1.98,-1.73,	C2D 1420
\$-1.57,-1.38,-1.21,-1.11,98,87,78,60,37,18,	C2D 1430
\$04,04,06,16,18,19,23,45, -1.02, -1.97,	C20 1440
\$-2.793.714.014.204.354.584.734.815.005.00.	C2 C 1450
\$-5,00,-5,000,-5,000,-5,000,-5,000,-5,000,-5,00000000	C20 1460
	020 1470
[[[A + A + A + A + A + A + A + A + A	020 1480
$\int dx = \int dx = $	C20 1400
	020 1490
1-5.00,	626 1510
4-5,00,-5,000,-5,000,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,000,-5,000,-5,000,-5,000,-5,000	G20 1520
j-5,00,-5,00,-f,00,-f,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,	C20 1530
6-5+00;+5+30;+5+00;-4+71;+4+31;+3;\$9;+3+60;+3+50;+3+34;*3+22;	S2C 1540
7-3,23,-3,25,-3,25,-3,-24,-3,-18,-3,10,-3,07,-3,18,-3,41,-3,41,-3,42,-4,12,3,44,-3,-4,12,3,-3,-3,-3,-3,-3,-3,-3,-3,-3,-3,-3,-3	C2D 1550
8-4.68,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-5.00,-4.51,-4.18,	C2D 15E0
9-3,73,-3,48,-2,17,-2,96,-2,73,-2,63,-2,58,-2,59,-2,57,-2,49,	C2C 1570
\$-2.422.382.482.62.3.023.494.165.005.005.00.	C2D 1580
\$-5,00,-5,00,-6,00,-5,00,-5,00,-5,00,-5,00,-5,00,-4,87,-4,50,	C2D 1590
4 -4, 21, -3, 90, -1, 66, -3, 56, -3, 51, -3, 51, -3, 51, -3, 49, -3, 41, -3, 34,	C20 1600
$ \mathbf{z} = \mathbf{z} + \mathbf{z} +$	C2D 1610
$a_{-5} = 0, -5 = 0, $	020 1430
$m = 2_{+} \cup 0_{+} = -2_{+} \cup 0_{+} \cup 0_{+} = -2_{+} \cup 0_{+} = -2_{+} \cup 0_{+} \cup 0_{+} = -2_{+} \cup 0_{+} \cup 0_{+} = -2_{+} \cup 0_{+} \cup 0_{+} \cup 0_{+} = -2_{+} \cup 0_{+} \cup 0_{+} \cup 0_{+} \cup 0_{+} = -2_{+} \cup 0_{+} \cup$	
3-4,021,-4,010,-2,,rc,-2,,rc,-2,,r0,-2,(4,''2,43,-2,40,-1,43,-1,14,-1,43,-1,14	020 1030
5-1.24, 1.07 , 81 , 70 , 73 , 50 , -1.19 , -1.19 , -1.47 ,	020 1640
\$-1.57,-1.56,-1.80,-1.91,-2.04,-2.18,-2.33,-2.47,-2.61,-2.78,	C2D 1650
\$-2.97,-3,10,-3,28,-3,44,-3,63,-3,81,-3,98,-4,15,-4,32,-4,61,	C2D 1660
\$-4,71,-4,80,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-4,32/	C2D 1678
DATA(C?(I), 1=1521, 1575)/	626 1660
1=3.24,-2.59,-2.12,-1.82,-1.57,-1.34,-1.16,-1.02,82,64,	C2D 1690
2 - 48 33 15 16. 18. 21. 39. 52. 61. 72.	C20 1700
\mathbf{T}_{1} (1.17) (1.17) (1.17) (1.17) (1.17) (1.17) (1.17) (1.17)	C2C 1710
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	C20 1720
$\tau = 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1$	C20 1720
	020 1738
0-7 • 0 • 9 = 7 • 1 0 9 = 7 • 0 0 9 = 7 • 0 0 9 = 7 • 0 0 7	020 1740 070 1740
	020 1750
RETURN	C2D 1760
END	C2D 1770

	SUBROUTINE CICTA (CILIL)	Ç3D	10
C	070NF	C 3 D	20
C	C3 LOCATION 1 V = 575 CM-1	C3C	30
ι	C3 LCCATION 510 V = 3270 CH-1	C 3D	40
	CONMON /C3/ C3(540)	C 3D	50
	OATA(C(I),I= 1, 19°)/	C3C	60
	1-4,15,-3,51,-3,00,-2,54,-2,12,-1,76,-1,50,-1,21, -,86, -,49,	C30	70
	2 29, 10, .07, .12, .24, .32, :43, .52, .58, .65,	C 3 D	80
	3 .72, .79, .76, .72, .68, .64, .68, .79, .83, .83,	C 3 D	50
	4 .80, .78, .68, .56, .49, .42, .34, .25, .14, .02,	C3r	100
	514,35,51,74,88,-1.17,-1.40,-1.58,-2.11,-2.47,	C 3 D	110
	6-2,83,-3,24,-3,59,-3,34,-5,000	C 30	120
	7-5,00,-5,00,-5,00,-5,00,-5,00,-4,46,-4,00,-3,50,-3,14,-2,-8,	C 3 D	1 2 0
	8-2.41,-2.10,-1.70,-1.49,-1.20,20, .15, .35, .57, .78,	C 3 D	140
	9 .95, 1.20, 1.40, 1.65, 1.80, 1.97, 2.10, 2.21, 2.21, 2.30,	C3D	150
	\$ 2.40, 2.42, 2.58, 2.52, 2.20, 2.48, 2.54, 2.45, 2.20, 2.00,	C 30	160
	\$ 1,20, .95, .92, .00, .90, .89, .90, .92, .94, .95,	C 3 E	\$70
	\$.96, .95, .90, .40, .68, .55, .40, .30, .19, .08,	C 3 D	180
	\$02,11,22,41,56,71,89,-1.03,-1.18,-1.33,	C 3 D	190
	\$-1.60,-1.76,-1.90,-2.02,-2.21,-2.46,-2.59,-2.79,-3.00,-3.22,	C 3 D	200
	\$-3.614.165.005.005.005.005.005.005.005.005.00.	C 3 0	210
	\$-5.00,	C 3 D	220
	\$-5.00,	C 3 D	230
	\$-5.00,	C 3D	240
	\$-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00,-5,00/	C30	250
	DATA(CT(1), 1= 191, 380)/	C 3 C	260
	1-5-00-5-10-5-20-5-20-5-20-5-20-5-20-5-2	0.30	270
	2-5,00,-5,00,-5,00,-5,00,-5,00,-4,16,-3,51,-3,66,-3,41,-3,05,-2,69,	C 3 C	280
	3-2+44 - 2+19 - 2+0 3+ -1+64 -1+71+-1+56+-1+48 - 1+39 - 1+26+ -1+13+	C30	290
	497,	C 3 D	300
	5 .10,14, .05, .26,02,42,80,82,00,74,	C 3 D	310
	6 - 74 - 79 - 884 - 299 - 85 - 281 - 76 - 70 - 68 - 64	C 3 D	320
	76565727884901. 421.141.241.33.	C 3 D	330
	8-1+47-1+61+-1+771+971+98+-2+04+-2+08+-2+09+-2+05+-2+03+	C 3 U	340
	9-1-961-971-871-871-761-711-651-591-591-44-	C 3D	350
	5-1.361.281.181.08988878695949.	C 3 C	360
	\$37251710. 0.001627385775.	C 3 D	370
	\$.93, 1.11, 1.20, 1.33, 1.44, 1.46, 1.46, 1.48, 1.64, 1.58,	C 3D	380
	£ 1.49, 1.23, .66, .38,33,71,66,58,49,44,	C 30	390
	\$40,40,46,53,64,76,89,-1.01,-1.14,-1.26,	C30	400
	\$-1.40, -1.55, -1.69, -1.83, -1.08, -2.13, -2.28, -2.43, -2.64, -2.86,	C 3 C	410
	\$-3.073.283.503.723.945.005.005.805.005.00.	C 30	420
	\$-5,00,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,000,-5,00000000	C 3D	430
	\$ -5,60,-5,000,-5,00,-5,00,-5,00,-5,00,-5,00,-5,000,-5,000,-5,000,-5,00	C 3D	440
	\$ -5 -00 - 5	C 3 C	450
	DATA (C3(I), I= 381, 540)/	C 3 C	460
	1-5.00,	050	475
	2-5.005.005.005.005.005.005.005.005.005.00.	C 3D	480
	3-5+00+-5+00+-5+00+-5+00+-5+00+-5+00+-5+00+-5+00+-5+00+-5+00+	0.30	400
	4-5-60-5-60-5-60-5-20-54-16-3-97-3-77-3-58-38-38-38-37-52-75-	C 3D	€00
	5-2-44-2-12-1-85-1-57-1-30-13-07948989-	0.30	F 10
	6 - 81 77 72 68 63 53 53 48 41 34.	0.30	520
	$7 - 26_{2} - 19_{2} - 17_{2} - 18_{2} - 18_{3}$	C 3D	530
	8-2.382.977.574.165.005.005.004.163.503.63.	C3C	540
	9-3, 37, -3, 10, -2, 79, -2, 47, -2, 18, -1, 84, -1, 73, -1, 63, -1, -5, -1, 41,	C 3 P	5 5 0
	\$-1.331.251.171.091.029689878768.	C 3D	560
	\$54472712031825313947.	Č 30	570
	1 48. 49. 50. 50. 56. 46. 26. 27. 61	C 3D	6.20
	f = -55, -77 , -83 , -848 , -904 , -902 , -103 , -10	0.3.0	E C (I
	\$ •.76, •.71,69, •.67, •.66, •.65, •.66, •.66, •.67,68.	0.30	6.00
		C=0	640
	a arvy tardy tables to control to voy the voy	0.30	610
	のった。よびタービック・サイト かどタート・スワタイフォイムターキャンやターウォリビターウォリビターウォリビタークォリビター のでしゃ のでくしい	0.30	C 20
	PETION	020	E 4.0
		0.70	C 4 U 4 5 6
	END	630	C 91

Table A1, Listing of Fortran Code LOWTRAN 5 (Cont.)

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Table A1. Listing of Fortran Code L	OWTRAN 5	(Cont.)
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SL	BROUTINE CACTA			Ç40 10
r c	MMON /C4C5C8/ F431	53),C3(15)	(,C8(102)	C4D 20
С	N2 CONTINUUM			C4D 30
C C 4	LOCATION 1 V	= 2050 CH	1-1	C4D 40
C (4	LOCATION 133 V	= 2740 CM	1-1	C4D 50
04	TA(C4(I),]= 1, 1	14)/		C4D 60
1 3	.93E-04, 3.86E-04,	5.09E-04	, f.56E-04, 8.85E-04, 1.06E-03,	C4D 70
2 1	.31E-03, 1.73E-03,	2.27E-03	, 2.73E-03. 3.36E-03, 3.95E-03,	C4C 80
3 5	+46E=03, 7.19E-03,	9.00E-03,	, 1.13E-02, 1.36E-02, 1.66E-02,	C4D 50
4 1	.96E-02, 2.16F-02,	2.365-02	, 2.63E-02, 2.90E-02, 3.15E-02,	C4C 100
5 3	.40E-12, 3.665-02,	3.926-02	, 4.26E-12, 4.60E-02, 4.95E-02,	C4D 110
6 5	.30E-02, 5.65E-02,	5 - 00£ - 02	6.30E-02, 6.60E-02, 6.89E-02,	C4D 120
77	.18E-02, 7.39E-02,	7.602-62	, 7.84E-02, 8.08E-02, 8.39E-02,	C4D 130
88	.705-02, 9,1%8-02,	9.561-02	1.08E-01, 1.20E-01, 1.36E-01,	C4D 140
91	.52E-01, 1.60E-01,	1.698-01	, 1.60E-01, 1.51E-01, 1.37E-01,	C4D 150
\$ 1	.23E=01, 1.19F=01,	1.165-01	, 1.14E-01, 1.12E-01, 1.12E-01,	C4D 160
\$ 1	.11E-01, 1.11E-01,	1.125-01	, 1.14E-01, 1.13E-01, 1.12E-01,	C40 170
S 1	.09F-01, 1.07F-01,	1.025-01	, 9.90E-02, 9.50E-02, 9.00E-02,	64D 100
5 8	.65E-02, *.20E-02,	7.65E-02	, 7.05E-02, 6.50E-02, f.10E-02,	C4D 150
\$ 5	.50E-02, 4.95E-02,	4.508-02	, 4.00E-02, 3.75E-02, 3.50E-02,	C4D 200
\$ 3	.10E-02, 2.65E-02.	2.505-02	2.20E-02, 1.95E-02, 1.75E-02,	C4D Z10
5 1	.60E-02, 1.40E-02,	1.205-02	, 1.05E-02, 9.50E-03, 9.00E-03,	C40 220
\$ 6	. DOE-13, 7. COE-03.	5.5003	. 6.00E 03, 5.50E+03, 4.75E-03,	C4D 230
5 4	.00E-13, 3.75E-03,	3.50E-03	, 3.0UE-03, 2.50E-03, 2.25E-03,	C/D 240
\$ 2	.00E-07, 1.85E-03,	1.705-03	, 1.60E-03, 1.50E-03, 1.50E-03/	C4D 250
DA	TA(C4(I),I= 115, 1	33)/	,	C40 260
1 1	.54E-07, 1.F0E-03.	1.47E-03	, 1.34E-03, 1.25E-03, 1.(6E-03,	C4D 270
2 9	.06E-04, 7.537-04.	6.41E-04	5.09E-04 -04E-04, 0.36E-04,	C4D 280
3 8	.86E-04, 7.*2E-04,	1,948-04	- 1.57E-04, 31E-04, 1-02E-04,	C4E 290
4 č	.07E-05/			C4D 300
C	4H H20 CONTINUUM			C4D 310
r 05	LOCATION 1 V	≠ 2350	CH-1	040 320
C C 5	LOCATION 15 V	= 2420	CH-1	C4D 330
04	TA(C5(I).I= 1.	15)/		C4D 3-0
10	.001915.	12, .10	, .ºY, .10, .12, .15, .17,	04D 350
2	.20, .24, .28,	. 3, 3, 00/	/	C4D 360
c -	OTONE U.V. + VISI	RLE		C4C 370
C CE	LOCATION 1 V	= 130 <i>0</i> 0	CH-1	C4D 380
C CE	LOCATION 56 V	= 242.00	CM-1	C4D 390
C	0V = 200 CM-1			C4D 460
c ce	LOCATION 57 V	= 27500	CH-1	C4D 410
C CE	LOCATION 152 V	= 50000	CH-1	C4D 420
С	CV = 500 CM-1			C4D 430
04	TA(C8(I),I= 1, 1	02)/		C4D 440
1 4	.50E-03, 8.00E-03,	1.072-02	, 1.10E-02, 1.27E-02, 1.71E-02,	C4D 450
2 3	.00E-02, 2.45E-02,	3.075-02	3.84E-02, 4.78E-02, 5.67E-02,	C4D 460
3 6	.54E-02, 7.62E-02,	9.155-02	, 1.00E-01, 1.09E-01, 1.20E-01,	C 4D 470
4 1	.28E-11, 1.12E-01.	1.118-11	, 1.16E-01, 1.19E-01, 1.13E-01,	C+C 480
5	.03E-01, 9,246-02,	8.285-02	, 7.57E-02, 7.07E-02, 6.58E-02,	C4D 450
6 5	.56E-02, 4,77E-02,	4.065-02	, 3.87E-02, 3.82E-02, 2.94E-02,	C40 500
7 (.09E-02, 1.80E-02.	1.911-02	. 1,66E-02, 1.17E-02, 7.70E-03,	C40 510
5 6	.10E-0*, 8, FOE-03,	6.10E-03	, 3.70E-03, 2.70E-03, 3.10E-03,	C4C 520
9 (.55E-03, 1.98F-03.	1.405-03	. 8.255-84. 2.505-84. 0	C4D 530
\$ (0	5.61 2-14	, 2.94E=03, 7.35E=03, 2.03E=02.	C4D 540
\$ 4	.98E-92, 1.18F-01.	2.465-01	, 5.18E-01, 1.02F+00, 1.95E+00,	C40 550
\$ 1	.79E+00, 6.65E+00.	1.24E+01	, 2.20E+D1, 3.€7E+01, ₹.95E+01.	C4D 560
5 2	.50E+01. 1.26E+02.	1.682+02	, 2. C6E+ 0Z, 2. 42E+ 0Z, 2. 71E+02.	C4E 570
\$.91E+02, 3.02F+02.	3.03.+02	, 2,94E+02, 2.77E+02, 2.54E+02,	C4D 580
\$. 16E+ 12, 1.96E+02.	1.685+02	, 1.44E+02, 1.17E+02, 9.75E+01,	C4D 590
\$.65E+01, 6.04E+01.	4.62 +01	, 3.46E+01, 2.52E+01, 2.00E+01.	C40 600
2	. F75+01, 1. 70F+01.	1.002+01	. 8.80E+00, 8.30E+00. 8.60E+00/	C40 €10
้ณ	TURN			C4C 620
51	0			G4U 630
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LOWEM		Main driver program. Reads control cards.
	MDTA	Contains the data for the six model atmospheres and HNO_3 profile.
	NSMDL	For user defined model atmospheres or aerosols,
	HPROF	Sets up horizontal profiles of attenuator densities in LOWTRAN units.
	AERPRF	Sets up appropriate acrosol horizontal prefiles for model selected.
	PRFDTA	Contains the different acrosol model vertical distri- butions.
	GEO	Calculates the absorber amounts along the atmos- pheric slant path.
	ANGL	Calculates the initial zenith angle for the slant path when H1, H2 and BETA are given.
	POINT	Computes mean refractive index above and below a given altitude and finds equivalent absorber densities at the altitude.
	EXABIN	Londs the aerosol extinction and absorption coefficients for the appropriate models and boundary layer relative humidity.
	EXTDTA	Contains all the aerosol attenuation coefficients.
	PATH	For radiance calculations, saves cumulative absorber emounts along slant path.
	TRANS	Calculates transmittances and radiances for slant path.
	TRFN	Contains transmittance functions.
	AEREXT	Interpolates acrosol attenuation coefficients for values at wavenumber ν_{*}
	HNO3	Determines nitric acid absorption coefficient at ν .
	CIDTA	Contains water vapor absorption coefficients.
	C2DTA	Contains uniformly mixed gases absorption coefficients.
	C3DTA	Contains IR ozone absorption coefficients.
	C4DTA	Contains absorption data for nitrogen continuum, $4-\mu m$ water continuum and ozone UV and visible data.

Table A2. Description of LOWTRAN Subroutines

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Appendix B

LOWEM Symbols and Definitions

ABSC	Aerosol absorption coefficient
ΑÎ.ÂM	Wavelength (µm)
ANGLE	Input zenith angle (degrees)
AVW	Average wavelength used in refractive index expression
BET	Angle subtended at the earth's center as path traverses adjacent levels
вета	Total angle subtended by path at earth's center
CA	Conversion factor from degrees to radians
CO	Wavelength dependent coefficient used in refractive index expression
CW	Wavelength dependent coefficient used in refractive index expression
DUMMY	Used when $IHAZE = 7$
DV	Wavenumber increment at which transmittance is calculated
Е(К)	Equivalent absorber amounts per km at height H1
EH(1,I)	Equivalent absorber amount per km for $ m K_2O$ at level Z(I)
EH(2, I)	Equivalent absorber amount per km for $OO_2 + N_2O$ etc. at level $Z(1)$
EH(3, I)	Equivalent absorber amount per km for O_3 at level Z(I)
EH(4,1)	Equivalent absorber amount per km for N_p at level Z(I)
EH(5, I)	Equivalent absorber amount per km for $H_2^{2}O$ continuum at level Z(I), (10 μ m)

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EH(6, 1)	Equivalent absorber amount per km for molecular seatter- ing at level Z(I)
EH(7, 1)	Equivalent absorber amount per km tor aerosol 1 (0 to 2 km) at the level Z(I)
EH(8, 1)	Equivalent absorber amount per kn. for ozone (UV and visible) at level Z(I)
EH(9,1)	Mean refractive index of layer above level Z(1)
EH(10, 1)	Equivalent absorber amount per km for ${ m H_2O}$ continuum at level Z(I), (4 $\mu{ m m}$)
EH(11, I)	Equivalent absorber amount per km for nitrie acid at level Z(I)
EH(12, I)	Equivalent absorber amount per km for aerosol 2 (2 to 10 km region) at the level Z(I)
EH(13, I)	Equivalent absorber amount per km for acrosol 3 (10 to 30 km) at the level Z(I)
EH(14, I)	Equivalent absorber amount per kin for aerosol 4 (30 to 100 km) at the level Z(1)
EH(15,1)	Relative humidity * EH(7, I)
EXTC	Aerosol extinction coefficient
H1	Initial altitude (km)
112	Final altitude (km)
HMIN	Minimum altitude of path trajectory (km)
HMIX(I)	Nitric acid volume mining ratio (times 1.0 12169) at the level Z(I)
HSTOR(I)	Interpolated nitric acid volume mixing ratios
HZ(I)	Hollerith titles for visibility
I	Running integer used as altitude (level) indicator and frequency indicator
ICH	Array used to select the correct acrosol extinction/ absorption coefficients from EXABIN
IEMISS	Input control parameter determining mode of program execution (=0 for transmittance, =1 for radiance mode)
IFUND	Indicator for using subroutine ANGL
IIIVZE	Boundary layer aerosol model parameter (0 to 2 km)
IJ	Running integer used as layer indicator along the atmospheric path
IKL,O	Lower limit of layer loop (-1)
IKMAX	Upper limit of layer loop
11.	Integer indicator used to determine if the atmospheric path intersects the earth
IM	Parameter used when reading in a new atmospheric model
ISEASN	Parameter for seasonal dependence of acrosol profile
II YPE	Indicator for type of atmospheric path
IVULCN	Volcame aerosol model parameter (10 to 30 km)
IXY	Parameter for terminating program and cycling indicator

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JEXTRA	Integer indicator used when H1, H2, and HMIN are in the same layer (ITYPE=2)
JMIN	Altitude indicator for minimum height of path
JP	Print option parameter
J1	Level indicator for altitude H1
J2	Level indicator for altitude H2
KMAX	Upper limit of absorber amount loops (=15)
LEN	Parameter used for defining longest of two paths
LENST	Integer storage for parameter LEN, needed for cases run in succession
Μ	Integer used to identify required model atmosphere
ML	Number of levels in radiosonde data input (MODEL=7)
MODEL	Integer used to identify required model atmosphere
M 1	Integer for selecting temperature altitude profile for (M=M1)
M2	Integer for selecting $H_2()$ altitude profile for (M=M2)
M3	Integer for selecting O_3 altitude profile for (M (M3))
NL.	Number of levels in model atmosphere data
NLL	Equals NL-1
NP1	Value of NP for altitude H1
P(M, 1)	Pressure (mb) at level I for model atmosphere M
ы	3.141592654 that is (π)
RANGE	Path length (km)
RE	Earth radius (km)
RELHUM(I)	Relative humidity (percent) at the level Z(I)
RO	Earth radius (km) read in as input ("RE)
SEASN(ISEASN)	Hollerith titles for the season for the 2 to 30 km region
T(M, I)	Temperature (⁰ K) for model atmo s phere M at level I
TBBY(IJ)	Average temperature of the IJ layer
TBOUND	Input temperature of the boundary in ^O K
ТХ(К)	Equivalent absorber amounts per km at a given altitude obtained from POINT; also transmittance values at a given wavelength for each absorber type (K = 1, KMAX)
TX(9)	Total transmittance at frequency V
TX(10)	Absorption due to acrosol only at frequency V
VH(K)	Integral of the equivalent absorber amounts from H1 to level I
VIS	Meteorological range (km) at sea level
VSB(IHAZE)	Default meteorological range for the boundary layer aerosol model IIIAZE
VULCN	Hollerith titles for the volcanic acrosol model (10 to 30 km)
VN2	Wavelength array associated with EXTC and ABCS
V1	Initial frequency for transmittance calculation, ${ m em}^{-1}$
V2	Final frequency for transmittance calculation, cm^{-1}

W(K)	Total equivalent absorber amount for entire path
WH(M, I)	Water vapor density for atmospheric model M at level I (gm m^{-3})
WLAY(I, K)	The absorber amount for the species, K, and the atmospheric layer, I
WO(M, I)	Czone density for atmospheric model M at level I (gm m^{-3})
WPATH(IJ, K)	The cumulative absorber amount of the species, K, for the IJ layer along the atmospheric slant path
X1	Earth center distance of level I
X2	Earth center distance of level I + 1
Z(I)	Altitude at level I in km

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Appendix C

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LOWTRAN 5 Segmented Loader Map, AFGL CDC 6600

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-998 e 12/11/79 15.10.34. COMMENTS COMPUTI Table C1. Listing of Segmented Load PROCSSE VER LEVEL HARCHARE 656X I 666X I CYBER LOADER 1.5-430 కేశలుటుటుటుట్లు • • • • • • • • • • ৮৮. గుడిగాడిదిగుద కే శే శే శే శే శే శే ৮৮. భితిపిత్తిత్తిత్తి LCURAN TRE LONEY- NSYOL HPROF JGEO LEXARTY, PATH, XTRANS) NGET GLOAL CASOL CASOL HPROF JGEO JEXARTY, PATH, XTRANS) NGEOF TACLUR HARL, JEANDE JERDE ART ACTOLUR HORT JEANE, PEGTA EXAMN TUCLURE GEOFPET HEAG EXAMN TUCLURE STANK, YOUT EXAMN TUCLURE STANK, YOUT FANS TUCLURE TANK, YOUT A, COTTAI TANS TUCLURE TANK, YOUT A, COTTAI 3140 1324 F11E PROSPAM AND PLOCK ANSIGHMENTS. FIGHER FEAST TANDE THE LOAD THAND ST HE LOAD CHERANK CCHELOON HEIREN TO FILE APS TTEN TO FILE APS TTANSFER ADDRESS -- LONEN LCAD MAP - SEGMENTED LOAD. SEGLOAC CIRECTIVES. ᆹᅶᅸᄢᅻᅌᇑᆧᅂ ᇈᇭᆄᅂᄞᅝᆋᅙᄘ ᇊᇊᇊᅌᇊᆊᄿᅖᄢ ------SEGMENT - LONEM TREE DIAGRAM. იიიიი KP. HSG 8L0CK

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Table C1. Listing of Segmented Load (Cont.)

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Appendix D

Water Vapor Density and Relative Humidity in LOWTRAN

LOWTRAN requires both the water vapor density, used in calculating the molecular and continuum absorption, and the relative humidity, needed for interpolating the relative humidity dependent aerosol extinction coefficients. The user is given a choice of meteorological parameters with which to specify these quantities. The possible choices are the ambient temperature and any one of the following: relative humidity, dew-point temperature, or water vapor density. From any one of these three combinations, the program will supply the missing values of water vapor density and/or relative humidity as described in the next section.

The percent relative humidity, RH, is defined as 100 times the ratio of the ambient mass mixing ratio in to the saturation mixing ratio, m_s . The mixing ratio is defined as the ratio of the density of water vapor ρ_v to the density of the de

Therefore

$$\frac{\text{III}}{100} = \frac{\text{m}}{\text{m}_{\text{s}}} = \frac{\rho_{\text{v}}/\rho_{\text{d}}}{\rho_{\text{s}}/\rho_{\text{ds}}}$$

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where ρ_s is the saturation density of water vapor at ambient temperature and ρ_{ds} is the density of the dry air at saturation. The saturation water vapor density at a given temperature T is given by the following empirical expression. Di

$$\rho_{\rm c}(t) = \Lambda \exp(18.9\%66 - 14.9595\Lambda - 2.4388\Lambda^2) \text{ gm m}^{-3}$$

where $A = T_0^{-1}(T_0^{-1}+t)$, $T_0^{-1} = 273.15$ K, and t is in ${}^{\circ}C$. This expression was found to give a good fit to published values of saturation water vapor density over water to better than 1 percent for temperatures between $-50^{\circ}C$ to $50^{\circ}C$. D^2

The following section describes the equation used to supply the missing values of water vapor density and/or relative humidity.

1. Given: ambient temperature t in ${}^{O}C$ and relative humidity RH; find ρ_{o} .

$$\rho_{\mathbf{v}} = \rho_{\mathbf{s}}(t) \times \frac{\mathrm{RH}}{100} \times \left[1 - \left(1 - \frac{\mathrm{RH}}{100} \right) \frac{\rho_{\mathbf{s}}(t) \mathrm{R}_{\mathbf{v}} \mathrm{T}}{\mathrm{p}} \right]^{-1}$$

where R_v is the gas constant for water vapor (4.6150 × 10⁻³ mb gm m⁻³ K⁻¹), T \cdot T_o + t and P is the total pressure in mb. If the ratio of ρ_d/ρ_{ds} were to be neglected in the equation for RH, then ρ_v is given simply by

$$\rho_{_{\rm V}} = \rho_{_{\mathcal{S}}}(t) \times \frac{\rm RH}{100}$$

2. Given: ambient temperature t and dew-point temperature t_D , both in ${}^{O}C$; find ρ_{x} and RH.

The dew-point temperature ' $_{\rm D}$ is defined as that temperature at which the ambient water vapor pressure would just saturate the air. This condition gives

$$\rho_{\rm v} = \frac{T_{\rm D}}{T} \rho_{\rm s}(t_{\rm D})$$

where T and T_{D} are the ambient and dew-point temperature in K,

The relative humidity is given by

$$\frac{\mathrm{RH}}{\mathrm{100}} = \frac{\rho_{\mathrm{V}}}{\rho_{\mathrm{S}}(\mathrm{t})} \frac{\rho^{*} - \rho_{\mathrm{S}}(\mathrm{t})}{\rho^{*} - \rho_{\mathrm{V}}}$$

- D1. Selby, J. E.A., and McClatchey, R.A. (1975) <u>Atmospheric Transmidance</u> <u>From 0, 25 to 28, 5 Microns: Computer Code Lewtran 3</u>, AFCRL-TR-75-0255, AD A017 734.
- D2. List, R.J. (1968) <u>Smithsonian Meteorological Tables (6th revised edition)</u>. Smithsonian Institute Press, Washington.

where $\rho^* = P/(R_vT)$. 3. Given: t and ρ_v ; find RH

KB is calculated in the same way as in 2.
Appendix E

Subroutine DRYSTR

Subroutine DRYSTR, listed in Table E1, can be used in LOWTRAN to generate "dry" stratespheric water vapor profiles. The subroutine uses a constant mass mixing ratio for water vapor above 15 km based on a recent analysis of field measurement data by Penndorf.^{E1} In order to use this subroutine, the user should insert a call statement in the main program (PROGRAM LOWEM) immediately after line LOW1240, as follows

CALL DRYSTR

LOW 1245

A message will be printed on the output file whenever this subroutine is called giving the value of the mass mixing ratio used to generate the modified water vapor profiles.

Figures E1a and E1b show the "dry" stratospheric water vapor profiles vs altitude from 0 to 100 km and expanded profiles from 0 to 30 km calculated from subroutine DRYSTR. A mass mixing ratio of 2,6 ppmm was used.

E1. Penndorf, R. (1978) <u>Analysis of Ozone and Water Vapor Field Measurement</u> <u>Data</u>, Federal Aviation Administration, Washington, D.C., Report FAA-EE-78-29.

Table E1. Listing of Subroutine DRYSTR

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Figure E1b. Water Vapor Density Profiles vs Altitude for a "Dry" Stratosphere for the Six Model Atmospheres with the Region from 0 to 30 km Expanded

Appendix F

Comparisons of LOWTRAN with Measurements

Comparisons of LOWTRAN with measurements from previous LOWTRAN reports $^{\rm F1}$, $^{\rm F2}$, $^{\rm F3}$ are presented here for ready reference. These earlier comparisons used either the rural or average continental extinction coefficients for the aerosol models.

Figures F1 and F2 show transmittance comparisions of LOWTRAN with laboratory measurements of Burch et al^{1/4} for some important water vapor and carbon dioxide bands. It will be seen that the LOWTRAN calculations agree closely with the measured spectral transmittance.

Figure F3 shows a transmittance comparison with a sea-level measurement by Ashley et al^{F5} (General Dynamics). The measurement, made with an

- F1. Selby, J. E.A., Kneizys, F.N., Chetwyn Mr., J.H., and McClatchey, R.A. (1978) <u>Atmospheric Transmittance/Rudiance: Computer Code LOWTRAN 4</u>, AFGL-TR-78-0053, AD A058 643.
- F2. Selby, J.E.A., Shettle, E.P., and McClatchey, R.A. (1976) <u>Atmospheric Transmittance from 0.25 to 28.5 am: Supplement LOWTRAN 3B</u>, AFGL-TR-76-0258, AD A940 701.
- F3. Selly, J.E.A., and McClatchey, R.A. (1975) <u>Atmospheric Transmittance</u> from 0.25 to 28.5 μm; Computer Code LOWTRAN 3, AFCRI -TR-75-0255, AD A012 734.
- F4. Burch, D. E., Gryvnak, D., Singleton, E. B., France, W.L., and Williams, D. (1962) <u>Infrared Absorption by Carbon Dioxide</u>, <u>Water Yapor</u>, and <u>Munor</u> <u>Atmospheric Constituents</u>, AFCRL-62-698.
- F5. Ashley, G.W., Gastineau, L., and Blay, D. (1973) Private Communication.

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interferometer of ~ 4 -cm⁻¹ resolution from 1.8 to 5.4 μ m, is for a 1.3-km sealevel horizontal path.

Figure F4 shows a comparison of the calculated upward atmospheric radiance with an interferometer measurement from a balloon flight over northern Nebraska by Chaney at the University of Michigan. F6 The measurement was taken at a float altitude of 111, 700 ft. The calculated radiance used the midlatitude winter model, with a 23-km visual range, and a ground temperature of 230^{0} K.

Figure F5 shows a comparison of an interferometer measurement made from the Nimbus 3 satellite^{F7} looking down over the Gulf of Mexico with the calculated atmospheric radiance. The resolution of the interferometer was 5 cm⁻¹ as compared to the 20 cm⁻¹ resolution of LOWTRAN. Two theoretical models, the tropical and midlatitude summer, were used for comparison, as shown in Figure F7 and are displaced two divisions above and below the measured radiance for clarity. Both models assumed a 23-km visual range and used the temperature at 0 KM in the model atmosphere as the boundary temperature.

Figure F6 shows the comparison of atmospheric radiance as seen from space between the LOWTRAN calculation and measurements from the Nimbus 4 satellite¹⁷⁸ for three different geographic locations. The spectra, obtained with a Michelson interferometer of resolution 2.8 cm⁻¹, were measured over the Sahara Desert, the Mediterranean, and the Antarctic. The calculated LOWTRAN radiances used the midlatitude winter model and a ground temperature of 320° K for the Sahara; the midlatitude winter model and a ground temperature of 285° K for the Mediterranean; and an arctic winter cold r ..., 1 taken from the AFCRL Handbook of Geophysics and Space Environments into a ground temperature of 190° K for the Antarctic comparison. All three calculations assumed a 23-km visual range for aereşols.

Figures F7 through F10 show comparisons of calculated and observed atmospheric spectral radiance vs wavelength in the 8- to 14- μ m spectral region. The measurements were made on a balloon flight launched from Holloman AFB. New Mexico by Mercray et al, $^{\rm E10}$ University of Denver. The instrument used for these observations was a life grating spectrometer, operated in the first and second order of the grating. The resolution was 0.03 μ m in the 8- to 14- μ m region. The data in these figures are presented as a function of altitude and as a function of zenith angle. The LOWTRAN radiance calculation used the pressure, temperature, ozone, and nitric acid profiles from the Murcray report, $^{\rm E10}$ and the midlatitude winter water vapor profile contained in LOWTRAN.

Because of the large number of references cited above, they will not be listed here. See References, page 233.



Figure F1. Representative Absorption Curves for the 6.3- μ m H₂O Band



Figure F2. Comparison of LOWTRAN Calculations and Burch et al F4 Calculations for CO $_2$ Bands at 4.3 μm and 15 μm



Figure F3. Comparison Between LOWTRAN and General Dynamics Measurements; Range = 1.3 km at Sea Level



Figure F4. Comparison Between LOWTRAN Predication and University of Michigan Balloon Measurement of Atmospheric Radiance over Northern Nebraska



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Figure F5. Comparison Between LOWTRAN Prediction and NIMBUS 3 Satellite Measurement of Atmospheric Radiance over the Gulf of Mexico



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Figure F6. Comparison Between LOWTRAN Predictions and NIMBUS 4 Satellite Measurements of Atmospheric Radiance over the Sahara Desert, the Mediterranean, and the Antarctic

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Figure F7. Sample Spectrum of Short Wavelength Region Observed at an Altitude of 9.5 km and a Zenith Angle of 63° on 19 February 1975, and LOWTRAN Comparison



Figure F8. Sample Spectrum of Short Wavelength Region Observed at an Altitude of 13.5 km and a Zenith Angle of 63° on 19 February 1975, and LOWTRAN Comparison







-- MURCRAY LT AL, HOLLOMAN AFB, NEW MEXICO,

Figure F10. Sample Spectrum of Short Wavelength Region Observed at an Aititude of 24.0 km and a Zenith Angle of 63° on 19 February 1975, and LOWTRAN Comparison

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References

F1. Selby, J.E.A., Kneizys, F.X., Chetwynd Jr., J.H., and McClatchey. R.A. (1978) <u>Atmospheric Transmittanee/Radiance: Computer Code LOWTRAN 4</u>, AFGL-TR-78-0053, AD A058 643.

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- F2. Selby, J. E.A., Shettle, E. P., and McClatchey, R.A. (1976) <u>Atmospheric</u> <u>Transmittance from 0.25 to 28,5 μm</u>: Supplement LOWTRAN <u>3B</u>, AFGL-TR-76-0258, AD A040 701.
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