2 mif

SQT

Copy No.
503

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

EARTH RESOURCES LABORATORY

@

MTF

A RADIATION MODEL FOR CALCULATING ATMOSPHERIC CORRECTIONS TO REMOTELY SENSED INFRARED MEASUREMENTS

VERSION II

by

Robert D. Boudreau

(NASA-TM-X-69939) A RADIATION MODEL FOR CALCULATING ATMOSPHERIC CORRECTIONS TO REMOTELY SENSED INFRARED MEASUREMENTS, VERSION 2 (NASA) ~~111~~ 110 p HC $8.75 CSCL 14B G3/14

N74-18095

Unclas 31666

September 1973

Report No. 053

LYNDON B. JOHNSON SPACE CENTER

A RADIATION MODEL FOR CALCULATING ATMOSPHERIC CORRECTIONS TO REMOTELY SENSED INFRARED MEASUREMENTS

VERSION II

Robert D. Boudreau

Principal Investigator

September 1973

Report 053

I

ACKNOWLEDGMENTS

The programming of the radiation model described here was done in its entirety by Messrs. James Halbach and Ron Clark of the Lockheed Electronics Company. Messrs. Paul Nichols and McKinley Jefferson of the Lockheed Electronics Co. and Mr. Andy Combs prepared the figures for this report. Ms. Jo Ann Sperry typed the manuscript.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

A numerical model is developed which calculates the atmospheric corrections to infrared radiometric measurements due to absorption and emission by water vapor, carbon dioxide, and ozone. The corrections due to aerosols are not accounted for. The transmissions functions for water vapor and carbon dioxide are those given by Davis and Viezee (1964). The transmission function for ozone is that given by Moskalenko (1969). The model requires as input the vertical distribution of temperature and water vapor as determined by a standard radiosonde. The vertical distribution of carbon dioxide is assumed to be constant. The vertical distribution of ozone is an average of observed values. The model also requires as input the spectral response function of the radiometer and the nadir angle at which the measurements were made. A listing of the FORTRAN program is given with details for its use and examples of input and output litsings. Calculations for four model atmospheres are presented to illustrate the nature of the atmospheric correction for a variety of atmospheric conditions and for two different radiometers.

INTRODUCTION

The infrared radiometers used on aircraft and satellites to determine the surface temperature of the earth sense radiation in the most transparent parts of the absorption spectrum of a cloudless, dustless atmosphere. Presently, the most used part of the spectrum is the 800 - 1200 cm^{-1} wavenumber (8-14μm) atmospheric "window". This window is somewhat dirty due mainly to absorption by water vapor, carbon dioxide, ozone and aerosols (haze, smog, pollution, etc.). Most clouds are so highly absorbing (McDonald, 1960) as to make infeasible the detection of radiation from the earth's surface through the clouds. When viewing clouds the radiometer essentially measures cloud top temperatures. For a comprehensive treatment of the absorption characteristics of the atmosphere, the reader is referred to Goody (1964).

In order to ascertain surface temperature from the radiance measured by the radiometer, the absorption and emission by water vapor, carbon dioxide, ozone and aerosols must be accounted for. This report describes the second version (Boudreau, 1972) of a computerized model which is being developed for calculating the atmospheric corrections to radiometric measurements made in the 800 - 1200 cm^{-1} window. The atmospheric correction is defined as the difference between the actual temperature and the temperature as determined remotely by radiometer. This model is written in FORTRAN IV and calculates the atmospheric correction due to water vapor, carbon dioxide, and ozone only. The transmission functions for water vapor and carbon dioxide are taken to be those given by Davis and Viezee (1964). The transmission function for ozone is that given by Moskalenko (1968, 1971).

The vertical distribution of temperature, water vapor, carbon dioxide and ozone must be specified for the model from the surface to the altitude for which the correction is to be calculated. The variation in the vertical distribution of carbon dioxide is small and assumed to be constant at 330 ppm. An average vertical distribution of ozone for 20°N given by Hering and Borden (1964) and shown in Fig. 1 is used since ozonesonde observations are not readily available. The model accepts as input the vertical distribution of temperature and water vapor as determined by a standard radiosonde. The model assumes that relative humidity is 10% when the humidity is low enough to cause "motorboating" to be reported in the radiosonde. Above the highest altitude for which measurements have been made by radiosonde and to a pressure altitude of 1 mb, the model uses the temperature structure from average soundings for 30°N which are given by Valley (1965). For the months of May through October and November through April, the 30°N soundings for the months of July and January, respectively, are used. The distributions for 30°N are used in the model since the model will be applied to remotely sensed data taken around that latitude, but it may be modified easily to incorporate other distributions.

The water vapor profiles used for the upper atmosphere are those proposed by Clark (1973) based on the work of Goldman, et al., (1973), Mastenbrook (1971), McKinnon and Morewood (1970), Murcray et al., (1969), and Scholtz et al., (1970). Two water vapor profiles are used: a summer profile for the months of May through October and a winter profile for the months of November through April. These profiles are shown in Fig. 2.

Since measurements of the vertical distribution of aerosol concentration and composition are not usually available and since the transmission

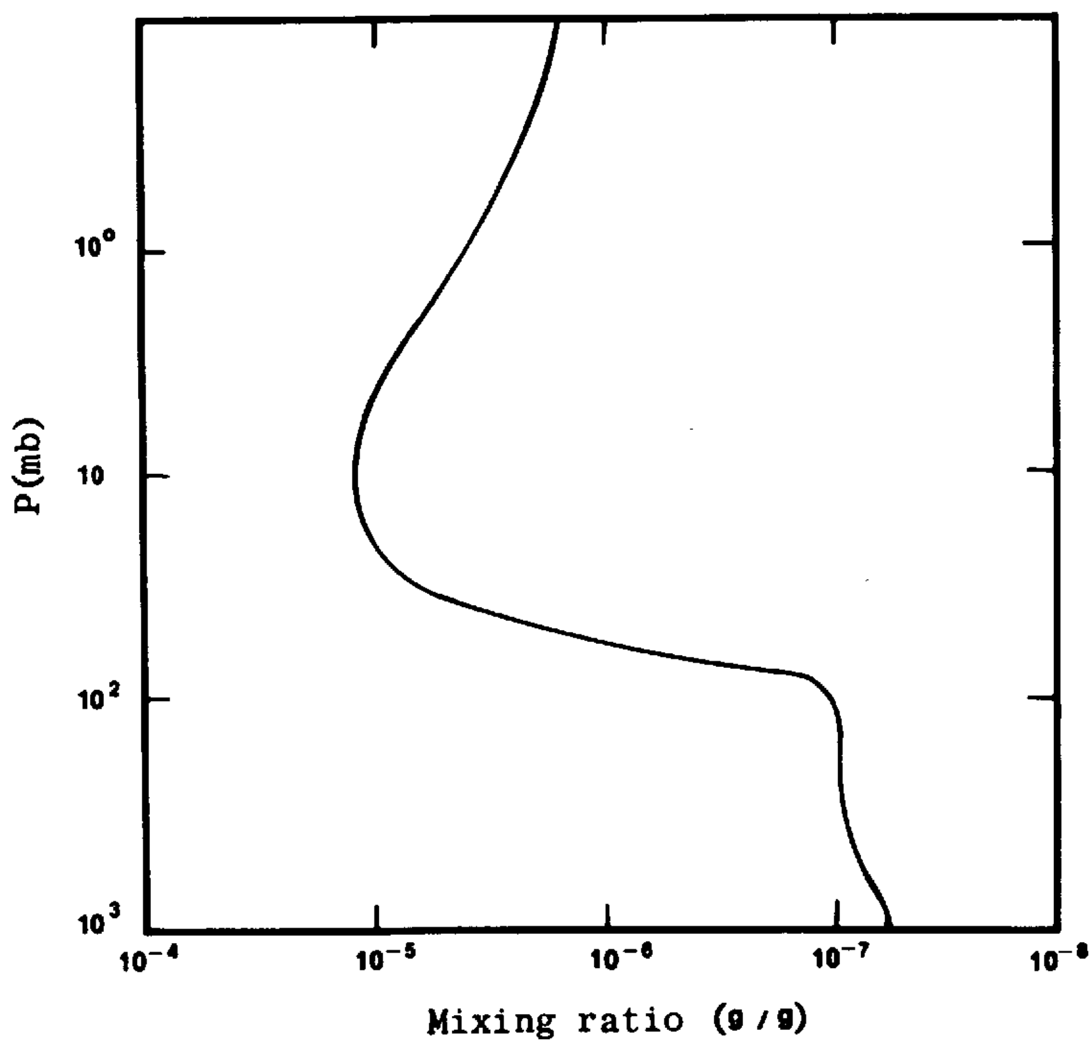


FIG. 1. Vertical distribution of ozone mixing ratio for 30° N (after Hering and Borden, 1964).

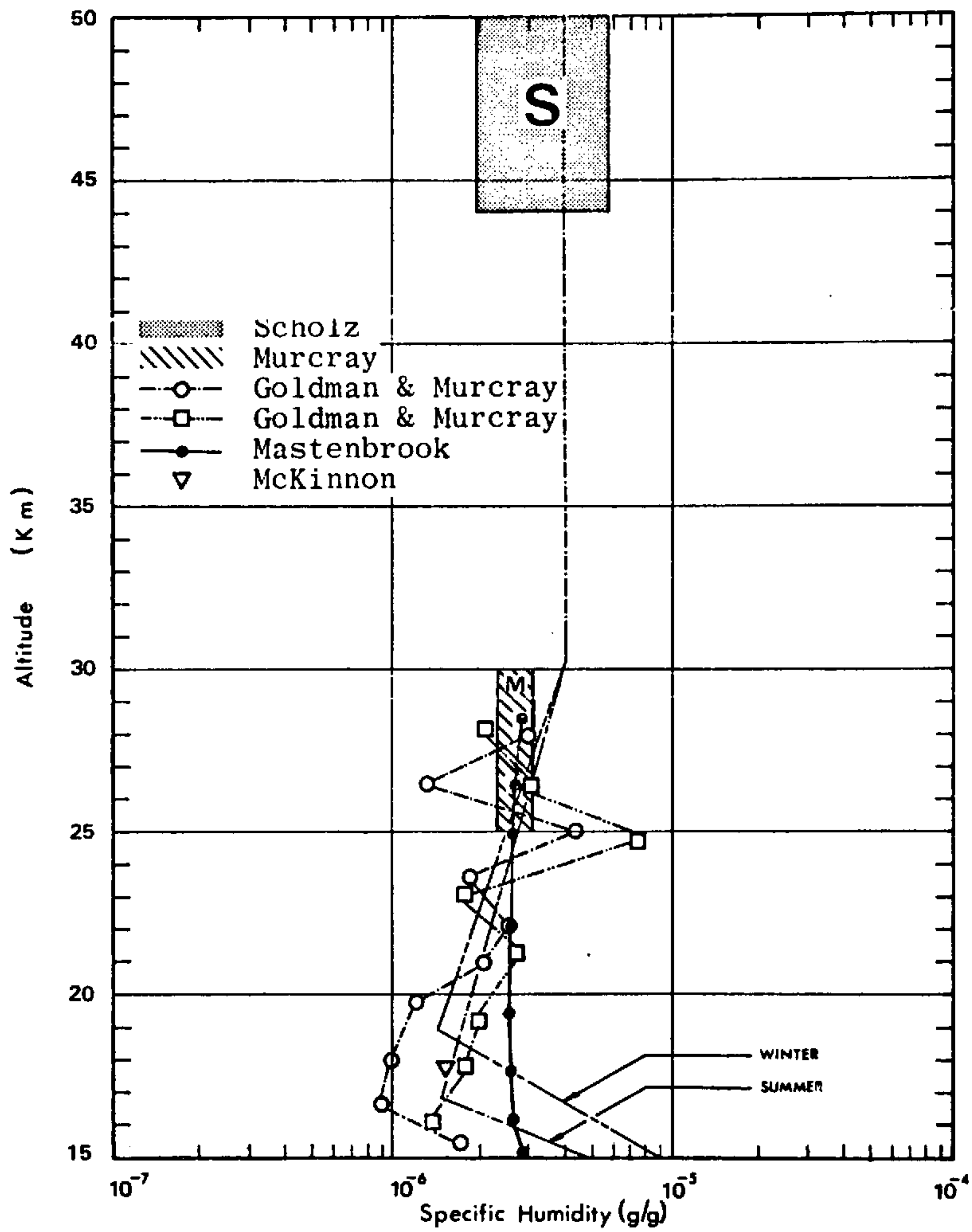


Fig. 2. Proposed average water vapor profiles for the upper atmosphere for summer and winter (from Clark, 1973).

functions for aerosols are not well known, the model at this stage of development does not include the atmospheric correction due to aerosols. The present model was developed in part to study the effects of aerosols on remotely sensed infrared data. The difference between the actual atmospheric correction determined from a remote sensing experiment and the calculated atmospheric correction given by the model described here for the same experimental condition would be due mainly to aerosols. Hence, the gross aerosol correction can be studied empirically using this model.

The atmospheric correction is specific to each radiometer, being a function of the radiometer's spectral response function, which describes the variation in the radiometer's response across the spectral band of 800 - 1200 cm^{-1}. Therefore, the model also requires as input the spectral response function of the radiometer for which the atmospheric correction is being calculated.

DEVELOPMENT

Radiometrically determined temperature. If no atmosphere were present, an infrared radiometer at altitude z would detect a radiance, D_O, expressed by

$$D_O = \int_{\nu_1}^{\nu_2} \gamma(\nu)S(\nu,\theta,T_S)d\nu, \tag{1}$$

where ν is wavenumber, $\gamma(\nu)$ is the radiometer's response function, ν_1 and ν_2 are the limits within which $\gamma(\nu)>o$, $S(\nu,T_S)$ is the radiant intensity leaving the earth's surface, T_S is the surface temperature of the earth, and θ is the nadir angle at which the radiometer is veiwing the earth's surface. Eq. (1) and the equations for radiance which follow implicity express the radiance integrated over the solid angle viewed by the radiometer.

Surface temperature may be obtained from measurements of D_O as follows. Eq. (1) may be written as

$$D_O = \gamma S(\nu_O,\theta,T_S)\Delta\nu, \tag{2}$$

where ν_0 is defined such that

$$S(\nu_O,\theta,T_S) = \int_{\nu_1}^{\nu_2} S(\nu,\theta,T_S)d\nu/(\nu 2-\nu 1), \tag{3}$$

$$\gamma = \int_{\nu 1}^{\nu 2} \gamma(\nu)S(\nu,\theta,T_S)d\nu \Big/ \int_{\nu 1}^{\nu 2} S(\nu,\theta,T_S)d\nu, \tag{4}$$

and

$$\Delta\nu = \nu_2 - \nu_1. \tag{5}$$

Assuming that the earth is a black-body radiator, we take

$$S(\nu,\theta,T_S) = B(\nu,T_S) = a\nu_0{}^3/[\exp(b\nu_0/T_S)-1], \tag{6}$$

where $a = 8.9349 \times 10^{-13}$ cal $cm^2 sec^{-1} ster^{-1}$ and $b = 1.4385$ cm deg. The use of (6) in (2) allows us to solve for T_S,

$$T_S = b\nu_0/\ln((\gamma\Delta\nu a^3{}_0\ /D_0)+1). \tag{7}$$

The surface temperature determined by this method is referred to as an equivalent blackbody temperature or a brightness temperature since it is not the actual surface temperature unless the surface radiates as a blackbody.

Sensing through a horizontally homogeneous atmosphere at a nadir angle θ, a radiometer at height, w_r, detects a radiance, $D(w_r)$, given by

$$D(w_r) = \int_{\nu 1}^{\nu 2} \gamma(\nu) \left[\int_0^{w_r} B(\nu,w)\frac{\partial\tau}{\partial w}(\nu,(w_r-w)f(\theta))dw + B(\nu,T_S)\tau(\nu,w_r f(\theta)) \right] d\nu, \tag{8}$$

where τ is the transmissivity of the atmosphere, $B(\nu,w)$ is the Planckian function given by (6), $f(\theta)$ a function which accounts for the increased atmospheric path length when viewing at nadir angle θ (if a flat earth is assumed, $f(\theta) = \sec\theta$), and height, z, is expressed in terms of precipitable water, w. The relation between height and precipitable water is given by

$$w = \int_0^z \rho dz/\rho', \tag{9}$$

where ρ and ρ' are the density of water vapor and liquid water, respectively. The Planckian function, $B(\nu,w)$, can be expressed as a function of w because atmospheric temperature, $T=T(w)$. A derivation of (8) is given by Boudreau (1968).

Spherical earth geometry. Due to its spherical shape, the earth appears as a disk below the aircraft or satellite. The edge of the disk is located at a nadir angle, θ', which with the help of Fig. 3 is seen to be given by

$$\theta' = \arc \sin (R/R+H) \tag{10}$$

where R = 6370 km, the radius of the earth, and H is the altitude of the sensor. Hence, we only need concern ourselves with data taken at $\theta < \theta'$. For $\theta < \theta'$, the path length, ds, at z is given by Wark, et al., (1963) as

$$ds = [(R+z)m_z dz]/[(R+z)^2 m_z^2 - m_0^2 (R+z_0)^2]^{1/2}, \tag{11}$$

where n_z and n_0 are the indices of refraction of air at z and the surface, respectively, and z_0 is the minimum height of the refracted ray. Now, n_z and n_0 are obtained from the formula

$$n = 1 + CP/T \tag{12}$$

where P and T are air pressure (mb) and temperature (K) and

$$C = 77.526 \times 10^{-6} \text{ K/mb}. \tag{13}$$

z_0 is obtained from Eqs. (2) and (4) of Wark et al., (1963), i.e.,

$$z_0 = ((R+z)\sin\theta)/n_0 - R. \tag{14}$$

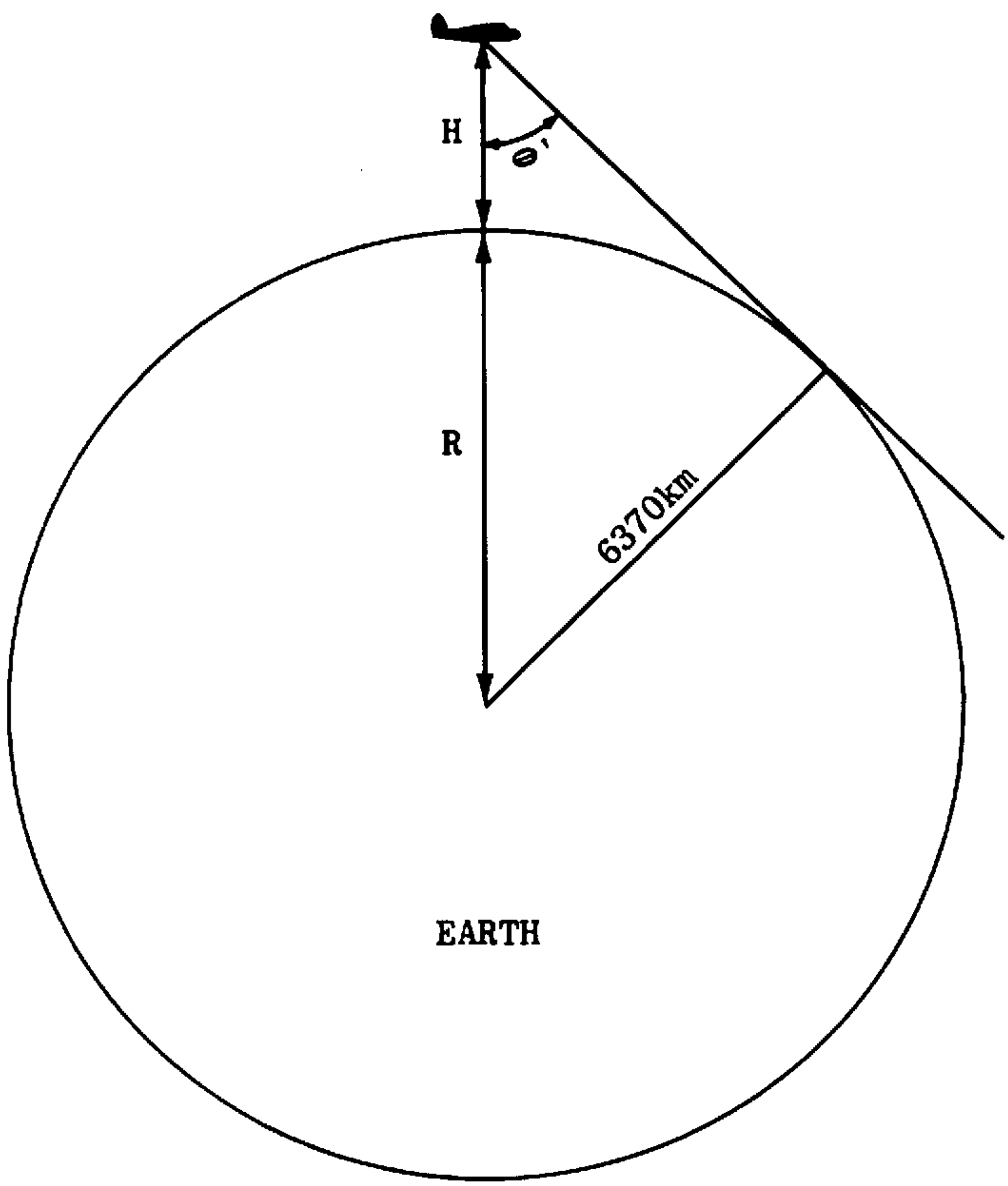


FIG. 3. The earth as seen from an altitude, H.

Transmissivity functions. The transmissivity, τ_w, of water vapor for wave number intervals of 25 cm^{-1} in the 800 to 1200 cm^{-1} window is given by Davis and Viezee (1964) as

$$\tau_w(\Delta\nu, w) = \exp\{-[L(\nu)wP]^{b(\nu)}\}. \tag{15}$$

Occasionally it is required to calculate atmospheric corrections for an instrument that has a response that extends slightly beyond the 800 to 1200 cm^{-1} window. Outside the 800 - 1200 cm^{-1} window, Davis and Viezee (1964) give the following transmissivity functions. For water vapor transmissivity at $\nu < 800$ cm^{-1},

$$\tau_w(\Delta\nu, w) = \exp\{-AL(\nu)w(1+3.17AL(\nu)w/P)^{-0.5}\}, \tag{16}$$

in which

$$A = [0.76+(0.58+0.48P^2)^{0.5}]\ P^{-0.1}(T/T_0)^{b(\nu)}. \tag{17}$$

For water vapor transmissivity at $\nu > 1200$ cm^{-1},

$$\tau_w(\Delta\nu, w) - \exp\{-BL(\nu)w(1+4.9BL(\nu)w/P)^{-0.5}\}, \tag{18}$$

in which

$$B = [1.18+(1.38+0.48P^2)^{0.5}]P^{-0.15}. \tag{19}$$

For carbon dioxide transmissivity at $550 \le \nu \le 800$ cm^{-1},

$$\tau_c(\Delta\nu, w_c) = \exp[-0.4P^{0.8}\{[ck(\nu)w_c+1]^{0.5}-1\}], \tag{20}$$

where

$$c = (0.87+P^{0.8})P^a(T/T_0)^{c(\nu)} \tag{21}$$

and

$$a = 1.2 - 0.15 \log P. \tag{22}$$

In (15) through (22), $P = p/1013.2$, where p is pressure in millibars, $T_0 = 273.16$K, w_c is the optical path in atmos-cm of carbon dioxide, and values of $L(\nu)$, $k(\nu)$, $b(\nu)$, and $c(\nu)$ for increments of $\Delta\nu$=25 cm^{-1} are listed in DECK 3, BLOCK DATA PROGRAM of the FORTRAN program given in the Appendix.

The transmissivity, $\tau_0(\delta\nu, w_0)$ of ozone for irregular wave number intervals of $\leq$ 10 cm^{-1} in the 602-847, 965-1175, 2000-2180 cm^{-1} bands is given by Moskalenko (1969, 1971)

$$\tau_0(\delta\nu, w_0) = \exp[-\beta(\nu) w_0^{m(\nu)} P^{n(\nu)}], \tag{23}$$

where w_0 is the optical depth of ozone and values of $\beta(\nu)$, $m(\nu)$ and $n(\nu)$ for $\delta\nu \leq$ 10cm^{-1} are listed in DECK 3, BLOCK DATA PROGRAM of the program given in the Appendix.

The ozone transmissivity is specified for $\delta\nu \leq$ 10cm^{-1} and is matched to the 25cm^{-1} intervals of the water vapor transmission as follows. The ozone transmissivity, $\tau_0(\Delta\nu, w_0)$, for the 25^{-1}cm intervals is taken to be Planckian - weighted transmissivity of the $\delta\nu$ intervals,

$$\tau_0(\Delta\nu, w_0) = \int_{\nu'}^{\nu''} B(\nu,T)\tau_0(\delta\nu, w_0)d\nu \Big/ \int_{\nu'}^{\nu''} B(\nu,T)d\nu, \tag{24}$$

where $\Delta\nu = \nu'' - \nu'$, the 25cm^{-1} interval of water vapor. The relationship between $\Delta\nu$ and $\delta\nu_k = \nu_{k+1} - \nu_k$ is shown in Fig. 4. Eq. (24) is calculated as (ommitting the w_0 symbolism for symplicity)

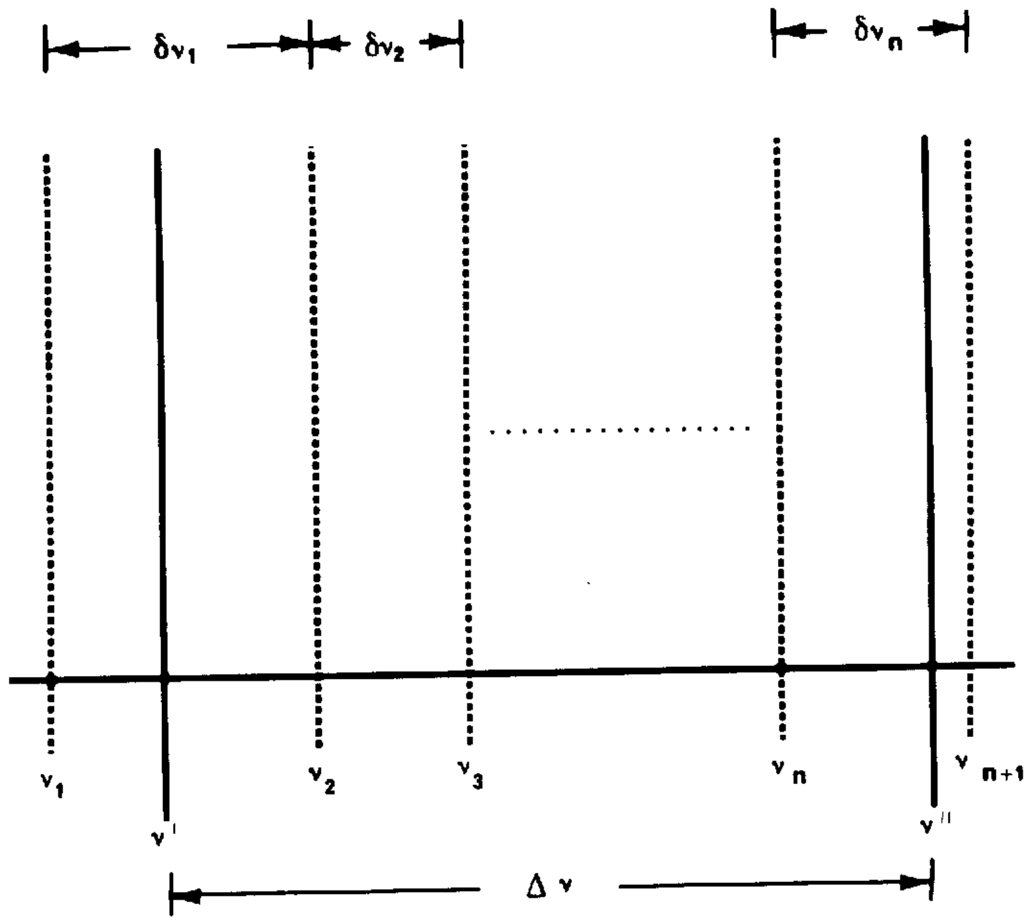


FIG. 4. The relationship between the irregularly-spaced ozone intervals, $\delta\nu_k$, and the larger ($25cm^{-1}$) water vapor intervals, $\Delta\nu$.

$$\tau_o(\Delta\nu) = \frac{1}{M}[B_1(T)\tau(\delta\nu_1)(\nu_2-\nu') + B_2(T)\tau(\delta\nu_2)(\nu_3-\nu_2)$$

$$+ \cdots + B_m(T)\tau(\delta\nu_m)(\nu''-\nu_m)], \tag{25}$$

in which

$$M = B_1(T)(\nu_2-\nu') + B_2(T)(\nu_3-\nu_2) + \cdots + B_n(T)(\nu''-\nu_n), \tag{26}$$

$$B_1(T) = B((\nu'+\nu_2)/2,T), \tag{27}$$

$$B_k(T) = B((\nu_k+\nu_{k+1})/2,T), \tag{28}$$

$$B_n(T) = B((\nu_n+\nu'')/2,T). \tag{29}$$

Since the highest ozone concentration are found in the stratosphere, an average T = 240°K is used in calculating (25) - (29).

Water vapor, carbon dioxide, and ozone radiate mutually in some bands in the spectrum. For these bands, the transmissivity is taken to be the product of the individual transmissivities, i.e.,

$$\tau = \tau_w(\Delta\nu,w)\tau_c(\Delta\nu,w_c)\tau_o(\Delta\nu,w_o). \tag{30}$$

outside the mutual bands, τ is taken to be τ_w.

Numerical model. We solve a numerical analog to (8) since is can not in general be solved in closed form. In finite difference notation, (8) may be approximated as

$$D(w_m) = \sum_{j=1}^{n} \gamma(\nu_j)\left[\sum_{i=1}^{m-1} B(\nu_j,\overline{T}_i)\{\tau(\nu_j,(w_m-w_{i+1})f(\theta))-\tau(\nu_j,(w_m-w_i)\sec)\} + B(\nu_j,T_s)\tau(\nu_j,w_m f(\theta))\right]\Delta\nu_j, \tag{31}$$

where the $\Delta\nu_j$ are constrained by the transmissivity functions to be $25cm^{-1}$, ν_j is the value of ν at the midpoint of the $25cm^{-1}$ interval, and

$$\overline{T}_i = (T_{i+1} + T_i)/2. \tag{32}$$

In the computation of the $\tau(\nu_j, w_k)$ from the Davis and Viezee functions and the Moskalenko function, in place of P and T, we use an effective pressure, P_e, and temperature, T_e, given by

$$X_e = \int_{w_k}^{w_m} X\,dw \Big/ \int_{w_k}^{w_m} dw \doteq \frac{1}{w_m - w_k} \sum_{\ell=k}^{m-1} \Delta w_\ell (X_{\ell+1} - X_\ell)/2, \tag{33}$$

where X can be pressure or temperature, w is the optical depth of the atmospheric constituent for which $\tau(\Delta\nu, w)$ is being calculated [e.g. $w=w_0$ for $\tau_0(\Delta\nu, w_0)$], and

$$\Delta w_\ell = w_{\ell+1} - w_\ell. \tag{34}$$

The concentration of carbon dioxide is assumed to be constant; therefore, the effective pressure of carbon dioxide can be calculated from (33) as follows:

$$P_e = \int_{w_k}^{w_m} P\,dw \Big/ \int_{w_k}^{w_m} dw = \int_{z_k}^{z_m} P\rho dz \Big/ \int_{z_k}^{z_m} \rho dz \tag{35}$$

through the use of (9). The use of the ratio, q_c, for carbon dioxide

$$q_c = \rho_c / \rho_a, \tag{36}$$

where ρ_c and ρ_a are the densities of carbon dioxide and air, respectively, and the hydrostatic equation,

$$\frac{\partial p}{\partial z} = -\rho_a g, \tag{37}$$

in which g is the acceleration of gravity (98 cm sec^{-2}), in (35) obtains

$$p_e = \int_{p_m}^{p_k} pq\, dp \Big/ \int_{p_m}^{p_k} q\, dp. \tag{38}$$

Now, q_c = constant, therefore (38) may be integrated to obtain

$$p_e = (p_k + p_m)/2. \tag{39}$$

The radiance $D(w_m)$ detected by the radiometer is converted to an equivalent blackbody temperature, T_r, through use of the calibration relation

$$D_c = \int_{\nu 1}^{\nu 2} \gamma(\nu)B(\nu,T_r)d\nu \doteq \sum_{j=1}^{n} \gamma(\nu_j)B(\nu_j,T_r)\Delta\nu_j. \tag{40}$$

Eq. (40) is used to calculate a table of D_c versus T_r over the range of T_r that is expected to be encountered when using the radiometer. Then we interpolate in this table to find T_r that corresponds to the value of $D(w_m)$ obtained from (31). The atmospheric correction, ΔT_s, is given by

$$\Delta T_s = T_s - T_r, \tag{41}$$

where T_s is assumed to be the air temperature at the surface as reported by the radiosonde observation.

Optical depths. Precipitable water, w, is computed from temperature, dew point temperature, and pressure as follows. The hydrostatic equation, (37), is used to write (9) as

$$w = \int_{p_o}^{p} q \; dp/\rho' g \doteq \sum_{\ell=1}^{L} \bar{q} \, \Delta\ell/\rho' g, \tag{42}$$

where $\bar{q}$ is the average specific humidity in the layer Δp.

In (42), q is obtained from the relation (Haltiner and Martin, 1957)

$$q = 0.622e/(p-0.378e), \tag{43}$$

in which vapor pressure, e, is determined from dew point temperature using the Goff-Gratch relation specified in List (1971).

The optical depth of carbon dioxide in atm-cm is computed from

$$w_c = \frac{1}{\rho'_c} \int_{0}^{z} \rho_c \; dz. \tag{44}$$

where ρ'_c is the density of carbon dioxide at STP. The use of (36) and (37) in (44) gives

$$w_c = -\frac{1}{\rho'_c g} \int_{p_o}^{p} q_c \; dp \tag{45}$$

which, since $q_c = 0.5 \times 10^{-3}$, may be integrated to obtain

$$w_c = 0.260 \; (p_o - p) \tag{46}$$

where p is in millibars.

The optical depth of ozone in atm-cm is computed from

$$w_o = \frac{1}{\rho'_o} \int_{0}^{z} \rho_o \; dz = -\frac{1}{\rho'_o g} \int_{p_o}^{p} \frac{\rho_o}{\rho_a} \; dp, \tag{47}$$

by (37). In (47), ρ_O is the density of ozone and ρ'_O is the density of ozone at STP. Letting

$$q_O = \rho_O / \rho'_O \tag{48}$$

(47) is calculated from

$$w_O \doteq \frac{1}{\rho' g} \sum_{\ell=1}^{L} \overline{q}_O \Delta p_\ell \tag{49}$$

where $\overline{q}_O$ is the average value for the layer Δp.

SAMPLE CALCULATIONS

For purposes of illustrating the atmospheric correction model and the nature of atmospheric corrections, calculations are presented for four typical distributions of water vapor and temperature given by Valley (1965) and for two radiometers: the NOAA-2 SR and the RS-18. The response functions for the NOAA-2 SR and the RS-18 are shown in Fig. 9. The vertical distributions to a pressure altitude of 100 mb of temperature and dew point for the four model atmospheres are shown in Figs. 10 - 13. The atmospheric corrections which correspond to the four model atmosphere are shown for the NOAA-2 SR in Fig. 14 and for the RS-18 in Figure 15.

As can be seen in Fig. 9, the response of the NOAA-2 SR avoids the ozone and carbon dioxide bands and is therefore only sensitive to absorption and emission by water vapor. Fig. 14 shows that for the four model atmospheres the atmospheric correction is positive and increases with height. In the upper levels (> 300 mb) the correction increases more slowly than at lower levels because specific humidity becomes very low. As the amount of water vapor approaches zero with increasing height, the atmospheric correction approaches a constant value with height.

The spectral response of the RS-18 radiometer is much broader (see Fig. 9) than that of the NOAA-2 SR; it's response extends into the carbon dioxide band and contains the ozone band. Fig. 15 shows that the atmospheric correction for the RS-18 does not approach zero with increasing height above 300 mb but due to emission and absorption by carbon dioxide and ozone continues to increase to approximately 10 mb and then decreases with increasing altitude. The decrease in correction above 10 mb is due

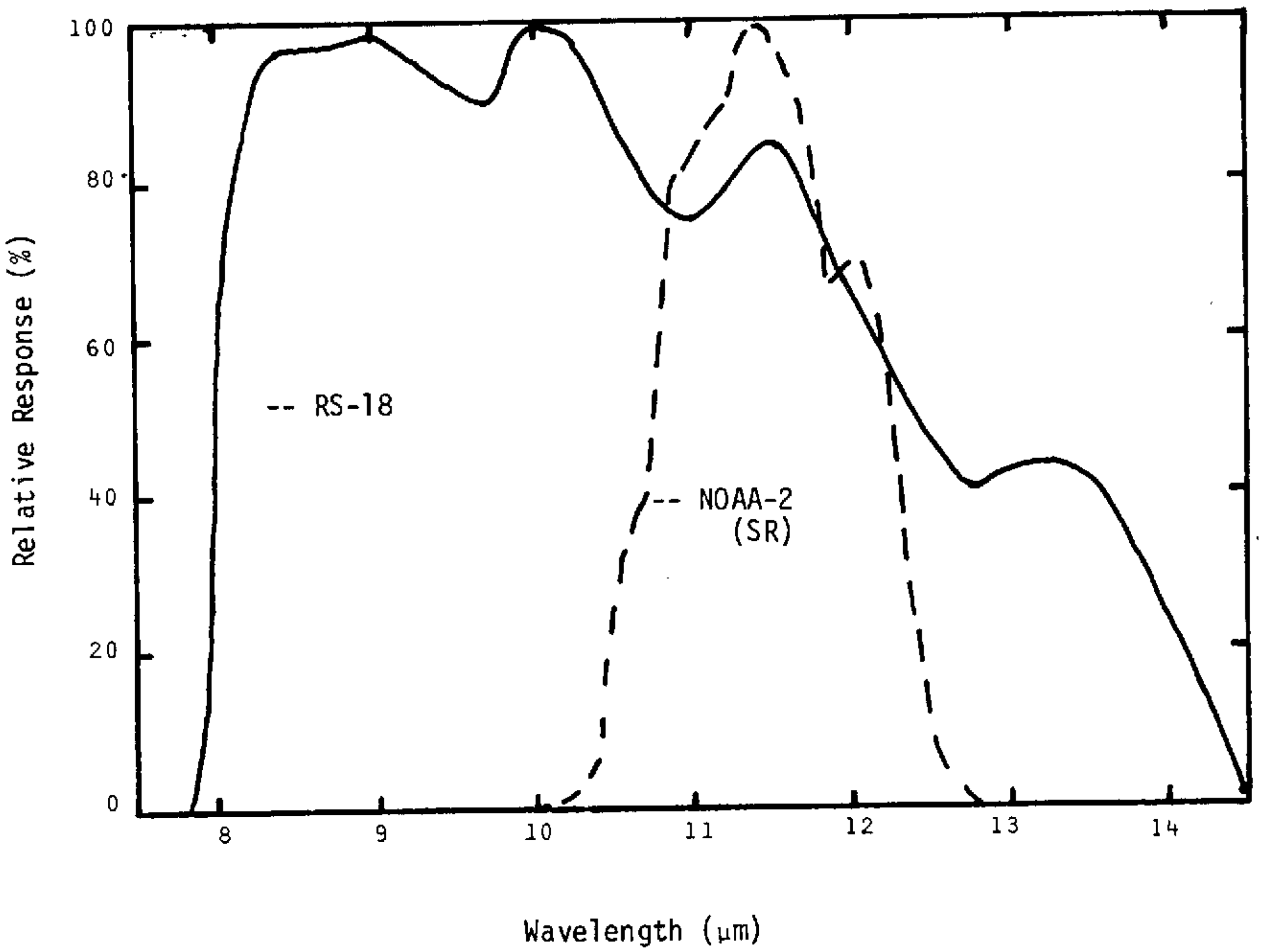


Fig. 9. Response Functions for the RS-18 and NOAA-2 SR.

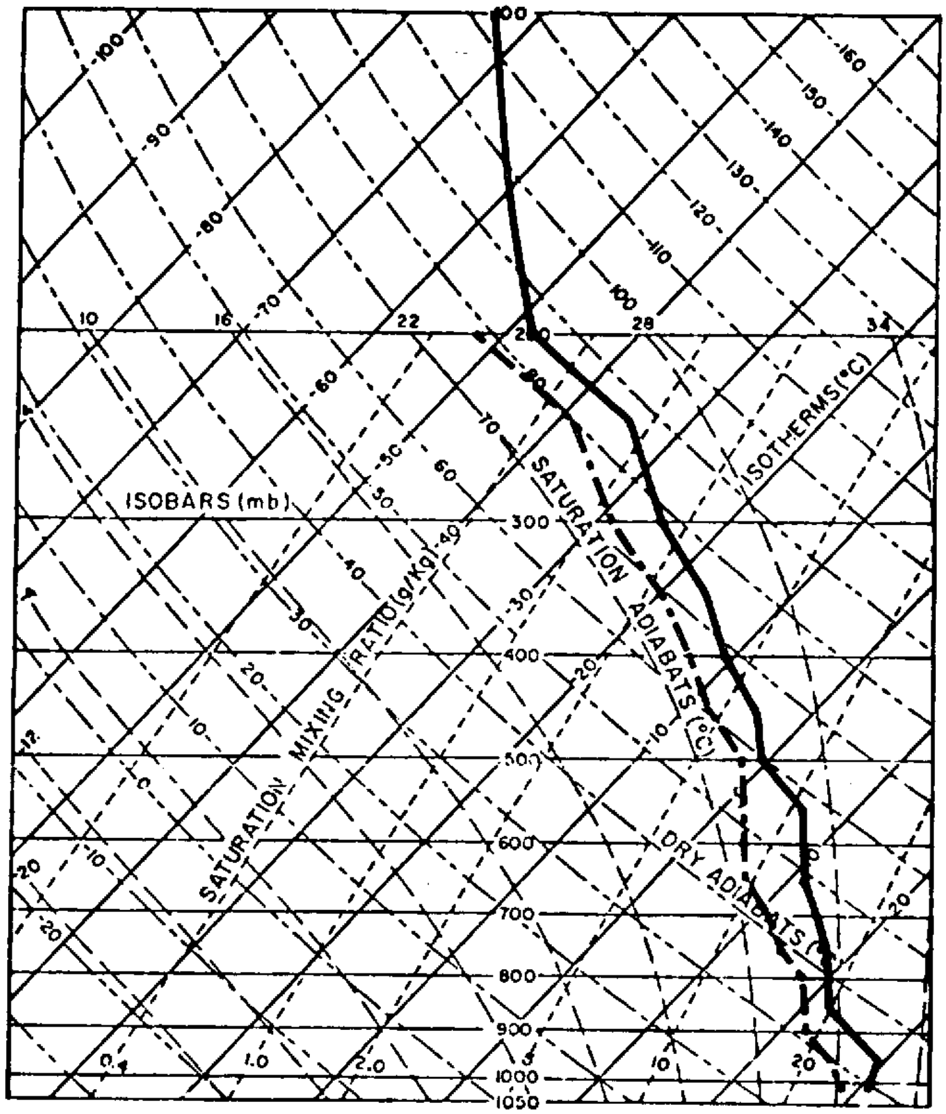


Fig. 10. Vertical Distribution of Temperature (Solid Line) and dew point (dashed line) for Model #1 - Tropical Storm.

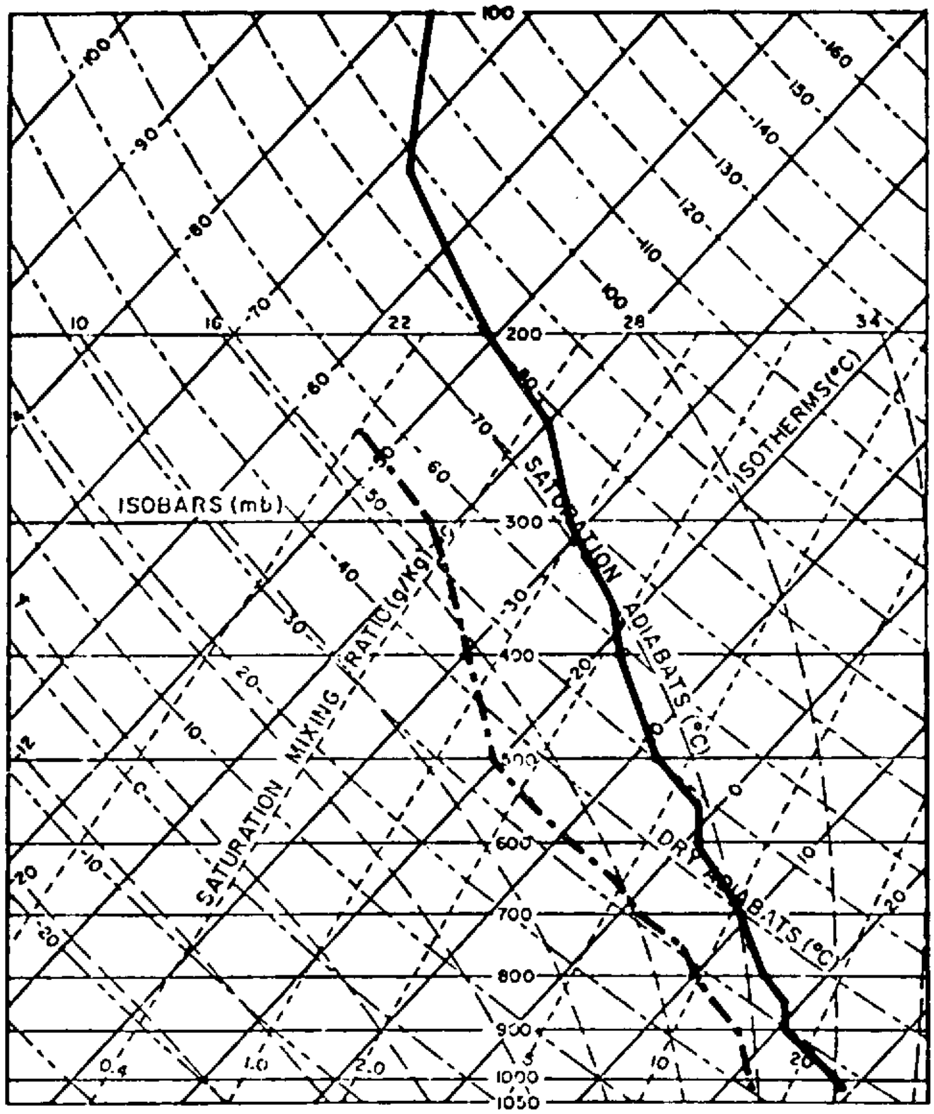


Fig. 11. Vertical Distribution of Temperature (Solid Line) and Dew Point (Dashed Line) for Model #2 - Sub-tropical Summer.

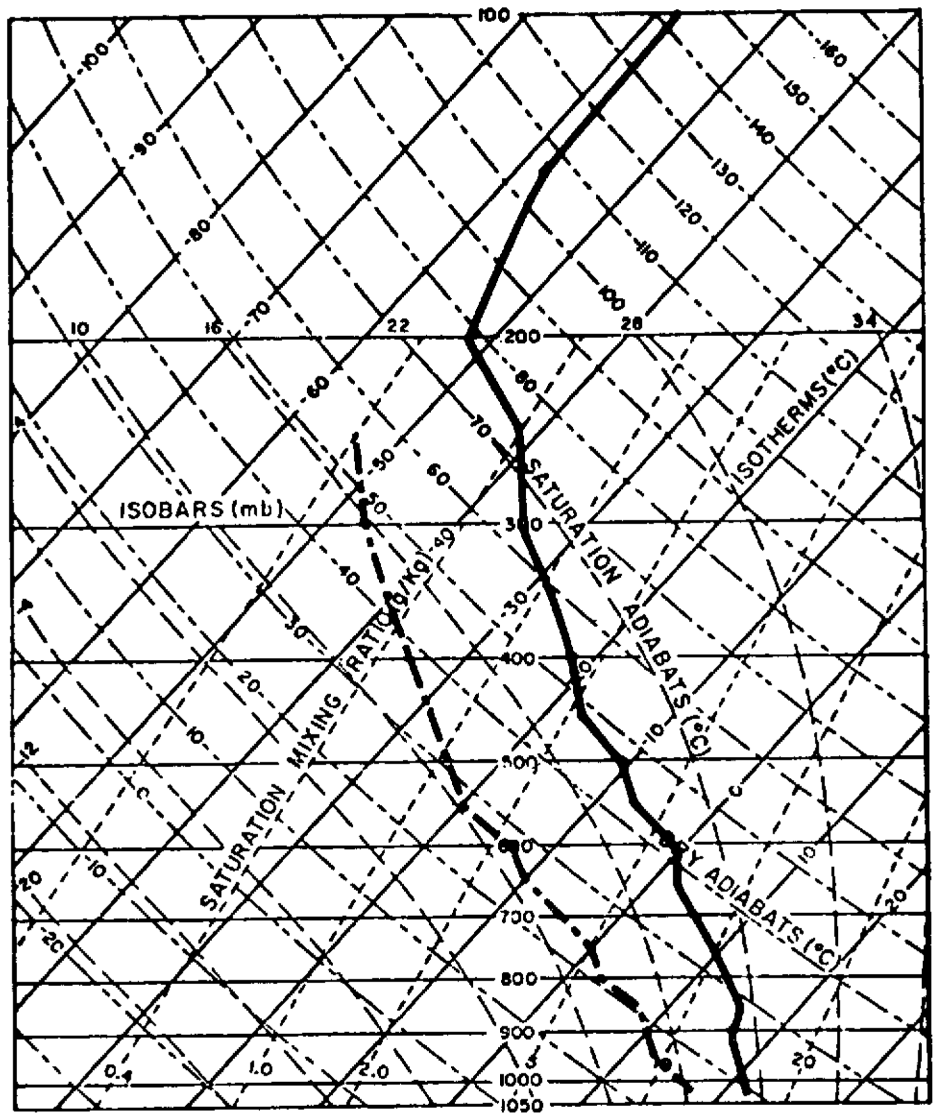


Fig. 12. Vertical Distribution of Temperature (Solid Line) and Dew Point (Dashed Line) for Model #3 - Mid-latitude Summer.

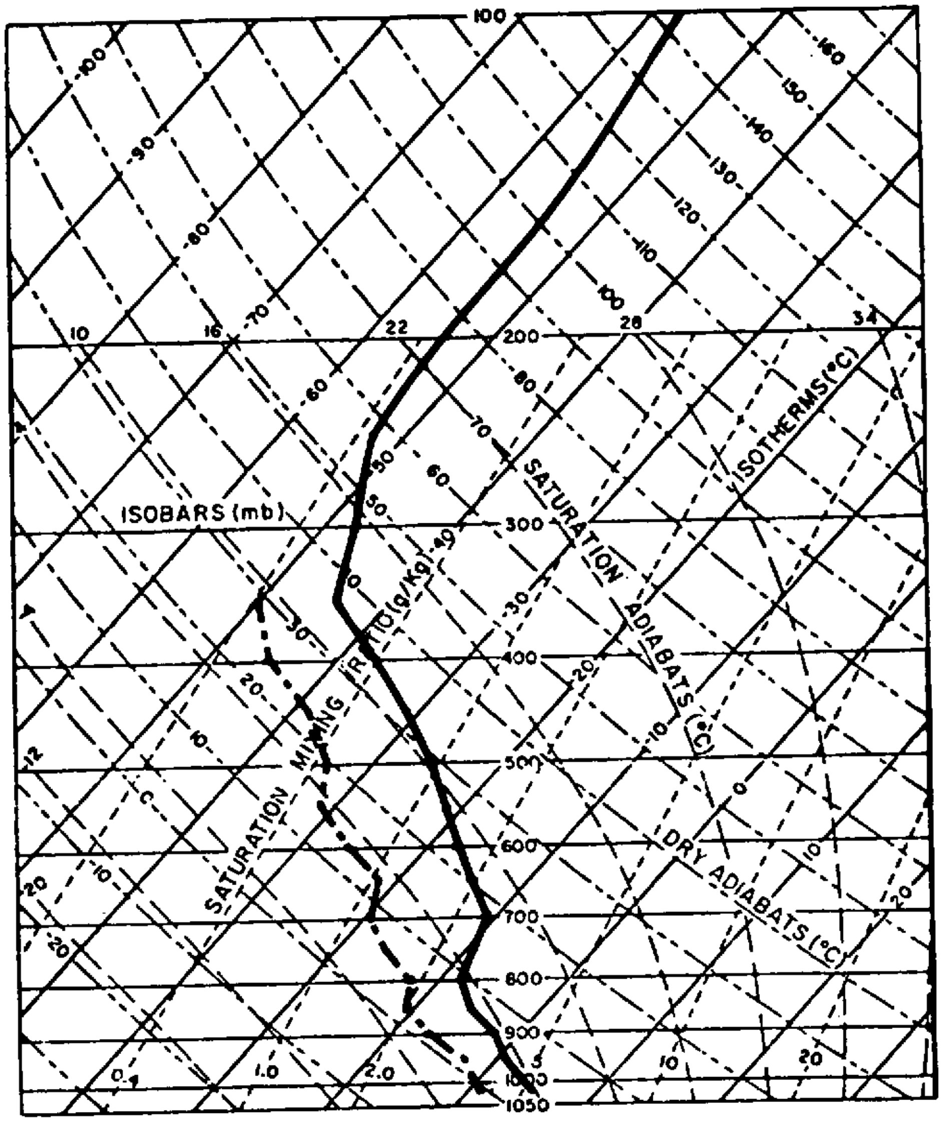


Fig. 13. Vertical Distribution of Temperature (Solid Line) and Dew Point (Dashed Line) for Model #4 - Mid-Latitude Winter.

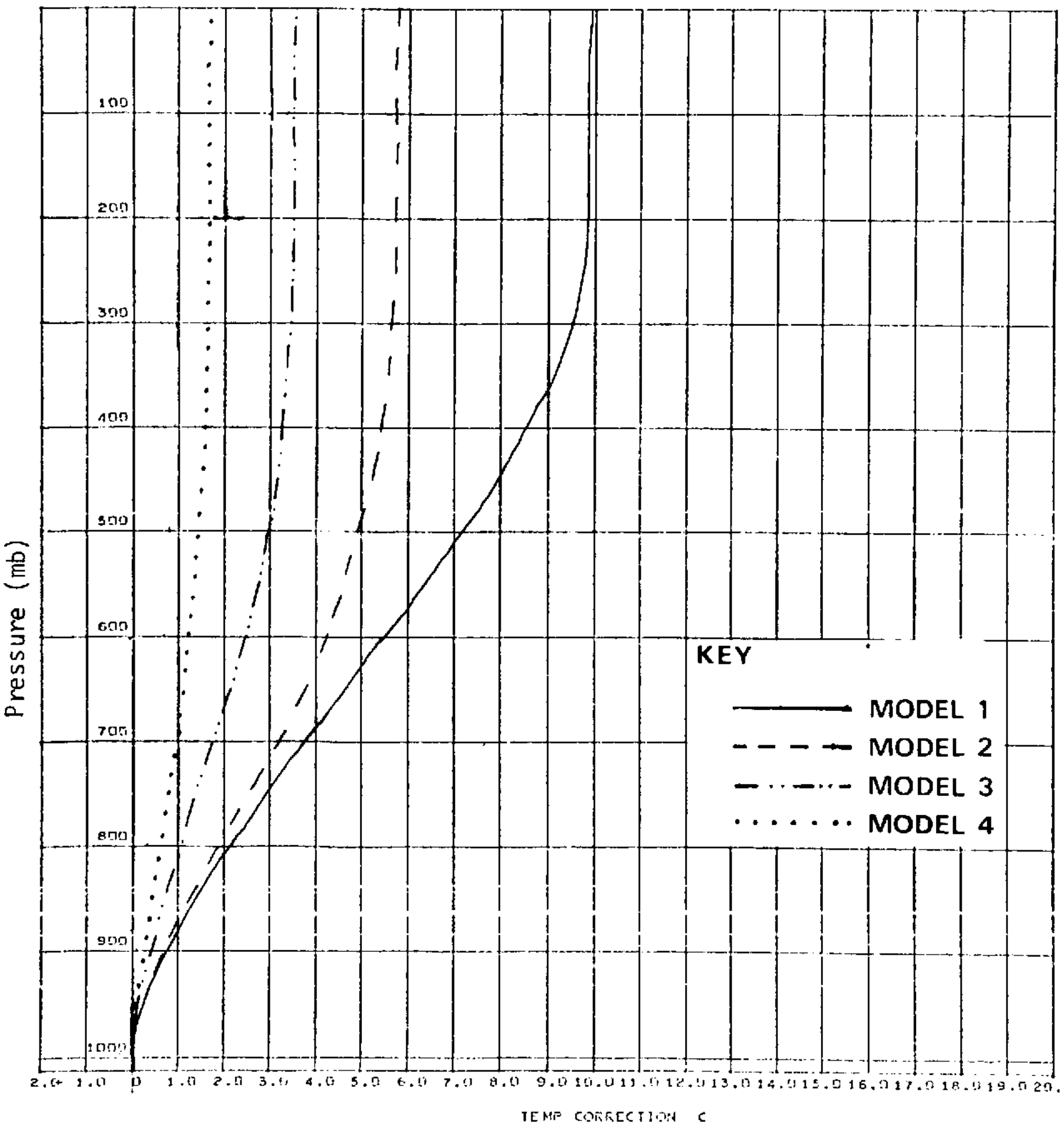


Fig. 14. Atmospheric Correction vs. Pressure Altitude for the NOAA-2 SR at Zero Nadir Angle.

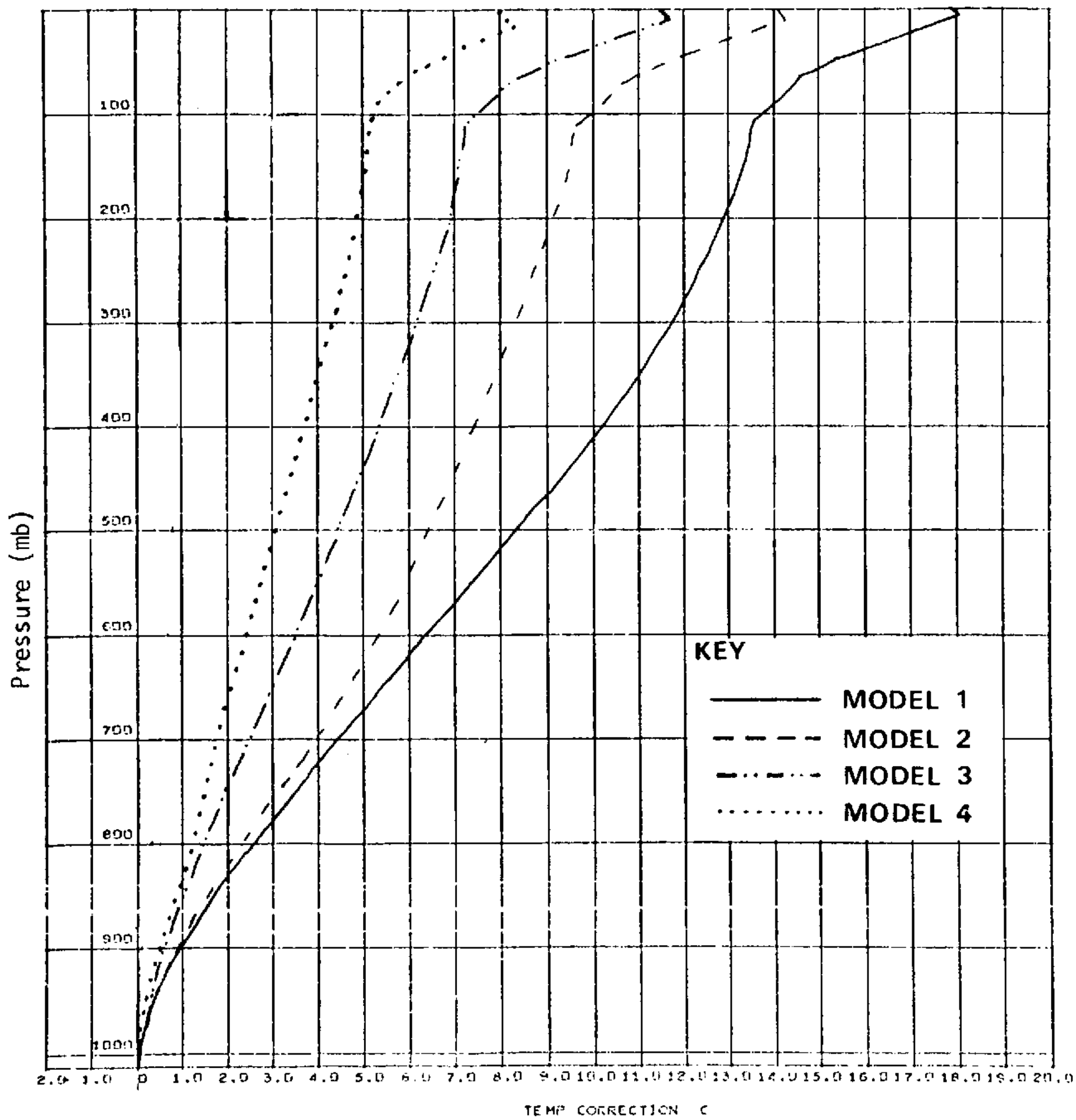


Fig. 15. Atmospheric Correction vs. Pressure Altitude for the RS-18 Radiometer at Zero Nadir Angle.

to the increase of temperature with height in the stratosphere ($\sim$100 - 1 mb) such that at about 10 mb the temperatures are greater than the effective radiating temperature of the atmosphere below. The maximum concentration of ozone occurs around 10 mb and the increased emission due to ozone at these warmer temperatures causes the radiance to increase with height above 10 mb which results in decreasing the atmospheric correction. The RS-18 is an airborne scanning radiometer designed for obtaining low altitude infrared imagery. It is obviously ill-suited for satellite application due to the effects of ozone and carbon dioxide.

The temperature lapse rates do not vary significantly in the model atmospheres. As such, the magnitude of the atmospheric correction is primarily a function of the amount of water vapor. The atmospheric correction for the NOAA-2 SR varies (see Fig. 14) from 9.8C for the very humid atmospheric model 1 (Tropical Storm) to 1.7C for the relatively dry atmospheric model 4 (Mid-latitude Winter). Similarly, the atmospheric correction for the RS-18 being flown at a pressure altitude of 700 mb ($\sim$10,000 ft.) varies from 4.4C for the humid Tropical Storm to 1.8C for the drier Mid-latitude Winter model.

The above calculations were made for zero nadir angle. The effect of viewing at a nadir angle greater than zero would be to displace the curves in Figs. 14 and 15 to the right, i.e. toward larger atmospheric correction. This larger correction is due to the longer atmospheric path encountered when the surface is viewed at a nadir angle greater than zero. The longer atmospheric path increases the magnitude of the atmospheric correction.

Atmospheric corrections for the Eglin, AFB, Florida, 1115 GMT, 21 November 1971 radiosonde (shown in Fig. 16) illustrate the effects of a

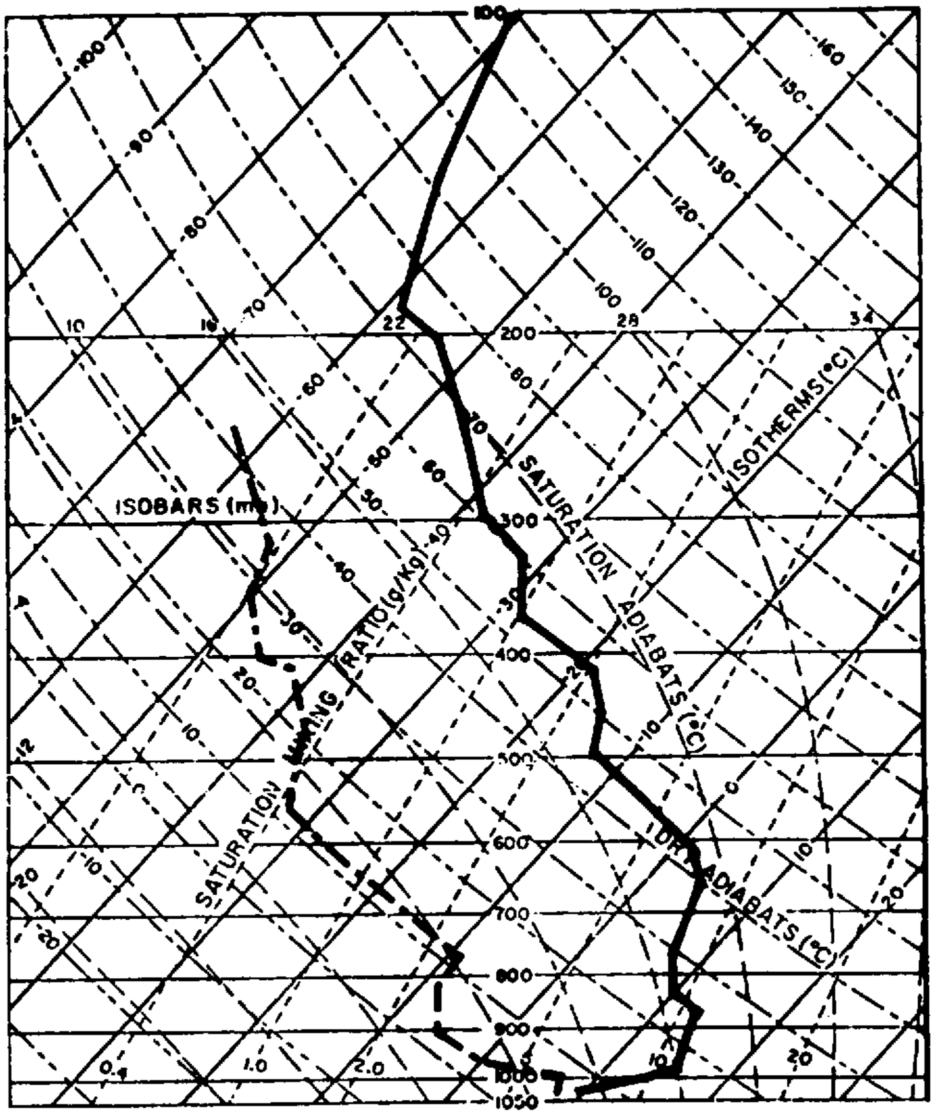


Fig. 16. Eglin AFB, Florida, 1115 GMT 21 November 1971 Radiosonde. Temperature (Solid Line) Dew Point (Dashed Line).

temperature inversion at the surface on atmospheric correction. The temperature increases approximately 5 degrees C from the surface to 1500 feet. The emission from this layer of air which is warmer than the surface causes the atmospheric correction as shown in Fig. 17 to be negative to an altitude of 14,000 ft. Above 14,000 ft. the correction becomes positive.

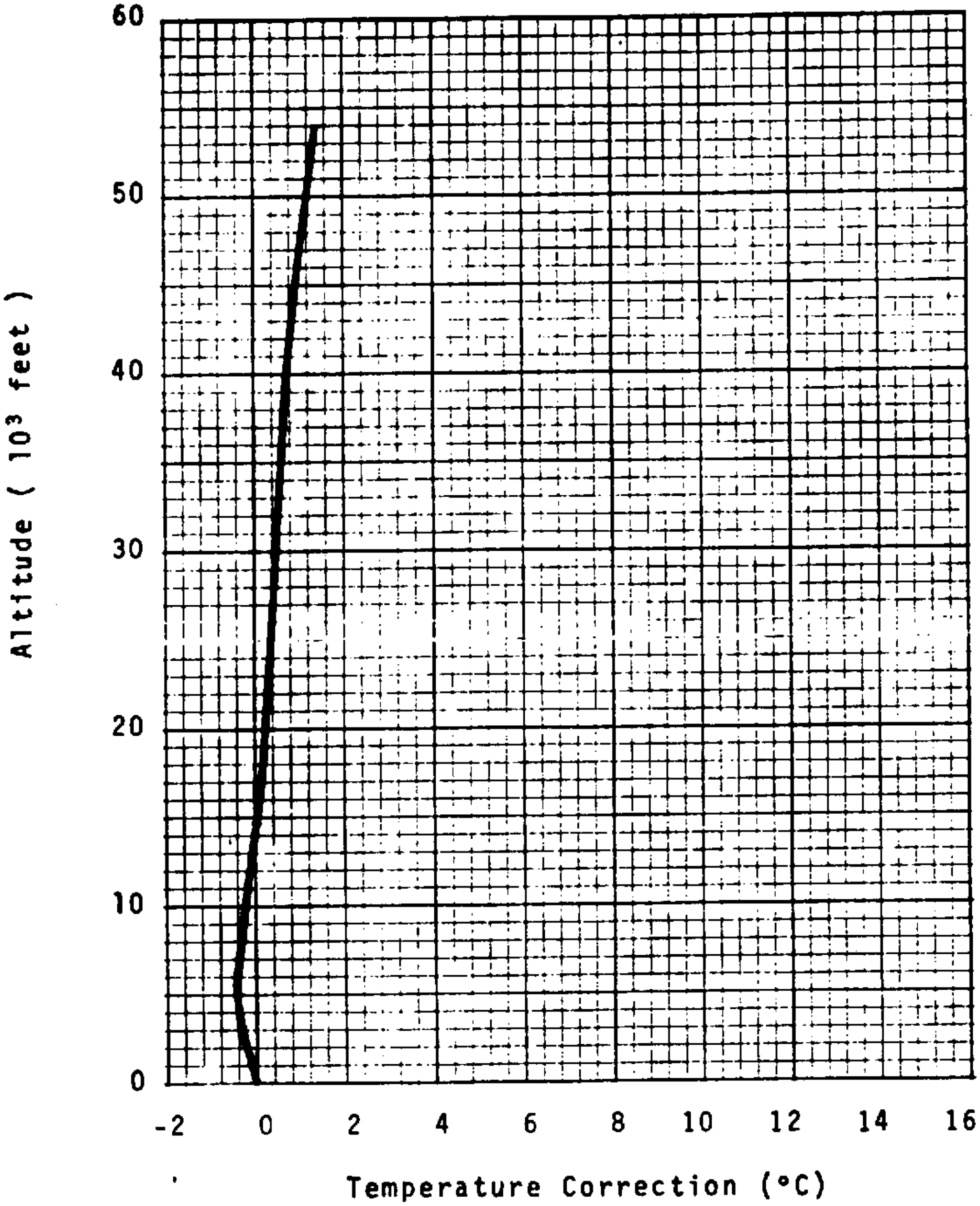


Fig. 17. Atmospheric Correction vs Altitude for Eglin AFB, Florida, 1115 GMT, 21 November 1971, Radiosonde. PRT-5 at Zero Nadir Angle.

SUMMARY AND RECOMMENDATIONS

A numerical model has been developed which calculates the atmospheric corrections due to water vapor, carbon dioxide and ozone. Future versions of this model should include the corrections due to aerosols so that the model will have more general applicability. When more general versions of this model are developed, they should be subjected to the test of comparison with observation. Of course the present model can be used to calculate atmospheric corrections when aerosol concentration is low. Furthermore, the difference between the actual correction determined from a remote sensing experiment and the calculated correction given by the radiation model for the same experimental condition would be due mainly to aerosols. Hence, the gross aerosol correction can be studied empirically using the model.

APPENDIX

FORTRAN PROGRAM OF MODEL

General. In order to facilitate the comparison of the model as described by formulae in the text and the FORTRAN program which follows, a listing of FORTRAN symbols and their corresponding text symbols is given in Table 1.

Table 1. FORTRAN symbols and their corresponding text symbols.

FORTRAN	TEXT	DEFINITION
A		A temporary variable used in transmission computations
ABSOR	L_ν	An absorption coefficient for transmission through water vapor in the wave number range 25 to 2150 cm^{-1}
ABSORC	k_ν	An absorption coefficient for transmission through carbon dioxide in the wave number range 550 to 800 cm^{-1}
ABSORO		An absorption coefficient for transmission through ozone in the wave number range 575 - 2150 cm^{-1}
ANGLE	θ	Observation angle from nadir to target
ATCENT	w_c	A table of optical depths of carbon dioxide in atmosphere centimeters
ATMOS	$B(\nu_j,\overline{T}_i)$	The blackbody function for wave number ν_j and temperature $\overline{T}_i$
B		A temporary variable used in transmission computations
BBODY	$B(\nu_j,\overline{T}_i)$	The blackbody function for wave number ν_j and temperature $\overline{T}_i$
BETA	β	A temporary variable used in transmission computations
C		A temporary variable used in transmission computations

Table 1. continued

FORTRAN	TEXT	DEFINITION
CPRESS		Effective pressure of carbon dioxide
D		A temporary variable used in transmission computations
DEGREE		A table of temperatures whose midpoint is the surface target temperature
DELTRA		The change in transmissivity between layers
DETECT	$D(w_m)$	The detector intensity, cal cm^{-2} sec
DEWAVG		Average dewpoint of an atmospheric layer
DEWPT		Dew point temperature
DLTEMP	ΔT_s	Temperature correction from surface to sensor
DRTEMP	T_r	Simulated temperature observed by sensor
EXPRESS	P_e	Effective pressure of water vapor
ETEMPS	T_e	Effective temperature of water vapor
EXPOMO	$m(\nu)$	An absorption exponent for transmission through ozone in the wave number range 600 to 2150 cm^{-1}
EXPON	b_ν	An absorption exponent for transmission through water vapor in the wave number range 800 to 1200 cm^{-1}
EXPONC	c_ν	An absorption exponent for transmission through carbon dioxide in the wave number range 550 to 800 cm^{-1}
EXPONO	$n(\nu)$	An absorption exponent for transmission through ozone in the wave number range 600 to 2150 cm^{-1}
FUNCTI	γ	The percent response of a sensor to energy in a given wave number interval
HEADER		A table for instrument names
HEAD1 HEAD2 HEAD3		Temporary variables for these instrument names

Table 1. continued

FORTRAN	TEXT	DEFINITION
HEATER	D_c	A blackbody intensity table simulating instrument response to a blackbody
HEIGHT	z	A table of radiosonde observation altitudes
HIGH		Average height of an atmospheric layer
HUM	q	A table of specific humidities for each atmospheric layer
HUMID		Average water vapor mixing ratio of an atmospheric layer
I	i	Atmospheric layer index
INTEN		Sum used to determine integral detector intensity
INTER	ν_j	A table of wave number mid-points
INTERV	$\Delta\nu_j$	A wave number interval
J	j	The wave number interval index
LEVELS		The number of levels at which radiosonde data is given or is interpolated
LIM	m-1	The maximum number of layers to the level of observation
LIMIT	m	The number of levels of data available
ONE		1.0
OTCENT	w_o	Optical depth of ozone in atmosphere centimeters
OZONE	$\bar{q}_o$	A table of ratios of the density of ozone to its density at STP for each atmospheric layer
PART	q	A specific humidity for determining precipitable water

Table 1. continued

FORTRAN	TEXT	DEFINITION
PART1 PART2 PART3 PART4 PART5 PART6		Temporary variables used to compute vapor pressure
PRATIO	P	The ratio of the average pressure within an atmospheric layer to a standard of 1013.2 mb
PRESS	p	A table of pressures
RESPON	$\gamma(\nu)$	A table of response functions defining an instrument
SFCBB		The contribution from a surface target image
SLOPEA SLOPEB		Temporary variables used to perform linear interpolation on blackbody intensity functions
STEPSZ		The desired step size between atmospheric levels
TEMPER	T_i	A table of atmospheric temperatures
TEMPOR	$\bar{T}_i$	The average temperature of an atmospheric layer
THETA		Angle in radians
TRANGE		The width in degrees of the temperature calibration table
TRANS	τ	The transmissivity of the atmosphere
TRANSC	$\tau_c(\Delta\nu,w_c)$	The transmissivity at a level due to carbon dioxide absorption
TRANSM	$\tau(\nu,w_k)$	The transmissivity of the atmosphere from the surface to level k
TRANSO	$\tau_o(\delta\nu,w_o)$	The transmissivity at a level due to ozone absorption
TRANSER	$\tau_w(\Delta\nu,w)$	The transmissivity at a level due to water vapor absorption

Table 1. continued

FORTRAN	TEXT	DEFINITION
TRATIO	T/T_0	The ratio of a level's average temperature to a standard temperature of 273.16K
	373.16/T	The ratio of the steam point to a saturation temperature when used to compute vapor pressure
VAPER	e	The vapor pressure used to compute precipitable water
WATER	w	A table of precipitable centimeters of water vapor
WATERC		The amount of carbon dioxide in atmos-centimeters for a given layer at a given angle
WATERO		The amount of ozone in atmosphere centimeters for a given layer at a given angle
WATERS		The amount of water vapor in precipitable centimeters for a given layer at a given angle
WAVENO	ν	The wave number mid-point
WHOLE		A temporary sum used to determine integral precipitable water and upwelling radiation

Program Description. The description of the FORTRAN program which follows is taken from Halbach (1973). The program is written for use on a UNIVAC 1108 EXECUTIVE system and has various types of computation schemes and output displays which are appropriate to the users needs. The program control flow charts (Figs. 7 and 8) and lead card descriptions (Tables 2-7 and Figs. 5 and 6) give a description of these options. The program requires 25,000 locations in core. The user should be familiar with the radiative transfer equation and the logic of the program which is outlined in the program control flow charts (Figs. 7 and 8) in order to execute the options available in the program. The formats for input of data to the program are given in FORMAT statements in the program listing.

Table 2. An Example of Lead Card Arrangement

Field	Columns	Format	Name	Identification
Card No. 1, Name CONTROL				
1	1-10	I10	LIMIT	An integer number telling how many non-control cards follow or defining a value used for control.
2	11-17	A6	LABEL	Six alphanumeric characters defining the type of data or action which follows:
				'TEMPER' Temperature range
				'ANGLE' Viewing angle from nadir
				'STEP' Pressure step size
				'SPHERE' Apply sphere function
				'FLAT' Do not apply sphere function
				'MAXCOR' S-C4020 minimum temperature
				'MINCOR' S-C4020 minimum temperature
				'MESSAG' One line message
				'RESPON' Response function data
				'TRACE' Transmission function data
				'WATER' Radiosonde data
				'EXECUT' Use previous radiosonde
				'LIMB' Make limb display
				'DEFAUL' Load mission radiosonde data
3	23-28	A6	HEAD1*	Six alphanumeric characters used as supplemental control data.
				'METERS' Change meters to feet

*HEAD1, HEAD2, and HEAD3 are sometimes used as display labels.

Table 2. (Continued)

4	29-34	A6	HEAD2	Six alphanumeric characters used as supplemental control data. 'KELVIN' Do not change temperatures
5	35-40	A6	HEAD3	Six alphanumeric characters used as supplemental control data. 'OZONE' Load ozone data from cards
Card No. 2, Name WATER				
1	2-8	F7.1	PRESS(I)	Atmospheric pressure in millibars
2	11-16	F6.1	DEWPT	Dew point at pressure level
3	21-27	F7.1	TEMPER (I)	Temperature at pressure level
4	31-40	F10.1	HEIGHT (I)	Height at pressure level
5	41-50	E10.5	OZONE(I)	Ozone at pressure level
Card No. 3, Name RESPON				
1	1-7	F7.1	INTERV	Wave-number midpoint interval
2	8-14	F7.4	FUNCT1	Percent response of instrument system in this interval
Card No. 4, Name TEMPER				
1	1-7	F7.1	TRANGE	Temperature range chosen for calibration table
Card No. 5, Name MESSAG				
1	2-61	10A6	MESSAG (I)	Lead message line for displays
Card No. 6, Name TRACE				
1	1-10	E10.5	WEIGHT (I)	Index and weighting function for trace gas transmission coefficients.
2	11-20	E10.5	ABSORO (I)	Coefficient for transmission function.

Table 2. (Continued)

3	21-30	E10.5	EXPOMO (I)	First exponent for transmission function
4	31-40	E10.5	EXPONO (I)	Second exponent for transmission function
Card No. 7, Name DEFAUL				
1	2-8	F7.1	PRESUR	Atmospheric pressure in millibars
2	11-20	E10.5	OZONES	Ozone at pressure level
3	23-28	F6.1	TEMPOR	Temperature at pressure level
4	31-40	E10.5	HUMID	Specific humidity at pressure level

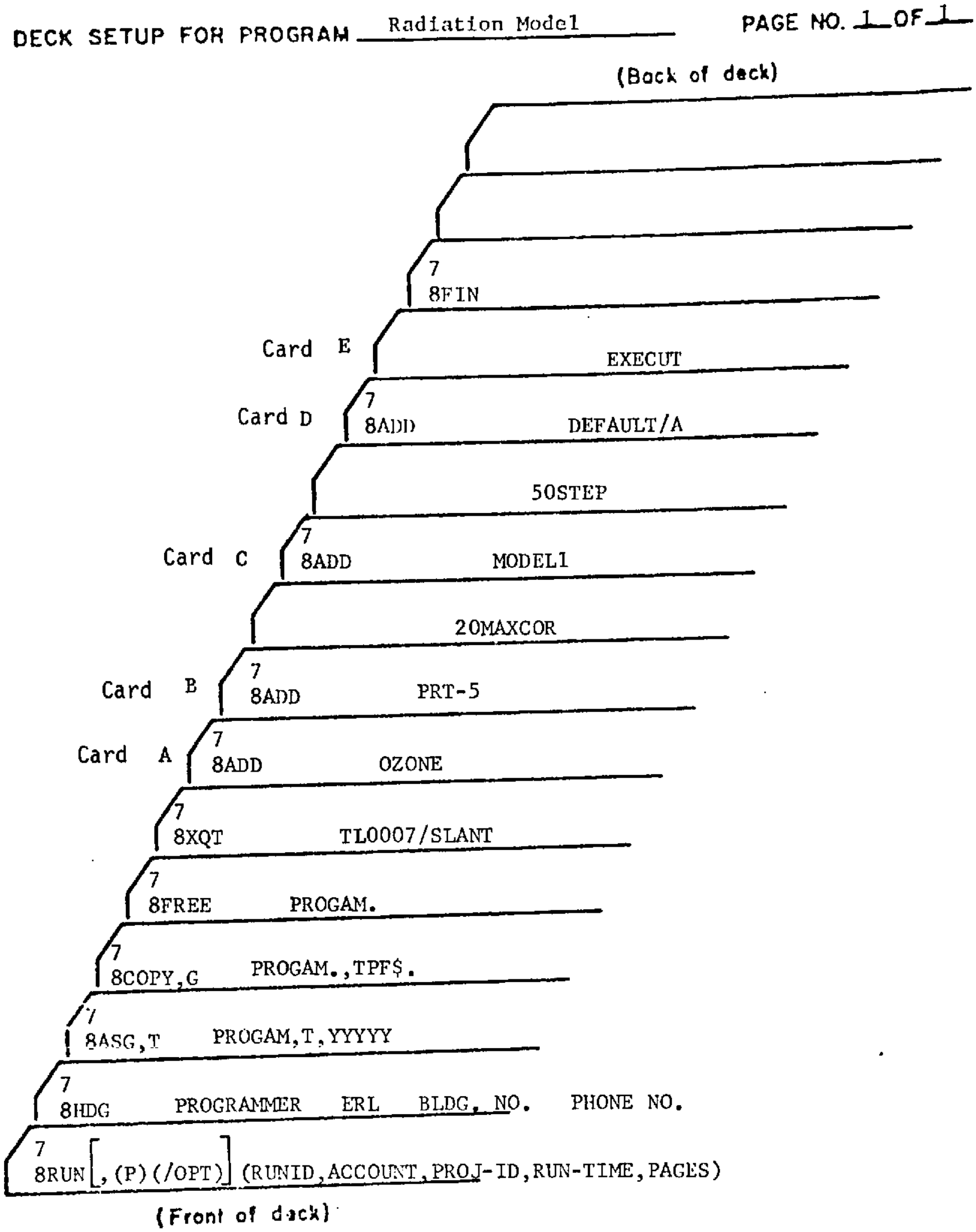


Fig. 5. Example of a Lead Card Setup

Table 3. Card Input and Printer Output Using Card A (Fig. 5).

	Input				Output				
	TPF$.OZONE				WAVENUMBER	A**(ATMOS-CENT**B)**(EP**C)			
1	81TRACE				INTERVAL	A	B	C	WEIGHT
2	.23119+02	.60000-02	.95000+00	.10000+00	575.0- 600.0	.0060	.9500	.1000	.1190
3	.24273+02	.60000-02	.95000+00	.10000+00	600.0- 625.0	.0060	.9500	.1000	.2230
4	.24301+02	.13000-01	.95000+00	.10000+00	600.0- 625.0	.0130	.9500	.1000	.3010
5	.24318+02	.32000-01	.90000+00	.15000+00	600.0- 675.0	.0320	.9000	.1500	.3180
6	.24158+02	.50000-01	.90000+00	.15000+00	600.0- 625.0	.0500	.9000	.1500	.1580
7	.25162+02	.50000-01	.90000+00	.15000+00	625.0- 650.0	.0500	.9000	.1500	.1620
8	.25322+02	.60000-01	.88000+00	.17000+00	625.0- 650.0	.0600	.8800	.1700	.3220
9	.25318+02	.90000-01	.85000+00	.18000+00	625.0- 650.0	.0900	.8500	.1800	.3180
10	.25197+02	.12000+00	.85000+00	.18000+00	625.0- 650.0	.1200	.8500	.1800	.1970
11	.26142+02	.12000+00	.85000+00	.18000+00	650.0- 675.0	.1200	.8500	.1800	.1420
12	.26363+02	.15000+00	.84000+00	.20000+00	650.0- 675.0	.1500	.8400	.2000	.3630
13	.26357+02	.18000+00	.82000+00	.22000+00	650.0- 675.0	.1800	.8200	.2200	.3570
14	.26138+02	.18000+00	.82000+00	.22000+00	650.0- 675.0	.1800	.8200	.2200	.1380
15	.27224+02	.22000+00	.82000+00	.22000+00	675.0- 700.0	.2200	.8200	.2200	.2240
16	.27362+02	.30000+00	.82000+00	.25000+00	675.0- 700.0	.3000	.8200	.2500	.3620
17	.27277+02	.36000+00	.80000+00	.25000+00	675.0- 700.0	.3600	.8000	.2500	.2770
18	.27137+02	.23000+00	.83000+00	.22000+00	675.0- 700.0	.2300	.8300	.2200	.1370
19	.28163+02	.23000+00	.83000+00	.22000+00	700.0- 725.0	.2300	.8300	.2200	.1630
20	.28303+02	.20000+00	.84000+00	.20000+00	700.0- 725.0	.2000	.8400	.2000	.3030
21	.28100+02	.28000+00	.82000+00	.20000+00	700.0- 725.0	.2800	.8200	.2000	.1000
22	.28434+02	.44000+00	.80000+00	.26000+00	700.0- 725.0	.4400	.8000	.2600	.4340
23	.29204+02	.44000+00	.80000+00	.26000+00	725.0- 750.0	.4400	.8000	.2600	.2040
24	.29202+02	.30000+00	.80000+00	.22000+00	725.0- 750.0	.3000	.8000	.2200	.2020
25	.29437+02	.20000+00	.80000+00	.22000+00	725.0- 750.0	.2000	.8000	.2200	.4370
26	.29157+02	.20000+00	.80000+00	.22000+00	725.0- 750.0	.2000	.8000	.2200	.1570
27	.30285+02	.14000+00	.84000+00	.24000+00	750.0- 775.0	.1400	.8400	.2400	.2850
28	.30479+02	.11000+00	.86000+00	.24000+00	750.0- 775.0	.1100	.8600	.2400	.4790
29	.30235+02	.11000+00	.86000+00	.24000+00	750.0- 775.0	.1100	.8600	.2400	.2350
30	.31245+02	.90000-01	.86000+00	.22000+00	775.0- 800.0	.0900	.8600	.2200	.2450
31	.31520+02	.70000-01	.89000+00	.20000+00	775.0- 800.0	.0700	.8900	.2000	.5200
32	.31235+02	.70000-01	.89000+00	.20000+00	775.0- 800.0	.0700	.8900	.2000	.2350
33	.32245+02	.50000-01	.90000+00	.18000+00	800.0- 825.0	.0500	.9000	.1800	.2450
34	.32559+02	.30000-01	.95000+00	.15000+00	800.0- 825.0	.0300	.9500	.1500	.5590
35	.32195+02	.30000-01	.95000+00	.15000+00	800.0- 825.0	.0300	.9500	.1500	.1950
36	.33327+02	.10000-01	.95000+00	.11000+00	825.0- 850.0	.0100	.9500	.1100	.3270
37	.33557+02	.70000-02	.96000+00	.10000+00	825.0- 850.0	.0070	.9600	.1000	.5570
38	.33117+02	.70000-02	.96000+00	.10000+00	825.0- 850.0	.0070	.9600	.1000	.1170
39	.38609+02	.35300-01	.10000+01	.00000	950.0- 975.0	.0353	1.0000	.0000	.6590
40	.38197+02	.35300-01	.10000+01	.00000	950.0- 975.0	.0353	1.0000	.0000	.1970
41	.38194+02	.89000-01	.79500+00	.00000	950.0- 975.0	.0890	.7950	.0000	.1940
42	.39206+02	.89000-01	.79500+00	.00000	975.0-1000.0	.0890	.7950	.0000	.2060
43	.39403+02	.34000+00	.91200+00	.99000-01	975.0-1000.0	.3400	.9120	.0990	.4030
44	.39391+02	.81700+00	.85400+00	.15000+00	975.0-1000.0	.8170	.8540	.1500	.3910
45	.40409+02	.20300+01	.91900+00	.23500+00	1000.0-1025.0	2.0300	.9190	.2350	.4090
46	.40397+02	.40300+01	.91500+00	.31000+00	1000.0-1025.0	4.0300	.9150	.3100	.3970
47	.40104+02	.53000+01	.92500+00	.33000+00	1000.0-1025.0	5.3900	.9250	.3300	.1940
48	[illegible]	[illegible]	[illegible]	.33000+00	1025.0-1050.0	5.3900	.9250	.3300	[illegible]
49	.41403+02	.48700+01	.91800+00	.26600+00	1025.0-1050.0	4.8700	.9180	.2660	.4030
50	.41391+02	.33600+01	.85100+00	.26100+00	1025.0-1050.0	3.3600	.8510	.2610	.3910
51	.42410+02	.70300+01	.90400+00	.34000+00	1050.0-1075.0	7.0300	.9040	.3400	.4100
52	.42397+02	.15500+01	.78900+00	.20500+00	1050.0-1075.0	1.5500	.7890	.2050	.3970
53	.42194+02	.18400+00	.76200+00	.86500-01	1050.0-1075.0	.1840	.7620	.0865	.1940
54	.43207+02	.18400+00	.76200+00	.86500-01	1075.0-1100.0	.1840	.7620	.0865	.2070
55	.43403+02	.97600-01	.72900+00	.35000-01	1075.0-1100.0	.0976	.7290	.0350	.4030
56	.43019+02	.97600-01	.72900+00	.35000-01	1075.0-1100.0	.0976	.7290	.0350	.0190

Table 3. (Continued)

57	.43371+02	.67600-01	.78700+00	.51000-01	1075.0-1100.0	.0876	.7870	.0510	.3710
58	.44410+02	.74300+00	79000+00	.84300-01	1100.0-1125.0	.7430	.7900	.0843	.4100
59	.44397+02	.10600+00	.88200+00	.12500+00	1100.0-1125.0	.1060	.8820	.1250	.3970
60	.44193+02	.14100+00	.90900+00	.15400+00	1100.0-1125.0	.1410	.9090	.1540	.1930
61	.45207+02	.14100+00	.90900+00	.15400+00	1125.0-1150.0	.1410	.9090	.1540	.2070
62	.45403+02	.11000+00	.89400+00	.10200+00	1125.0-1150.0	.1100	.8940	.1020	.4030
63	.45390+02	.68700-01	.82500+00	.49000-01	1125.0-1150.0	.0687	.8250	.0490	.3900
64	.46410+02	.47700-01	.71600+00	.34500-01	1150.0-1175.0	.0477	.7160	.0345	.4100
65	.46397+02	.33700-01	.60000+00	.00000	1150.0-1175.0	.0337	.6000	.0000	.3970
66	.46193+02	.24200-01	.50000+00	.00000	1150.0-1175.0	.0242	.5000	.0000	.1930
67	.80191+02	.32000-01	.82000+00	.20000+00	2000.0-2025.0	.0320	.8200	.2000	.1910
68	.81414+02	.32000-01	.82000+00	.20000+00	2025.0-2050.0	.0320	.8200	.2000	.4140
69	.81395+02	.42000-01	.80000+00	.20000+00	2025.0-2050.0	.0420	.8000	.2000	.3950
70	.81191+02	.55000-01	.80000+00	.18000+00	2025.0-2050.0	.0550	.8000	.1800	.1910
71	.82209+02	.55000-01	.80000+00	.18000+00	2050.0-2075.0	.0550	.8000	.1800	.2090
72	.82404+02	.68000-01	.80000+00	.20000+00	2050.0-2075.0	.0680	.8000	.2000	.4040
73	.82386+02	.14000+00	.78000+00	.20000+00	2050.0-2075.0	.1400	.7800	.2000	.3860
74	.83414+02	.28000+00	.78000+00	.20000+00	2075.0-2100.0	.2800	.7800	.2000	.4140
75	.83395+02	.48000+00	.76000+00	.20000+00	2075.0-2100.0	.4800	.7600	.2000	.3950
76	.83191+02	.50000+00	.76000+00	.20000+00	2075.0-2100.0	.5000	.7600	.2000	.1910
77	.84209+02	.50000+00	.70000+00	.20000+00	2100.0-2125.0	.5000	.7600	.2000	.2090
78	.84404+02	.36000+00	.80000+00	.20000+00	2100.0-2125.0	.3600	.8000	.2000	.4040
79	.84386+02	.48000+00	.76000+00	.20000+00	2100.0-2125.0	.4800	.7600	.2000	.3860
80	.85414+02	.56000+00	.74000+00	.21000+00	2125.0-2150.0	.5600	.7400	.2100	.4140
81	.85395+02	.33000+00	.80000+00	.22000+00	2125.0-2150.0	.3300	.8000	.2200	.3950
82	.85191+02	.60000-01	.83000+00	.20000+00	2125.0-2150.0	.0600	.8300	.2000	.1910

Table 4. Card Input and Printer Output Using Card B (Fig. 5)

	Input			Output	
	JCFS,PRT-5				
1		25RESPONS	PRT-5	WAVENUMBER MIDPOINTS AND PERCENT RESPONSE	
2	637.5	.02		637.5	.0200
3	662.5	.10		662.5	.1000
4	687.5	.25		687.5	.2500
5	712.5	.45		712.5	.4500
6	737.5	.63		737.5	.6300
7	762.5	.74		762.5	.7400
8	787.5	.78		787.5	.7800
9	812.5	.83		812.5	.8300
10	837.5	.91		837.5	.9100
11	862.5	.92		862.5	.9200
12	887.5	.92		887.5	.9200
13	912.5	.93		912.5	.9300
14	937.5	.96		937.5	.9600
15	962.5	.99		962.5	.9900
16	987.5	1.00		987.5	1.0000
17	1012.5	.99		1012.5	.9900
18	1037.5	.96		1037.5	.9600
19	1062.5	.91		1062.5	.9100
20	1087.5	.86		1087.5	.8600
21	1112.5	.82		1112.5	.8200
22	1137.5	.79		1137.5	.7900
23	1162.5	.76		1162.5	.7600
24	1187.5	.71		1187.5	.7100
25	1212.5	.56		1212.5	.5600
26	1237.5	.22		1237.5	.2200

Table 5. Card Input and Printer Output Using Card C (Fig. 5)

Input

TFF$.MCDEL1

1	MESSAG			
2	MCDEL NUMBER 1,TROPICAL STORM AFTER RIEHL«1954)			
3	19WATER		METERSKELVIN	
4	1013.2	300.2	303.7	.
5	950.0	297.6	301.0	577.
6	900.0	295.3	298.5	1057.
7	850.0	293.1	296.1	1560.
8	800.0	290.3	293.4	2088.
9	750.0	287.3	290.7	2645.
10	700.0	284.7	287.8	3233.
11	650.0	281.2	284.4	3858.
12	600.0	277.8	281.1	4525.
13	550.0	274.0	277.5	5239.
14	500.0	271.3	272.9	6010.
15	450.0	265.2	268.0	6847.
16	400.0	259.8	262.3	7763.
17	350.0	253.2	255.9	8778.
18	300.0	244.9	248.2	9916.
19	250.0	234.2	238.5	11215.
20	200.0	221.2	226.5	12734.
21	150.0	373.2	211.0	14577.
22	100.0	373.2	189.2	16950.

Output

MODEL NUMBER 1,TROPICAL STORM AFTER RIEHL«1954)

PRESSURE	DEW POINT	TEMPERATURE	HEIGHT	PRECIP	ATMOS-CENT		EFFECTIVE	CONSTANT	EFFECTIVE
			FEET	WATER	CO2	OZONE	PRESSURE	CONCENTRATION	TEMPERATURE
1013.2	27.0	30.5							
950.0	24.4	27.8	1893.0	1.3699	16.4	.001	981.6	981.6	302.3
900.0	22.1	25.3	3467.8	2.3621	29.4	.003	957.8	956.6	301.3
850.0	19.9	22.9	5118.0	3.2758	42.4	.004	934.7	931.6	300.2
800.0	17.1	20.2	6850.3	4.1048	55.4	.005	912.6	906.6	299.1
750.0	14.1	17.5	8677.7	4.8383	68.4	.006	891.7	881.6	298.0
700.0	11.5	14.6	10606.8	5.4918	81.4	.007	871.9	856.6	297.0
650.0	8.0	11.2	12657.3	6.0645	94.4	.008	853.3	831.6	295.9
600.0	4.6	7.9	14845.6	6.5532	107.4	.009	836.3	806.6	294.9
550.0	.8	4.3	17188.1	6.9657	120.4	.010	820.8	781.6	294.0
500.0	-1.9	-.3	19717.6	7.3229	133.4	.011	806.4	756.6	293.1
450.0	-8.0	-5.2	22463.6	7.6074	146.4	.013	794.0	731.6	292.3
400.0	-13.4	-10.9	25468.9	7.8108	159.4	.014	784.4	706.6	291.6
350.0	-20.0	-17.3	28798.9	7.9519	172.4	.015	777.1	681.6	291.0
300.0	-28.3	-25.0	32532.4	8.0374	185.4	.016	772.3	656.6	290.6
250.0	-39.0	-34.7	36794.2	8.0789	198.4	.017	769.7	631.6	290.3
200.0	-52.0	-46.7	41777.7	8.0938	211.4	.018	768.7	606.6	290.2
150.0	100.0	-62.2	47824.2	8.0941	224.4	.019	768.7	581.6	290.2
100.0	100.0	-84.0	55609.6	8.0941	237.4	.020	768.7	556.6	290.2

Table 6. Card Input and Printer Output Using Card D (Fig. 5)

Input

TPF$.DEFAULT/A

1	34DEFAUL			
2	112.4	.36910-06	203.1	.13000-02
3	95.2	.50000-06	205.2	.14100-02
4	80.8	.90000-06	207.4	.15300-02
5	68.7	.18000-05	209.6	.16500-02
6	58.5	.25000-05	211.7	.17900-02
7	49.8	.40000-05	213.9	.19400-02
8	42.6	.50000-05	215.9	.21000-02
9	36.4	.55000-05	217.9	.22800-02
10	31.2	.70000-05	219.9	.24700-02
11	26.8	.80000-05	211.8	.26800-02
12	23.0	.10000-04	223.8	.29000-02
13	19.8	.10000-04	225.8	.31400-02
14	17.0	.10000-04	227.8	.34100-02
15	14.7	.10500-04	229.8	.36900-02
16	12.7	.10500-04	231.8	.40000-02
17	11.0	.10500-04	233.7	.40000-02
18	9.5	.11000-04	235.7	.40000-02
19	8.2	.10900-04	238.0	.40000-02
20	7.2	.10500-04	240.4	.40000-02
21	6.2	.10000-04	242.7	.40000-02
22	5.4	.95000-05	245.1	.40000-02
23	4.7	.90000-05	247.5	.40000-02
24	4.1	.80000-05	249.8	.40000-02
25	3.6	.70000-05	252.3	.40000-02
26	3.2	.69000-05	254.6	.40000-02
27	2.8	.60000-05	256.9	.40000-02
28	2.4	.58000-05	259.3	.40000-02
29	2.1	.54000-05	261.7	.40000-02
30	1.9	.54000-05	264.1	.40000-02
31	1.6	.45000-05	266.4	.40000-02
32	1.5	.40000-05	268.8	.40000-02
33	1.3	.38000-05	271.2	.40000-02
34	1.1	.36000-05	272.1	.40000-02
35	1.0	.35000-05	272.1	.40000-02

Output

DEFAULTED STRATOSPHERE PROFILES

PRESSURE MB	OZONE GM/KGM	TEMP SOUNDING K	SPECIFIC HUMIDITY GM/KGM
112.4	.36910-06	203.1	.13000-02
95.2	.50000-06	205.2	.14100-02
80.8	.90000-06	207.4	.15300-02
68.7	.18000-05	209.6	.16500-02
58.5	.25000-05	211.7	.17900-02
49.8	.40000-05	213.9	.19400-02
42.6	.50000-05	215.9	.21000-02
36.4	.55000-05	217.9	.22800-02
31.2	.70000-05	219.9	.24700-02
26.8	.80000-05	211.8	.26800-02
23.0	.10000-04	223.8	.29000-02
19.8	.10000-04	225.8	.31400-02
17.0	.10000-04	227.8	.34100-02
14.7	.10500-04	229.8	.36900-02
12.7	.10500-04	231.8	.40000-02
11.0	.10500-04	233.7	.40000-02
9.5	.11000-04	235.7	.40000-02
8.2	.10900-04	238.0	.40000-02
7.2	.10500-04	240.4	.40000-02
6.2	.10000-04	242.7	.40000-02
5.4	.95000-05	245.1	.40000-02
4.7	.90000-05	247.5	.40000-02
4.1	.80000-05	249.8	.40000-02
3.6	.70000-05	252.3	.40000-02
3.2	.69000-05	254.6	.40000-02
2.8	.60000-05	256.9	.40000-02
2.4	.58000-05	259.3	.40000-02
2.1	.54000-05	261.7	.40000-02
1.9	.54000-05	264.1	.40000-02
1.6	.45000-05	266.4	.40000-02
1.5	.40000-05	268.8	.40000-02
1.3	.38000-05	271.2	.40000-02
1.1	.36000-05	272.1	.40000-02
1.0	.35000-05	272.1	.40000-02

Table 7. Printer Output Using Card E (Fig. 5)

PRESS	SPECIFIC HUMIDITY	TEMP SOUNDING	OZONE
MB	GM/KGM	K	GM/KGM
1013.2	.22232+02	303.70	.46700-07
963.2	.21449+02	301.56	.46700-07
913.2	.19865+02	299.14	.46700-07
863.2	.18317+02	296.73	.46700-07
813.2	.16681+02	294.10	.46700-07
763.2	.14859+02	291.41	.46700-07
713.2	.13236+02	288.55	.46700-07
663.2	.11646+02	285.27	.46700-07
613.2	.10010+02	281.97	.46700-07
563.2	.84864+01	278.43	.46700-07
513.2	.73121+01	274.06	.46700-07
463.2	.59384+01	269.26	.46700-07
413.2	.43936+01	263.75	.46700-07
363.2	.31067+01	257.54	.46700-07
313.2	.19737+01	250.15	.46700-07
263.2	.10564+01	240.93	.46700-07
213.2	.45184+00	229.51	.46700-07
163.2	.98410-01	214.87	.46700-07
113.2	.20772-01	194.56	.46700-07
63.2	.11597-01	210.73	.21775-05
13.2	.24221-02	231.30	.10500-04

MODEL NUMBER 1,TROPICAL STORM AFTER RIEHL(1954)

PRT-5
ANGLE .0 DEGREES FROM NADIR
SURFACE TEMPERATURE 303.7

PRESSURE	PRECIP WATER	HEIGHT	SPECIFIC HUMIDITY	TEMP SOUNDING	CORRECTION
MB	CM	FT	GM/KGM	K	K
963.2	1.0943	1491.5	.21449+02	301.56	.23
913.2	2.1078	3049.2	.19865+02	299.14	.77
863.2	3.0424	4679.9	.18317+02	296.73	1.52
813.2	3.8934	6391.6	.16681+02	294.10	2.40
763.2	4.6515	8193.6	.14859+02	291.41	3.36
713.2	5.3268	10097.6	.13236+02	288.55	4.36
663.2	5.9210	12116.5	.11646+02	285.27	5.42
613.2	6.4317	14266.6	.10010+02	281.97	6.50
563.2	6.8647	16569.5	.84864+01	278.43	7.56
513.2	7.2378	19049.3	.73121+01	274.06	8.66
463.2	7.5498	21735.8	.59384+01	269.26	9.76
413.2	7.7649	24670.0	.43936+01	263.75	10.80
363.2	7.9234	27907.8	.31067+01	257.54	11.77
313.2	8.0241	31526.3	.19737+01	250.15	12.67
263.2	8.0780	35634.2	.10564+01	240.93	13.49
213.2	8.1011	40399.4	.45184+00	229.51	14.27
163.2	8.1061	46107.9	.98410-01	214.87	15.03
113.2	8.1072	53306.8	.20772-01	194.56	15.86
63.2	8.1078	64660.8	.11597-01	210.73	17.35
13.2	8.1079	97933.5	.24221-02	231.30	20.45

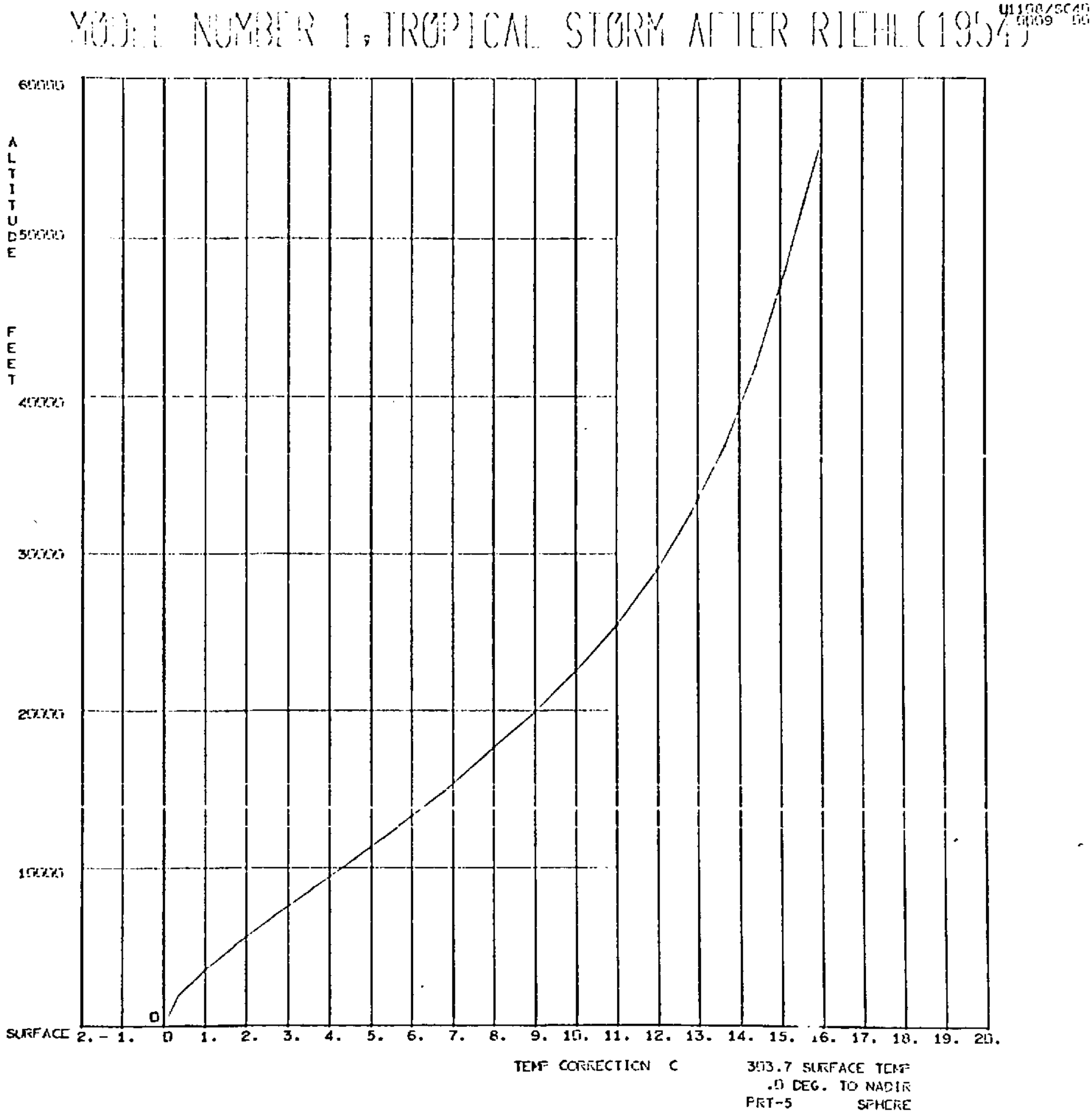
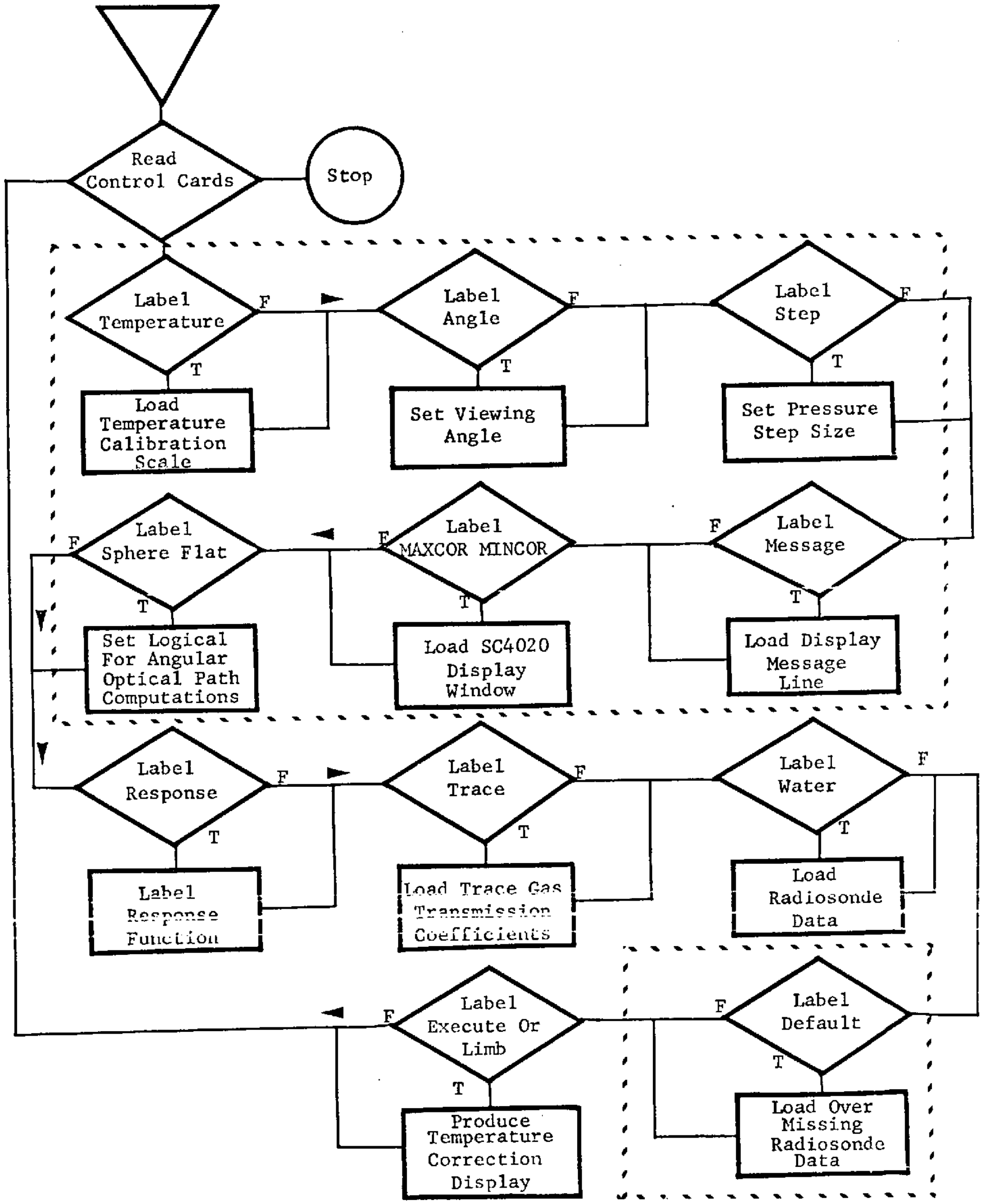


Fig. 6. Film Output Using Card E (Fig. 5).



Dashed line encloses optional functions not needed for program execution.

Fig. 7. Program Control Flown Chart 1.

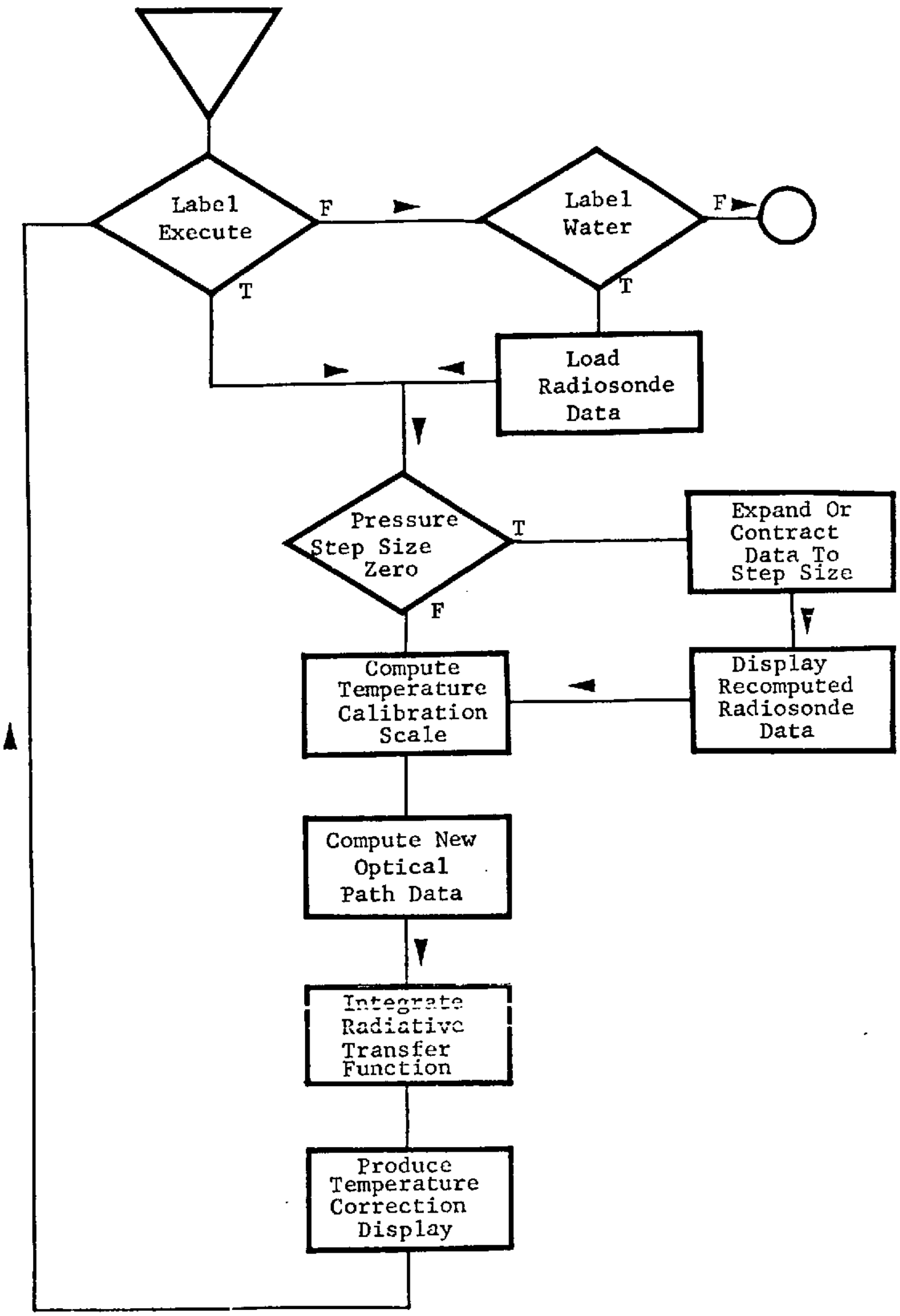


Fig. 8. Program Control Flow Chart 2.

Program Listing

D	NAME	VERSION	TYPE	DATE	TIME	SEQ	SIZE-PRE,	TEXT	(CYCLE	WORD)	PSRMODE	LOCATION
*	VAPRES	SLANT	SYMBOLIC	17 JUL 73	11'01'55	1		5	5	0	1	1792
*	TEMTAB	SLANT	SYMBOLIC	17 JUL 73	11'01'42	2		16	5	0	1	1797
*	COEF	SLANT	SYMBOLIC	17 JUL 73	11'01'58	3		28	5	0	1	1813
*	TRANS	SLANT	SYMBOLIC	17 JUL 73	11'01'47	4		26	5	0	1	1841
*	MAIN	SLANT	SYMBOLIC	17 JUL 73	11'02'05	5		128	5	0	1	1867
*	MAIN	SLANT1	SYMBOLIC	17 JUL 73	11'03'10	6		126	5	0	1	1995
*	RADMOD	SLANT1	SYMBOLIC	17 JUL 73	11'02'59	7		25	5	0	1	2121
*	RADMOD	SLANT	SYMBOLIC	17 JUL 73	11'01'51	8		27	5	0	1	2146
*	TL0007	SLANT	ABSOLUTE	17 JUL 73	11'02'54	9		563				2173
*	TL0007	SLANT1	ABSOLUTE	17 JUL 73	11'03'59	10		546				2736
*	VAPRES		RELOCATABLE	17 JUL 73	11'01'57	11	1	4				3282
*	TEMTAB		RELOCATABLE	17 JUL 73	11'01'44	12	1	8				3287
*	COEF		RELOCATABLE	17 JUL 73	11'01'59	13	1	20				3296
*	TRANS		RELOCATABLE	17 JUL 73	11'01'49	14	2	20				3317
	MODEL1		ELT SYMB	15 SEP 72	15'36'21	15		7	5	0	1	3339
	MODEL2		ELT SYMB	15 SEP 72	15'36'22	16		7	5	0	1	3346
	MODEL3		ELT SYMB	15 SEP 72	15'36'23	17		7	5	0	1	3353
	MODEL4		ELT SYMB	15 SEP 72	15'36'24	18		7	5	0	1	3360
	MODEL5		ELT SYMB	23 APR 73	09'57'13	19		7	5	0	1	3367
	MODEL6		ELT SYMB	15 SEP 72	15'36'25	20		7	5	0	1	3374
	MODEL7		ELT SYMB	15 SEP 72	15'36'25	21		7	5	0	1	3381
	MODEL8		ELT SYMB	17 JUL 73	11'04'11	22		11	5	0	1	3388
	MODEL9		ELT SYMB	17 JUL 73	11'04'12	23		7	5	0	1	3399
	MODE10		ELT SYMB	17 JUL 73	11'04'12	24		6	5	0	1	3406
	MODE11		ELT SYMB	17 JUL 73	11'04'12	25		8	5	0	1	3412
	MODE12		ELT SYMB	17 JUL 73	11'04'12	26		11	5	0	1	3420
	MODE13		ELT SYMB	17 JUL 73	11'04'13	27		8	5	0	1	3431
	OZONE		ELT SYMB	07 APR 73	08'59'10	28		24	5	0	1	3439
	FRT-5		ELT SYMB	09 JUN 72	15'56'12	29		4	5	0	1	3463
	RS-18	8-15	ELT SYMB	15 SEP 72	15'36'39	30		4	5	0	1	3467
	DEFAULT	A	ELT SYMB	31 JUL 73	09'35'20	31		10	5	0	1	3471
	DEFAULT	B	ELT SYMB	31 JUL 73	09'35'21	32		10	5	0	1	3481
*	RADMOD	SLANT	SYMBOLIC	31 JUL 73	09'35'42	33		27	5	0	1	3491
*	RADMOD		RELOCATABLE	31 JUL 73	09'35'44	34	2	13				3518
*	TRANS	SLANT1	SYMBOLIC	31 JUL 73	09'35'49	35		26	5	0	1	3533
*	TRANS		RELOCATABLE	31 JUL 73	09'35'51	36	2	20				3559
*	TRANS	SLANT	SYMBOLIC	31 JUL 73	09'35'53	37		26	5	0	1	3581
*	TRANS		RELOCATABLE	31 JUL 73	09'35'55	38	2	20				3607
*	MAIN	SLANT	SYMBOLIC	31 JUL 73	09'35'58	39		133	5	0	1	3629
*	MAIN		RELOCATABLE	31 JUL 73	09'36'04	40	4	140				3762
	RADMAP	SLANT	MAP SYMB	31 JUL 73	09'36'05	41		2	5	0	1	3906
*	TL0007	SLANT	ABSOLUTE	31 JUL 73	09'36'24	42		601				3908
*	TRANS	SLANT1	SYMBOLIC	31 JUL 73	09'36'27	43		26	5	0	1	4509
*	TRANS		RELOCATABLE	31 JUL 73	09'36'30	44	2	20				4535
*	RADMOD	SLANT1	SYMBOLIC	31 JUL 73	09'36'32	45		25	5	0	1	4557
*	RADMOD		RELOCATABLE	31 JUL 73	09'36'34	46	2	9				4582
*	MAIN	SLANT1	SYMBOLIC	31 JUL 73	09'36'39	47		132	5	0	1	4593
*	MAIN		RELOCATABLE	31 JUL 73	09'36'45	48	3	97				4725
*	TL0007	SLANT1	ABSOLUTE	31 JUL 73	09'37'04	49		556				4825
	RADMOD	SLANT	SYMBOLIC	20 AUG 73	18'50'07	50		27	5	0	1	5381
*	RADMOD		RELOCATABLE	20 AUG 73	18'50'10	51	2	13				5408
	TRANS	SLANT	SYMBOLIC	20 AUG 73	18'50'11	52		26	5	0	1	5423
*	TRANS		RELOCATABLE	20 AUG 73	18'50'13	53	2	20				5449
	VAPRES	SLANT	SYMBOLIC	20 AUG 73	18'50'15	54		5	5	0	1	5471
	VAPRES		RELOCATABLE	20 AUG 73	18'50'16	55	1	4				5476
	TEMTAB	SLANT	SYMBOLIC	20 AUG 73	18'50'17	56		16	5	0	1	5481
	TEMTAB		RELOCATABLE	20 AUG 73	18'50'19	57	1	8				5497
	COEF	SLANT	SYMBOLIC	20 AUG 73	18'50'19	58		28	5	0	1	5506
	COEF		RELOCATABLE	20 AUG 73	18'50'21	59	1	20				5534
	MAIN	SLANT	SYMBOLIC	20 AUG 73	18'50'23	60		135	5	0	1	5555
*	MAIN		RELOCATABLE	20 AUG 73	18'50'31	61	4	142				5690
	TL0007	SLANT	ABSOLUTE	20 AUG 73	18'50'47	62		601				5836
	TRANS	SLANT1	SYMBOLIC	20 AUG 73	18'50'48	63		26	5	0	1	6437
	TRANS		RELOCATABLE	20 AUG 73	18'50'51	64	2	20				6463
	RADMOD	SLANT1	SYMBOLIC	20 AUG 73	18'50'52	65		25	5	0	1	6485
	RADMOD		RELOCATABLE	20 AUG 73	18'50'54	66	2	9				6510
	MAIN	SLANT1	SYMBOLIC	20 AUG 73	18'50'56	67		132	5	0	1	6521
	MAIN		RELOCATABLE	20 AUG 73	18'51'03	68	3	97				6653
	TL0007	SLANT1	ABSOLUTE	20 AUG 73	18'51'21	69		554				6753
	TEST1		ELT SYMB	20 AUG 73	18'51'22	70		3	5	0	1	7307

NEXT AVAILABLE LOCATION- 7310

```
FOR,S   MAIN/SLANT1,MAIN,MAIN/SLANT1
FOR 9AL-08/25-18'50 (0,0)


  MAIN PROGRAM

  STORAGE USED: CODE(1) 002347  DATA(0) 000764  BLANK COMMON(2) 000000

   COMMON BLOCKS:

   0003   Z1     001464
   0004   Z2     002575
   0005   Z3     000005


  EXTERNAL REFERENCES (BLOCK, NAME)

   0006   VAFRES
   0007   TAPLOT
   0010   IDFRMV
   0011   GRIDIV
   0012   PLTNO
   0013   PLTERM
   0014   TABTEM
   0015   RADMOD
   0016   LINEV
   0017   NXV
   0020   NYV
   0021   NINTR$
   0022   NRDU$
   0023   NIO2$
   0024   NWDU$
   0025   NIO1$
   0026   ALOG
   0027   NSTOP$
   0030   NERR3$
   0031   ASIN
   0032   SIN
   0033   SQRT
   0034   NERR4$


  STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

  0001    002044 10L     0001    000576 10L     0001    002161 10L     0001    000013 100L    0001    002206 1041G
  0001    002223 1052G   0001    002277 1070G   0000    000551 11F     0000    000220 11F     0001    001403 1100L
  0000    000223 12F     0000    000575 12F     0000    000232 13F     0000    000250 14F     0000    000313 15F
  0000    000315 16F     0000    000320 17F     0000    000334 18F     0000    000344 19F     0001    000620 200L
  0000    000354 21F     0000    000363 22F     0000    000414 23F     0000    000416 24F     0000    000422 25F
  0000    000426 26F     0001    000267 264G    0000    000427 27F     0000    000431 28F     0000    000433 29F
  0001    000313 300G    0001    000132 300L    0000    000441 31F     0000    000465 32F     0000    000506 33F
  0000    000514 35F     0001    002272 40L     0001    000705 400L    0001    000640 435G    0001    000643 435G
  0001    000737 472G    0001    002104 5L      0001    000722 500L    0001    001037 524G    0001    001123 545G
  0001    001134 554G    0001    000731 600L    0001    001236 607G    0001    001267 626G    0001    001417 662G
  0001    000744 700L    0001    000771 710L    0001    001024 720L    0001    001514 721G    0001    001027 730L
  0001    001032 740L    0001    001742 773G    0001    001174 800L    0001    001366 810L    0001    001307 815L
  0003 R  000000 ABSOR   0003 R  000620 ABSORC  0003 R  001320 ABSORO  0000 R  000131 AMAX   0000 R  000130 AMIN
```

```
0005 R 000001 ANGLE     0004 R 000764 ATCENT    0000 R 000200 BEGIN     0004 R 001750 CPRESS    0004 I 002260 DEFAUL
0004 R 001440 DELTRA    0000 R 000126 DEST      0000 R 000153 DEWAVG    0000 R 000146 DEWPNT    0000 R 000145 DEWPT
0004 R 001604 EPRESS    0004 R 002111 ETEMPS    0000 R 000143 EWHOLE    0003 R 001010 EXPOND    0003 R 000144 EXPON
0003 R 000632 EXPONC    0003 R 001154 EXPONO    0000 R 000201 FINIS     0000 R 000155 FUNCTI    0000 R 000137 HEAD1
0000 R 000140 HEAD2     0000 R 000141 HEAD3     0000 R 000157 HEIGHS    0004 R 000454 HEIGHT    0000 R 000160 HIGH
0004 R 000620 HUM       0000 R 000154 HUMID     0000 R 000174 HUMIDP    0000 I 000135 I         0000 I 000161 IHIGH
0000 I 000176 II        0000   000664 INJP$     0000   000752 INJP$     0000   000711 INJP$     0000   000676 INJP$
0000   000672 INJP$     0000 I 000072 INSTR     0003 R 000310 INTER     0000 R 000000 INTERV    0000 I 000156 J
0000 I 000162 K         0000 I 000136 LABEL     0000 R 000001 LEADER    0005 I 000004 LEVELS    0000 R 000004 LIMB
0005 I 000000 LIMIT     0000 I 000213 LOCINT    0000 I 000215 LOCSIZ    0000 I 000056 MESSAG    0000 I 000070 NAME
0017 I 000000 NXV       0020 I 000000 NYV       0004 R 001130 OTCENT    0004 R 002424 OZONE     0000 R 000172 OZONEP
0000 R 000175 OZONES    0000 R 000150 PART      0000 R 000204 PART1     0000 R 000205 PART2     0000 R 000206 PART3
0000 R 000207 PART4     0000 R 000133 PHONE     0004 R 000000 PRESS     0000 R 000171 PRESSP    0000 R 000152 PRESUR
0000 R 000214 PREWAN    0003 R 000454 RESPON    0005 L 000003 SHELL     0000 R 000211 SLOPEA    0000 R 000212 SLOPEB
0001 R 001663 SPHERE    0000 R 000202 SPHERE    0000 R 000132 STEPSZ    0004 R 000310 TEMPER    0000 R 000151 TEMPOR
0000 R 000173 TEMPRE    0000 R 000163 TEMP1     0000 R 000164 TEMP2     0001 R 001720 TERP      0000 R 000210 TERP
0000 R 000203 TEST      0005 R 000002 THETA     0000 R 000134 TRANGE    0004 R 001274 TRANSM    0000 R 000144 TWHOLE
0000 R 000147 VAPER     0006 R 000000 VAPRES    0004 R 000144 WATER     0000 R 000177 WEIGH     0003 R 000644 WEIGHT
0000 R 000142 WHOLE     0000 R 000167 X         0000 R 000165 XP        0000 R 000170 Y         0000 R 000166 YP
```

```
00101          COMPILER(DATA=SHORT)
00103          EXTERNAL VAPRES
00105          REAL INTERV
00106          REAL INTER
00107          REAL LEADER
00110          REAL LIMB
00111          LOGICAL SHELL
00112          PARAMETER SIZTRA=100
00113          PARAMETER SIZPTH=100
00114          COMMON/Z1/   ABSOR(SIZTRA), EXPON(SIZTRA), INTER(SIZTRA),
00114         *             RESPON(SIZTRA),ABSORC(10),     EXPONC(10),
00114         *             WEIGHT(SIZTRA),EXPONO(SIZTRA),EXPOND(SIZTRA),
00114         *             ABSORO(SIZTRA)
00115          COMMON/Z2/   PRESS(SIZPTH), WATER(SIZPTH), TEMPER(SIZPTH),
00115         *             HEIGHT(SIZPTH),HUM(SIZPTH),    ATCENT(SIZPTH),
00115         *             OTCENT(SIZPTH),TRANSM(SIZPTH),DELTRA(SIZPTH),
00115         *             EPRESS(SIZPTH),CPRESS(SIZPTH),ETEMPS(SIZPTH),
00115         *             DEFAUL(SIZPTH),OZONE(SIZPTH)
00116          COMMON/Z3/   LIMIT,    ANGLE,    THETA,    SHELL,    LEVELS
00117          INTEGER DEFAUL
00120          DIMENSION LEADER(3)
00121          DIMENSION LIMB(42)
00122          DIMENSION MESSAG(10)
00123          DIMENSION NAME(2),INSTR(28)
00124          DIMENSION DEST(2)
00125          DATA SHELL/.TRUE./
00127          DATA AMIN/-2.0/
00131          DATA AMAX/11.0/
00133          DATA STEPSZ/0.0/
00135          DATA NAME/"J HALBACH"/,DEST/"MTF-CLC 1100"/,PHONE/"2146"/
00141          DATA INSTR/"ONE HARD COPY - ONE MICROFILM - PLOT TO EOFILE - T-020
00141         *"/
00143          DATA TRANGE/100./
00145          DATA(TEMPER(I),I=1,SIZPTH)/SIZPTH*9000./
```

```
00147            DATA(OZONE(I),I=1,SIZPTH)/SIZPTH*4.67E-8/
00147      C
00147      C     COMPUTE RADIANS FROM ANGLES
00147      C
00151            RAD(ANG)=ANG/57.29578
00151      C
00151      C     COMPUTE SPECIFIC HUMIDITY FROM PRESSURE AND VAPOR PRESSURE
00151      C
00152            RATMIX(V,P)=622.*V/(P-(.378*V))
00152      C
00152      C     COMPUTE THE INDEX OF REFRACTION OF WATER-VAPOR AT THE TEMPERATURE
00152      C     AND PRESSURE OF A GIVEN LEVEL
00152      C
00153            REFRAX(L1)=1.+(77.526E-6)*PRESS(L1)/TEMPER(L1)
00154            CALL TAPLOT(1HH)
00155            CALL IDFRMV(NAME,DEST,PHONE,INSTR)
00156      100   CONTINUE
00156      C
00156      C     INPUT CONTROL CARDS
00156      C
00157            READ(5,11,END=500) LIMIT,LABEL,HEAD1,HEAD2,HEAD3
00157      C
00157      C     SET FLAGS TO ADJUST PRECIPITATBLE WATER COMPUTATIONS FOR
00157      C     REFRACTION AT HIGH ALTITUDES
00157      C
00166            IF(LABEL.EQ."SPHERE") SHELL=.TRUE.
00170            IF(LABEL.EQ."FLAT  ")SHELL=.FALSE.
00170      C
00170      C     ADJUST DISPLAY WINDOW ON THE SC-4020 PLOTS
00170      C
00172            IF(LABEL.EQ."MAXCOR") AMAX=LIMIT
00174            IF(LABEL.EQ."MINCOR") AMIN=LIMIT
00174      C
00174      C     INPUT THE ANGLE OF OBSERVATION
00174      C
00176            IF(LABEL.EQ."ANGLE ") ANGLE=LIMIT/10.
00176      C
00176      C     INPUT RESPONSE FUNCTIONS
00176      C
00200            IF(LABEL.EQ."RESPON") GO TO 200
00200      C
00200      C     INPUT RADIOSONDE DATA
00200      C
00202            IF(LABEL.EQ."WATER ") GO TO 300
00202      C
00202      C     INPUT TEMPERATURE RANGE OF 100 POINT TABLE
00202      C
00204            IF(LABEL.EQ."TEMPER") GO TO 400
00204      C
00204      C     INPUT MESSAGE LINES DESCRIBING OUTPUT
00204      C
00206            IF(LABEL.EQ."MESSAG") GO TO 600
00206      C
00206      C     COMPUTE A LIMB FUNCTION TO 50 DEGREES CENTERED AT A GIVEN NADIR
00206      C     ANGLE
00206      C
00210            IF(LABEL.EQ."LIMB  ") GO TO 700
```

```
00210     C
00210     C     RECORD A PRESSURE INCREMENT TO ESTABLISH THE STEP SIZE FOR RADIOSONDE
00210     C     DATA FROM THE SURFACE TO ONE MILLIBAR
00210     C
00212           IFαLABEL.EQ."STEP  ") STEPSZ=LIMIT
00212     C
00212     C     OVER-WRITE MISSING RADIOSONDE DATA TO SATELLITE ALTITUDE WITH DEFAULT
00212     C     DATA
00212     C
00214           IFαLABEL.EQ."DEFAUL") GO TO 800
00214     C
00214     C     INPUT SPECIAL TRACE GAS TRANSMISSION FUNCTIONS
00214     C
00216           IFαLABEL.EQ."TRACE") GO TO 1100
00220           GO TO 100
00221     300   CONTINUE
00221     C
00221     C     SET OBSERVATION ANGLE
00221     C
00222           THETA=RADαANGLE)
00222     C
00222     C     INITIALIZE PRECIPITABLE WATER COMPUTATION
00222     C
00223           WHOLE=0.
00223     C
00223     C     INITIALIZE EFFECTIVE PRESSURE COMPUTATION
00223     C
00224           EWHOLE=0
00224     C
00224     C     INITIALIZE EFFECTIVE TEMPERATURE COMPUTATION
00224     C
00225           TWHOLE=0.
00225     C
00225     C     INPUT SURFACE RADIOSONDE DATA
00225     C
00226           READα5,12) PRESSα1),DEWPT,TEMPERα1),HEIGHTα1),OZONEα1)
00235           DEFAULα1)=0
00236           IFαHEAD2.NE."KELVIN") DEWPT=DEWPT+273.16
00240           IFαHEAD2.NE."KELVIN") TEMPERα1)=TEMPERα1)+273.16
00242           IFαHEAD3.NE."OZONE") OZONEα1)=4.67E-8
00244           IFαHEAD3.NE."OZONE ") FLDα2,1,DEFAULα1))=1
00246           DEWPNT=DEWPT
00246     C
00246     C     COMPUTE SURFACE VAPOR PRESSURE
00246     C
00247           VAPER=VAPRESαDEWPT)
00247     C
00247     C     USE DEW-POINT GREATER THAN 77 DEGREES TO ASSUME 10 PERCENT
00247     C     RELATIVE HUMIDITY
00247     C
00250           IFαDEWPT.GE.350.) VAPER=VAPRESαTEMPERα1))*.1
00252           IFαDEWPT.GE.350.) FLDα3,1,DEFAULα1))=1
00252     C
00252     C     COMPUTE THE SURFACE SPECIFIC HUMIDITY
00252     C
00254           PART=RATMIXαVAPER,PRESSα1))
00254     C
```

```
00254    C      STORE THE SPECIFIC HUMIDITY COMPUTED AT THE SURFACE
00254    C
00255           HUM(1)=PART
00255    C
00255    C      THE ATMOS-CENTIMETERS OF CARBON DIOXIDE AND OZONE AT THE SURFACE
00255    C
00256           ATCENT(1)=0.
00257           OTCENT(1)=0.
00257    C
00257    C      THE EFFECTIVE PRESSURE AT THE SURFACE IS EQUAL TO THE RADIOSONDE
00257    C      SURFACE PRESSURE
00257    C
00260           EPRESS(1)=PRESS(1)
00261           CPRESS(1)=PRESS(1)
00261    C
00261    C      LABEL THIS PAGE OF ABSORBING GAS CONCENTRATIONS.
00261    C
00262           WRITE(6,27) (MESSAG(I),I=1,10)
00270           DEWPT=DEWPT-273.16
00271           TEMPOR=TEMPER(1)-273.16
00272           WRITE(6,14) PRESS(1),DEWPT,TEMPOR
00277           DO 10 I=2,LIMIT
00277    C
00277    C      EXTRACT A LEVEL'S DATA
00277    C
00302           READ(5,12) PRESS(I),DEWPT,TEMPER(I),HEIGHT(I),OZONE(I)
00311           DEFAUL(I)=0
00311    C
00311    C      CONVERT HEIGHT TO FEET IF NEEDED
00311    C
00312           IF(HEAD1.EQ.'METERS') HEIGHT(I)=HEIGHT(I)*3.2808
00312    C
00312    C      COMPUTE AVERAGE PRESSURE OF A LAYER
00312    C
00314           PRESUR=(PRESS(I)+PRESS(I-1))/2.
00314    C
00314    C      CONVERT FROM CENTIGRADE TO KELVIN IF NEEDED
00314    C
00315           IF(HEAD2.NE.'KELVIN') DEWPT=DEWPT+273.16
00317           IF(HEAD2.NE.'KELVIN') TEMPER(I)=TEMPER(I)+273.16
00317    C
00317    C      IMPOSE A CONSTANT OZONE PROFILE IF NEEDED
00317    C
00321           IF(HEAD3.NE.'OZONE') OZONE(I)=4.67E-8
00323           IF(HEAD3.NE.'OZONE ') FLD(2,1,DEFAUL(I))=1
00323    C
00323    C      COMPUTE THE AVERAGE LAYER DEW POINT
00323    C
00325           DEWAVG=(DEWPNT+DEWPT)/2.
00325    C
00325    C      COMPUTE THE VAPOR PRESSURE
00325    C
00326           VAPER=VAPRES(DEWAVG)
00326    C
00326    C      USE DEW-POINT GREATER THAN 77 DEGREES TO ASSUME 10 PERCENT
00326    C      RELATIVE HUMIDITY
00326    C
```

```
00327          IFαDEWPT.GE.350.) VAPER=VAPRESαTEMPERαI))*.1
00331          IFαDEWPT.GE.350.) FLDα3,1,DEFAULαI))=1
00331     C
00331     C    COMPUTE THE MIXING RATIO OF THIS LAYER
00331     C
00333          HUMID=622.*VAPER/αPRESUR-VAPER)
00333     C
00333     C    COMPUTE THE AVERAGE TEMPERATURE OF THIS LAYER
00333     C
00334          TEMPOR=αTEMPERαI)+TEMPERαI-1))/2.
00334     C
00334     C    COMPUTE THE HEIGHT OF THE TOP OF THIS LAYER IF NEEDED
00334     C
00335          IFαHEIGHTαI).LE.0.)
00335         *HEIGHTαI)=HEIGHTαI-1)+29.3*TEMPOR*ALOGαPRESSαI-1)/PRESSαI))
00335         **α1.+.00061*HUMID)*3.2808
00335     C
00335     C    STORE THE SPECIFIC HUMIDITY AT EACH LAYER TOP
00335     C
00337          HUMαI)=RATMIXαVAPER,PRESUR)
00337     C
00337     C    COMPUTE THE PRECIPITABLE WATER AT THIS LEVEL
00337     C
00340          WATERαI)=WATERαI-1)+αHUMαI)*SPHEREα$10,I)*αPRESSαI-1)-PRESSαI)))/
00340         *   980.
00340     C
00340     C    COMPUTE THE ATMOS-CENTIMETERS OF CARBON-DIOXIDE AND OZONE TO THIS
00340     C    LAYER
00340     C
00341          ATCENTαI)=αPRESSαI)-PRESSαI))*.260
00342          OTCENTαI)=OTCENTαI-1)+αPRESSαI-1)-PRESSαI))*αOZONEαI)+OZONEαI-1))*
00342         *   237.968
00342     C
00342     C    COMPUTE THE EFFECTIVE TEMPERATURES AND PRESSURES USED TO RELATE
00342     C    HOMOGENEOUS PATH TRANSMISSION FUNCTIONS TO INHOMOGENEOUS SLANT
00342     C    PATHS THROUGH THE ATMOSPHERE
00342     C
00343          EWHOLE=EWHOLE+αWATERαI)-WATERαI-1))*PRESUR
00344          TWHOLE=TWHOLE+αWATERαI)-WATERαI-1))*TEMPOR
00345          CPRESSαI)=αPRESSαI)+PRESSαI))/2.
00346          EPRESSαI)=EWHOLE/WATERαI)
00347          ETEMPSαI)=TWHOLE/WATERαI)
00347     C
00347     C    COMPUTE CENTIGRADE VALUES FOR DISPLAY
00347     C
00350          DEWAVG=DEWPT-273.16
00351          TEMPOR=TEMPERαI)-273.16
00351     C
00351     C    PRINT INTERMEDIATE RESULTS OF THIS PROCESS
00351     C
00352          WRITEα6,13) PRESSαI),DEWAVG,TEMPOR,HEIGHTαI),WATERαI),ATCENTαI),
00352         *   OTCENTαI),EPRESSαI),CPRESSαI),ETEMPSαI)
00366          DEWPNT=DEWPT
00367     10   CONTINUE
00371     11   FORMATαI10,A6,6X,3A6)                                                -01
00372     12   FORMATα1X,F7.1,2X,F6.1,4X,F7.1,3X,F10.1,E10.5)
00373     13   FORMATα1X,F7.1,2X,F6.1,4X,F7.1,3X,F10.1,1X,F7.4,1X,F6.1,F6.3,2X,
```

```
00373          *F6.1,
00373          *6X,F6.1,6X,F5.1)
00374    14     FORMAT(" PRESSURE  DEW POINT  TEMPERATURE HEIGHT  PRECIP  ATMOS-CE
00374          *NT  EFFECTIVE  CONSTANT      EFFECTIVE",/," ",F7.1,2X,F6.1,4X,F7.1
00374          *,"          FEET      WA.ER    CO2  OZONE PRESSURE   CONCENTRATION TEMP
00374          *ERATURE")
00375    15     FORMAT(F7.1,F7.4)
00376    16     FORMAT(1X,F7.1,F7.4)
00377    17     FORMAT(7H ANGLE ,F4.1,20H DEGREES FROM NADIR ,/,20H SURFACE TEMPER
00377          *ATURE,F7.1)
00400    18     FORMAT(1X,36HTEMPERATURE RANGE OF 100 POINT TABLE)
00401    19     FORMAT(  42H1WAVENUMBER MIDPOINTS AND PERCENT RESPONSE)
00402    21     FORMAT(  37H1TEMPERATURE RANGE OF 100 POINT TABLE)
00403    22     FORMAT(51H0PRECIP    HEIGHT    SPECIFIC    TEMP        CORRECTION,/,
00403          *38H WATER                HUMIDITY   SOUNDING,/,
00403          *42H CM         FT         GM/KGM       K            K)
00404    23     FORMAT(1H ,3A6)
00405    24     FORMAT(F4.1,14H DEG. TO NADIR)
00406    25     FORMAT(F5.1,13H SURFACE TEMP)
00407    26     FORMAT(10A6)
00410    27     FORMAT(1H1,10A6,/)
00411    28     FORMAT(4E10.5)
00412    29     FORMAT(1X,F6.1,"-",F6.1,4(3X,F7.4))
00413    31     FORMAT(1H0,3A6,/," WAVENUMBER        A((ATMOS-CENT((B)((EP((C)",/,
00413          *" INTERVAL             A            B            C            WEIGHT")
00414    32     FORMAT("0INTERPOLATED LIMB FUNCTION TO ",F7.0," FEET ",F5.1,
00414          *" DEGREES FROM NADIR",2(/,1X,21(F6.2)))
00415    33     FORMAT(1X,F7.1,2X,E10.5,2X,F6.1,2X,E10.5)
00416    35     FORMAT("1DEFAULTED STRATOSPHERE PROFILES",/,                              NEW
00416          *        " PRESSURE OZONE        TEMP        SPECIFIC",/,                NEW
00416          *        "                       SOUNDING    HUMIDITY",/,                NEW
00416          *        " MB        GM/KGM      K           GM/KGM")                    NEW
00417           CALL GRID1V(1,-50.,50.,AMIN,AMAX,10.,.5,0,0,1,1,4,4)
00420           GO TO 100
00420          C
00420          C     INPUT RESPONSE FUNCTIONS AS PERCENTAGES AT MIDPOINTS OF EACH
00420          C     INTERVAL
00420          C
00421    200    CONTINUE
00422           LEADER(1)=HEAD1
00423           LEADER(2)=HEAD2
00424           LEADER(3)=HEAD3
00425           WRITE(6,19)
00427           DO 30 I=1,85
00432    30     RESPON(I)=0.
00434           DO 40 I=1,LIMIT
00437           READ(5,15) INTERV,FUNCTI
00443           WRITE(6,16) INTERV,FUNCTI
00447           J=(INTERV-12.5)/25.
00450    40     RESPON(J)=FUNCTI
00452           GO TO 100
00452          C
00452          C     INPUT THE TEMPERATURE RANGE OF THE BLACK-BODY INTENSITY/
00452          C     TEMPERATURE SCALE IN CENTIGRADE
00452          C
00453    400    READ(5,15) TRANGE
00456           WRITE(6,18)
```

```
00460          WRITE«6,16) TRANGE
00463          GO TO 100
00464     500  CONTINUE
00465          CALL FLTND«0)
00466          CALL FLTERM
00467          STOP
00467     C
00467     C    INPUT DISPLAY LABELS
00467     C
00470     600  READ«5,26)«MESSAG«I),I=1,10)
00476          GO TO 100
00476     C
00476     C    PRODUCE A LIMB FUNCTION DISPLAY TO 50 DEGREES CENTERED AT THE
00476     C    GIVEN NADIR ANGLE
00476     C
00477     700  CONTINUE
00500          HEIGHS=LIMIT                                                        NEW
00501          IF«STEPSZ.GT.0.) CALL STEPER
00503          IF«STEPSZ.GT.0.) CALL DISPLY
00503     C
00503     C    ESTABLISH A TEMPERATURE/BLACKBODY INTENSITY SCALE
00503     C
00505          CALL TABTEM«TEMPER«1),TRANGE)
00506          I=1
00507     710  I=I+1
00507     C
00507     C    DETERMINE INDEX TO INTERPOLATION LEVELS FROM THE REQUESTED HEIGHT
00507     C
00510          IF«I.GT.100) GO TO 730
00512          IF«HEIGHS.GE.HEIGHT«I-1).AND.HEIGHS.LE.HEIGHT«I)) GO TO 720        NEW
00514          IF«HEIGHT«I).LE.0.) GO TO 730                                       NEW
00516          GO TO 710                                                           -02
00517     720  HIGH=HEIGHS                                                         NEW
00520          GO TO 740                                                           -01
00520     C
00520     C    DATA UNAVAILABLE FOR THE REQUESTED INTERPOLATION
00520     C
00521     730  HIGH=HEIGHT«I-1)
00522     740  IHIGH=I-1
00523          DO 750 K=1,21
00523     C
00523     C    COMPUTE THE LIMB ANGLE FROM NADIR IN 5 DEGREE STEPS
00523     C
00526          LIMB«K)=ANGLE-55.+K*5.
00527          THETA=RAD«LIMB«K))
00527     C
00527     C    COMPUTE THE LOWER LAYER TEMPERATURE
00527     C
00530          LIMIT=IHIGH
00531          CALL CPATHS
00532          CALL RADMOD«TEMP1)
00533          IF«LIMIT.EQ.1) TEMP1=0.
00533     C
00533     C    COMPUTE THE UPPER LAYER TEMPERATURE
00533     C
00535          LIMIT=IHIGH+1
00536          CALL RADMOD«TEMP2)
```

```
00536     C
00536     C     INTERPOLATE A TEMPERATURE TO THE REQUESTED HEIGHT
00536     C
00537     750   LIMD(K+21)=TERP(HEIGHT(LIMIT-1),HEIGHT(LIMIT),TEMP1,TEMP2,HIGH)
00541           WRITE(6,32) HIGH,ANGLE,(LIMD(K),K=1,42)
00551           XP=-50.
00552           YP=0.
00553           DO 760 I=1,21
00556           X=LIMD(I)
00557           Y=LIMD(I+21)
00560           CALL LINEV(NXV(XP),NYV(YP),NXV(X),NYV(Y))
00561           XP=X
00562     760   YP=Y
00564           GO TO 100
00565     800   CONTINUE
00565     C
00565     C     READ DEFAULT PROFILES AND INTERPOLATE MISSING DATA
00565     C
00566           IF(STEPSZ.GT.0) CALL STEPER                                    NEW
00570           WRITE(6,35)                                                    NEW
00572           READ(5,33,END=100) PRESSP,OZONEP,TEMPRE,HUMIDP
00600           WRITE(6,33)        PRESSP,OZONEP,TEMPRE,HUMIDP
00606           DO 820 J=2,LIMIT
00611           READ(5,33,END=100) PRESUR,OZONES,TEMPOR,HUMID
00617           WRITE(6,33)        PRESUR,OZONES,TEMPOR,HUMID
00617     C
00617     C     SCAN REQUESTED LEVELS FOR DEFAULT PRESSURE WINDOW
00617     C
00625           DO 810 I=2,LEVELS
00630           IF(PRESS(I).LT.PRESSP.AND.PRESS(I).GE.PRESUR) GO TO 815
00632           GO TO 810
00633     815   CONTINUE
00633     C
00633     C     INTERPOLATE MISSING TEMPERATURE
00633     C
00634           IF(TEMPER(I).GT.1000.) TEMPER(I)=TERP(PRESSP,PRESUR,TEMPRE,TEMPOR,
00634          *   PRESS(I))
00634     C
00634     C     INTERPOLATE MISSING SPECIFIC HUMIDITY
00634     C
00636           IF(FLD(3,1,DEFAUL(I)).EQ.1) HUM(I)=TERP(PRESSP,PRESUR,HUMIDP,HUMID
00636          *   ,PRESS(I))
00636     C
00636     C     INTERPOLATE MISSING OZONE
00636     C
00640           IF(FLD(2,1,DEFAUL(I)).EQ.1) OZONE(I)=TERP(PRESSP,PRESUR,OZONEP,
00640          *   OZONES,PRESS(I))
00642     810   CONTINUE
00642     C
00642     C     FETCH NEXT LEVEL DEFAULT PARAMETERS
00642     C
00644           PRESSP=PRESUR
00645           OZONEP=OZONES
00646           TEMPRE=TEMPOR
00647           HUMIDP=HUMID
00650     820   CONTINUE
00652           GO TO 100
```

```
00652     C
00652     C      INPUT TRACE GAS TRANSMISSION FUNCTIONS WHERE
00652     C
00652     C      WEIGHT TRUNCATED TO AN INTEGER IS AN INDEX TO THE WAVENUMBER
00652     C             INTERVAL FOR WHICH THIS ANALYTIC FUNCTION APPLYS
00652     C
00652     C      WEIGHT FRACTION IS THE GEOMETRIC MEAN WEIGHTING MODIFIED BY THE
00652     C             PLANCKIAN FUNCTION FOR THE WAVE-NUMBER INTERVAL FRACTION
00652     C             OF THIS ANALYTIC FUNCTION
00652     C
00652     C      ABSCRO = A        THESE ARE PARAMETERS APPEARING IN ANALYTIC
00652     C      EXPOMO = B        FUNCTIONS OF THE FORM  A*(ATMOS-CENT**B)*(EP**C)
00652     C      EXPONO = C        FOR THE INTERVAL AND WEIGHTING DESCRIBED ABOVE
00652     C
00653     1100   CONTINUE
00654            WRITE(6,31) HEAD1,HEAD2,HEAD3
00661            DO 1110 I=1,LIMIT
00664            IF(I.GT.100) GO TO 100
00666            READ(5,28,END=100) WEIGHT(I),ABSCRO(I),EXPOMO(I),EXPONO(I)
00674            II=WEIGHT(I)
00675            WEIGH=WEIGHT(I)-II
00676            BEGIN=INTER(II)-12.5
00677            FINIS=INTER(II)+12.5
00700            WRITE(6,29) BEGIN,FINIS,ABSCRO(I),EXPOMO(I),EXPONO(I),WEIGH
00710     1110   CONTINUE
00712            GO TO 100
00713            SUBROUTINE DISPLY
00713     C
00713     C      THIS SUBROUTINE DISPLAYS THE MODIFIED DATA BASE
00713     C
00716            WRITE(6,11)
00720            DO 10 I=1,LEVELS
00723     10     WRITE(6,12) PRESS(I),HUM(I),TEMPER(I),OZONE(I)
00732     11     FORMAT("1PRESS     SPECIFIC    TEMP     OZONE",/,
00732           *        "          HUMIDITY    SOUNDING",/,
00732           *        " MB       GM/KGM      K        GM/KGM")
00733     12     FORMAT(1X,F7.1,1X,E10.5,2X,F6.2,1X,E10.5)
00734            LIMIT=LEVELS
00735            RETURN
00736            FUNCTION SPHERE(*,L)
00736     C
00736     C      THIS IS A CONDITIONAL FUNCTION WHICH MODIFIES THE PRECIPITABLE
00736     C      WATER AT SATELLITE ALTITUDES FOR THE SPHERICAL SHAPE OF THE
00736     C      EARTH
00736     C
00741            SPHERE=1.
00742            IF(.NOT.SHELL) RETURN
00742     C
00742     C      TEST IS THE SINE OF THE ANGLE OF OBSERVATION TO THE HORIZON
00742     C
00744            TEST=20898696./(20898696.+HEIGHT(L))
00744     C
00744     C      NO COMPUTATIONS ARE MADE WHEN THE FIELD OF VIEW IS ABOVE THE
00744     C      HORIZON
00744     C
00745            IF(THETA.GT.ASIN(TEST)) RETURN1
00745     C
```

```
00745   C      HIGH IS THE AVERAGE HEIGHT OF THE WATER VAPOR LAYER
00745   C
00747          HIGH=αHEIGHTαL)+HEIGHTαL-1))/2.
00747   C
00747   C      ADD THE AVERAGE HEIGHT OF THE LAYER TO THE RADIUS OF THE EARTH
00747   C
00750          PART1=HIGH+20898696.
00750   C
00750   C      MULTIPLY BY THE MEAN INDEX OF REFRACTION AT THE AVERAGE HEIGHT
00750   C      OF THIS LAYER
00750   C
00751          PART2=PART1*αREFRAXαL)+REFRAXαL-1))/2.
00751   C
00751   C      MULTIPLY BY THE INDEX OF REFRACTION AT THE HEIGHT OF THE SENSOR
00751   C      AND BY THE SINE OF THE ANGLE OF OBSERVATION
00751   C
00752          PART3=PART1*REFRAXαL)*SINαTHETA)
00753          PART4=SQRTααPART2*PART2)-αPART3*PART3))
00753   C
00753   C      COMPUTE THE MEAN FUNCTION ASSUMING THE OBSERVING SENSOR IS JUST
00753   C      ABOVE THE MEAN LAYER TO WHICH IT IS APPLIED
00753   C
00754          SPHERE=PART2/PART4
00755          RETURN
00756          FUNCTION TERPαX1,X2,Y1,Y2,X)
00756   C
00756   C      THIS FUNCTION PERFORMS LAGRANGIAN INTERPOLATION
00756   C
00761          SLOPEA=αX-X2)/αX1-X2)
00762          SLOPEB=αX-X1)/αX2-X1)
00763          TERP=SLOPEA*Y1+SLOPEB*Y2
00764          RETURN
00765          SUBROUTINE OPATHS
00765   C
00765   C      THIS SUBROUTINE COMPUTES ANGLE DEPENDENT OPTICAL PATHS
00765   C
00770          EWHOLE=0.
00771          TWHOLE=0.
00772          DO 10 I=2,LIMIT
00775          OTCENTαI)=OTCENTαI-1)+αPRESSαI-1)-PRESSαI))*αOZONEαI)+OZONEαI-1))*
00775         *  237.968
00776          WATERαI)=WATERαI-1)+αHUMαI)*SPHEREα$10,I)*αPRESSαI-1)-PRESSαI)))/
00776         *  980.
00777          PRESUR=αPRESSαI)+PRESSαI-1))/2.
01000          TEMPOR=αTEMPERαI)+TEMPERαI-1))/2.
01001          ATCENTαI)=αPRESSα1)-PRESSαI))*.260
01002          EWHOLE=EWHOLE+αWATERαI)-WATERαI-1))*PRESUR
01003          TWHOLE=TWHOLE+αWATERαI)-WATERαI-1))*TEMPOR
01004          EPRESSαI)=EWHOLE/WATERαI)
01005          ETEMPSαI)=TWHOLE/WATERαI)
01006          IFαI.GT.1)
01006         *HEIGHTαI)=HEIGHTαI-1)+29.3*TEMPOR*ALOGαPRESSαI-1)/PRESSαI))
01006         **α1.+.00061*HUMαI))*3.2808
01010   10     CONTINUE
01012          RETURN                                                          -05
01013          SUBROUTINE STEPER
01013   C
```

```
01013   C     THIS SUBROUTINE EXPANDS OR CONTRACTS THE DATA TO THE NEEDED STEP SIZE
01013   C
01016         J=1
01017         LOCINT=MIN(PRESS(1)/STEPSZ,SIZFTH)
01017   C
01017   C     TEST FOR END OF AVAILABLE DATA
01017   C
01020   5     IF(J.GT.LOCINT) RETURN
01020   C
01020   C     SET AVAILABLE DATA
01020   C
01022         PRESSP=PRESS(J)
01023         PRESUR=PRESS(J+1)
01023   C
01023   C     SET WANTED DATA
01023   C
01024         TEMPRE=TEMPER(J)
01025         TEMPOR=TEMPER(J+1)
01026         OZONEP=OZONE(J)
01027         OZONES=OZONE(J+1)
01030         HUMIDP=HUM(J)
01031         HUMID=HUM(J+1)
01032         PREWAN=PRESS(1)-STEPSZ*J
01032   C
01032   C     IS WANTED DATA WITHIN AVAILABLE DATA WINDOW
01032   C
01033         IF(PREWAN.LT.PRESSP.AND.PREWAN.GE.PRESUR) GO TO 10
01035         GO TO 40
01036   10    CONTINUE
01036   C
01036   C     HOW MANY LEVELS OF WANTED DATA ARE WITHIN WINDOW
01036   C
01037         LOCSIZ=(PRESSP-PRESUR)/STEPSZ
01037   C
01037   C     MAKE SPACE IN AVAILABLE DATA FOR WANTED DATA
01037   C
01040         DO 20 K=LEVELS,J,-1
01043         PRESS(K+LOCSIZ)=PRESS(K)
01044         TEMPER(K+LOCSIZ)=TEMPER(K)
01045         OZONE(K+LOCSIZ)=OZONE(K)
01046   20    HUM(K+LOCSIZ)=HUM(K)
01050         LEVELS=LEVELS+LOCSIZ
01050   C
01050   C     LOAD DATA OVER WANTED INTERVAL
01050   C
01051         DO 30 K=1,LOCSIZ
01054         J=J+1
01055         TEMPER(J)=TERP(PRESSP,PRESUR,TEMPRE,TEMPOR,PREWAN)
01056         OZONE(J)=TERP(PRESSP,PRESUR,OZONEP,OZONES,PREWAN)
01057         HUM(J)=TERP(PRESSP,PRESUR,HUMIDP,HUMID,PREWAN)
01060         PRESS(J)=PREWAN
01061         PREWAN=PREWAN-STEPSZ
01062         DEFAUL(J)=DEFAUL(J-1)
01063   30    CONTINUE
01063   C
01063   C     RESET BOTTOM LEVEL OF AVAILABLE DATA
01063   C
```

```
01565        GO TO 5
01566   40   CONTINUE
01566   C
01566   C    DESTROY TOP LEVEL OF AVAILABLE DATA
01566   C
01567        DO 50 K=J,LEVELS
01572        PRESS(K+1)=PRESS(K+2)
01573        TEMPER(K+1)=TEMPER(K+2)
01574        OZONE(K+1)=OZONE(K+2)
01575        HUM(K+1)=HUM(K+2)
01576        DEFAUL(K+1)=DEFAUL(K+2)
01577   50   CONTINUE
01101        LEVELS=LEVELS-1
01102        GO TO 5
01103        END

     END OF COMPILATION'        NO DIAGNOSTICS.


 PREP   TPF$.
PURPUR 0256-08/20-18'51
```

```
 FOR,S    MAIN/SLANT,MAIN,MAIN/SLANT
FOR 9*L-08/20-18'50 (0,0)


   MAIN PROGRAM

   STORAGE USED' CODE(1) 002555  DATA(0) 000750  BLANK COMMON(2) 000000

    COMMON BLOCKS'

    0003   Z1      001464
    0004   Z2      015530
    0005   Z3      000005


   EXTERNAL REFERENCES (BLOCK, NAME)

    0006   VAPRES
    0007   TAPLOT
    0010   IDFRMV
    0011   TABTEM
    0012   SETMIV
    0013   GRIDIV
    0014   PRINTV
    0015   LINEV
    0016   NXV
    0017   NYV
    0020   NNCOD$
    0021   APRNTV
    0022   CHSIZV
    0023   RITE2V
    0024   RADMOD
    0025   FLTND
    0026   FLTERM
    0027   NINTR$
    0030   NRDU$
    0031   NIO2$
    0032   NWDU$
    0033   NIO1$
    0034   ALOG
    0035   NSTOP$
    0036   ASIN
    0037   SIN
    0040   SQRT
    0041   NERR4$
    0042   NERR3$


   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000600 10L      0001   002252 10L      0001   002367 10L      0001   000013 100L     0001   002042 1004G
    0001   002143 1036G    0000   000465 11F      0000   000150 11F      0001   001603 1100L    0001   002414 1105G
    0001   002431 1116G    0001   002505 1134G    0000   000511 12F      0000   000153 12F      0000   000162 13F
    0000   000200 14F      0000   000243 15F      0000   000245 16F      0000   000250 17F      0000   000264 18F
    0000   000274 19F      0001   001250 200L     0000   000304 21F      0000   000313 22F      0000   000351 23F
    0000   000353 24F      0000   000357 25F      0000   000363 26F      0001   000271 264G     0000   000364 27F
    0000   000366 28F      0000   000370 29F      0001   000315 300G     0001   000132 300L     0000   000376 31F
```

```
0000     000422 33F      0000     000430 35F      0001     000603 390L     0001     002505 40L      0001     001330 400L
0001     000631 427G     0001     000722 454G     0001     000767 464G     0001     002312 5L       0001     001352 500L
0001     001241 543G     0001     001270 561G     0001     001273 566G     0001     001361 600L     0001     001367 623G
0001     001436 652G     0001     001467 671G     0001     001620 725G     0001     001374 800L     0001     001566 810L
0001     001507 815L     0003 R 000000 ABSOR    0003 R 000620 ABSORC   0003 R 001320 ABSORO   0000 R 000063 AMAX
0000 R 000062 AMIN     0005 R 000001 ANGLE    0004 R 004704 ATCENT   0000 R 000126 BEGIN    0004 R 011610 CPRESS
0004 I 013560 DEFAUL   0004 R 007640 DELTRA   0000 R 000057 DEST     0000 R 000104 DEWAVG   0000 R 000077 DEWPNT
0000 R 000076 DEWPT    0004 R 010624 EPRESS   0004 R 012574 ETEMPS   0000 R 000074 EWHOLE   0003 R 001010 EXPOMD
0003 R 000144 EXPON    0003 R 000632 EXPONC   0003 R 001154 EXPOND   0000 R 000127 FINIS    0000 R 000116 FUNCTI
0000 R 000016 HEADER   0000 R 000070 HEAD1    0000 R 000071 HEAD2    0000 R 000072 HEAD3    0004 R 002734 HEIGHT
0000 R 000132 HIGH     0004 R 003720 HUM      0000 R 000105 HUMID    0000 R 000122 HUMIDP   0000 I 000066 I
0000 I 000107 IFUNCT   0000 I 000124 II       0000     000656 INJP$   0000     000652 INJP$   0000     000675 INJP$
0000     000662 INJP$   0000     000666 INJP$   0000 I 000023 INSTR    0003 R 000310 INTER    0000 R 000000 INTERV
0000 I 000106 J        0000 I 000110 JFUNCT   0000 I 000145 K        0000 I 000067 LABEL    0000 R 000001 LEADER
0005 I 000004 LEVELS   0000 I 000115 LIM      0005 I 000000 LIMIT    0000 I 000142 LOCINT   0000 I 000144 LOCSIZ
0000 I 000004 MESSAG   0000 I 000021 NAME     0000 I 000114 NLAST    0016 I 000000 NXV      0017 I 000000 NYV
0004 R 005670 OTCENT   0004 R 014544 OZONE    0000 R 000120 OZONEP   0000 R 000123 OZONES   0000 R 000101 PART
0000 R 000133 PART1    0000 R 000134 PART2    0000 R 000135 PART3    0000 R 000136 PART4    0000 R 000064 PHONE
0004 R 000000 PRESS    0000 R 000117 PRESSP   0000 R 000103 PRESUR   0000 R 000143 PREWAN   0003 R 000454 RESPON
0005 L 000003 SHELL    0000 R 000140 SLOPEA   0000 R 000141 SLOPEB   0001 R 002022 SPHERE   0000 R 000130 SPHERE
0000 R 000061 STEPSZ   0004 R 001750 TEMPER   0000 R 000102 TEMPOR   0000 R 000121 TEMPRE   0000 R 000137 TERP
0001 R 002121 TERP     0000 R 000131 TEST     0005 R 000002 THETA    0000 R 000065 TRANGE   0004 R 006654 TRANSM
0000 R 000075 TWHOLE   0000 R 000100 VAPER    0006 R 000000 VAPRES   0004 R 000764 WATER    0000 R 000125 WEIGH
0003 R 000644 WEIGHT   0000 R 000073 WHOLE    0000 R 000112 X        0000 R 000113 XP       0000 R 000111 Y
```

```
00101      1*          COMPILER(DATA=SHORT)
00103      2*          EXTERNAL VAPRES
00105      3*          REAL INTERV
00106      4*          REAL INTER
00107      5*          REAL LEADER
00110      6*          LOGICAL SHELL
00111      7*          PARAMETER SIZTRA=100
00112      8*          PARAMETER SIZPTH=500
00113      9*          COMMON/Z1/   ABSOR(SIZTRA), EXPON(SIZTRA), INTER(SIZTRA),
00113     10*      *                RESPON(SIZTRA),ABSORC(10),    EXPONC(10),
00113     11*      *                WEIGHT(SIZTRA),EXPOMD(SIZTRA),EXPOND(SIZTRA),
00113     12*      *                ABSORO(SIZTRA)
00114     13*          COMMON/Z2/   PRESS(SIZPTH), WATER(SIZPTH), TEMPER(SIZPTH),
00114     14*      *                HEIGHT(SIZPTH),HUM(SIZPTH),   ATCENT(SIZPTH),
00114     15*      *                OTCENT(SIZPTH),TRANSM(SIZPTH),DELTRA(SIZPTH),
00114     16*      *                EPRESS(SIZPTH),CPRESS(SIZPTH),ETEMPS(SIZPTH),
00114     17*      *                DEFAUL(SIZPTH),OZONE(SIZPTH)
00115     18*          COMMON/Z3/   LIMIT,    ANGLE,    THETA,    SHELL,    LEVELS
00116     19*          DIMENSION LEADER(3)
00117     20*          DIMENSION MESSAG(10)
00120     21*          DIMENSION HEADER(3)
00121     22*          DIMENSION NAME(2),INSTR(28)
00122     23*          DIMENSION DEST(2)
00123     24*          DATA SHELL/.TRUE./
00125     25*          DATA STEPSZ/0.0/
00127     26*          INTEGER DEFAUL
00130     27*          DATA AMIN/-2.0/
00132     28*          DATA AMAX/11.0/
00134     29*          DATA NAME/"R CLARK"/,DEST/"MTF  T-020"/,PHONE/"2146"/
```

```
00140          DATA INSTR/"ONE HARD COPY - ONE MICROFILM - PLOT TO ECFILE - T-020
00140         *"/
00142          DATA TRANGE/100./
00144          DATA(TEMPER(I),I=1,SIZPTH)/SIZPTH*9000./
00146          DATA(OZONE(I),I=1,SIZPTH)/SIZPTH*4.67E-8/
00146    C
00146    C     COMPUTE RADIANS FROM ANGLES
00146    C
00150          RAD(ANG)=ANG/57.29578
00150    C
00150    C     COMPUTE SPECIFIC HUMIDITY FROM PRESSURE AND VAPOR PRESSURE
00150    C
00151          RATMIX(V,P)=622.*V/(P-(.378*V))
00151    C
00151    C     COMPUTE THE INDEX OF REFRACTION OF WATER-VAPOR AT THE TEMPERATURE
00151    C     AND PRESSURE OF A GIVEN LEVEL
00151    C
00152          REFRAX(L1)=1.+(77.526E-6)*PRESS(L1)/TEMPER(L1)
00153          CALL TAPLOT(1HM)
00154          CALL IDFRMV(NAME,DEST,PHONE,INSTR)
00155    100   CONTINUE
00155    C
00155    C     INPUT CONTROL CARDS
00155    C
00156          READ(5,11,END=500) LIMIT,LABEL,HEAD1,HEAD2,HEAD3
00156    C
00156    C     SET FLAGS TO ADJUST PRECIPITATBLE WATER COMPUTATIONS FOR
00156    C     REFRACTION AT HIGH ALTITUDES
00156    C
00165          IF(LABEL.EQ."SPHERE") SHELL=.TRUE.
00167          IF(LABEL.EQ."FLAT  ")SHELL=.FALSE.
00167    C
00167    C     ADJUST DISPLAY WINDOW ON THE SC-4020 PLOTS
00167    C
00171          IF(LABEL.EQ."MAXCOR") AMAX=LIMIT
00173          IF(LABEL.EQ."MINCOR") AMIN=LIMIT
00173    C
00173    C     INPUT THE ANGLE OF OBSERVATION
00173    C
00175          IF(LABEL.EQ."ANGLE ") ANGLE=LIMIT/10.
00175    C
00175    C     INPUT RESPONSE FUNCTIONS
00175    C
00177          IF(LABEL.EQ."RESPON") GO TO 200
00177    C
00177    C     INPUT RADIOSONDE DATA
00177    C
00201          IF(LABEL.EQ."WATER ") GO TO 300
00201    C
00201    C     INPUT TEMPERATURE RANGE OF 100 POINT TABLE
00201    C
00203          IF(LABEL.EQ."TEMPER") GO TO 400
00203    C
00203    C     EXECUTE WITH DATA FROM PREVIOUS SOUNDING
00203    C
00205          IF(LABEL.EQ."EXECUT") GO TO 390
00205    C
```

```
00205   C       RECORD A PRESSURE INCREMENT TO ESTABLISH THE STEP SIZE FOR RADIOSONDE
00205   C       DATA FROM THE SURFACE TO ONE MILLIBAR
00205   C
00207           IF(LABEL.EQ."STEP  ") STEPSZ=LIMIT
00207   C
00207   C       INPUT MESSAGE LINES DESCRIBING OUTPUT
00207   C
00211           IF(LABEL.EQ."MESSAG") GO TO 600
00211   C
00211   C       OVER-WRITE MISSING RADIOSONDE DATA TO SATELLITE ALTITUDE WITH DEFAULT
00211   C       DATA
00211   C
00213           IF(LABEL.EQ."DEFAUL") GO TO 800
00213   C
00213   C       INPUT SPECIAL TRACE GAS TRANSMISSION FUNCTIONS
00213   C
00215           IF(LABEL.EQ."TRACE") GO TO 1100
00217           GO TO 100
00220   300     CONTINUE
00220   C
00220   C       RECORD NUMBER OF LEVELS FOR INPUT RADIOSONDE
00220   C
00221           LEVELS=LIMIT
00221   C
00221   C       SET OBSERVATION ANGLE
00221   C
00222           THETA=RAD(ANGLE)
00222   C
00222   C       INITIALIZE PRECIPITABLE WATER COMPUTATION
00222   C
00223           WHOLE=0.
00223   C
00223   C       INITIALIZE EFFECTIVE PRESSURE COMPUTATION
00223   C
00224           EWHOLE=0
00224   C
00224   C       INITIALIZE EFFECTIVE TEMPERATURE COMPUTATION
00224   C
00225           TWHOLE=0.
00225   C
00225   C       INPUT SURFACE RADIOSONDE DATA
00225   C
00226           READ(5,12) PRESS(1),DEWPT,TEMPER(1),HEIGHT(1),OZONE(1)
00235           DEFAUL(1)=0
00236           IF(HEAD2.NE."KELVIN") DEWPT=DEWPT+273.16
00240           IF(HEAD2.NE."KELVIN") TEMPER(1)=TEMPER(1)+273.16
00242           IF(HEAD3.NE."OZONE ") FLD(2,1,DEFAUL(1))=1
00244           IF(HEAD3.NE."OZONE") OZONE(1)=4.67E-8
00246           DEWPNT=DEWPT
00246   C
00246   C       COMPUTE SURFACE VAPOR PRESSURE
00246   C
00247           VAPER=VAPRES(DEWPT)
00247   C
00247   C       USE DEW-POINT GREATER THAN 77 DEGREES TO ASSUME 10 PERCENT
00247   C       RELATIVE HUMIDITY
00247   C
```

```
00250        IF(DEWPT.GE.350.) VAPER=VAPRES(TEMPER(1))*.1
00252        IF(DEWPT.GE.350.) FLD(3,1,DEFAUL(1))=1
00252   C
00252   C    COMPUTE THE SURFACE SPECIFIC HUMIDITY
00252   C
00254        PART=RATMIX(VAPER,PRESS(1))
00254   C
00254   C    STORE THE SPECIFIC HUMIDITY COMPUTED AT THE SURFACE
00254   C
00255        HUM(1)=PART
00255   C
00255   C    THE ATMOS-CENTIMETERS OF CARBON DIOXIDE AND OZONE AT THE SURFACE
00255   C
00256        ATCENT(1)=0.
00257        OTCENT(1)=0.
00257   C
00257   C    THE EFFECTIVE PRESSURE AT THE SURFACE IS EQUAL TO THE RADIOSONDE
00257   C    SURFACE PRESSURE
00257   C
00260        EPRESS(1)=PRESS(1)
00261        CPRESS(1)=PRESS(1)
00261   C
00261   C    LABEL THIS PAGE OF ABSORBING GAS CONCENTRATIONS.
00261   C
00262        WRITE(6,27) (MESSAG(I),I=1,10)
00270        DEWPT=DEWPT-273.16
00271        TEMPOR=TEMPER(1)-273.16
00272        WRITE(6,14) PRESS(1),DEWPT,TEMPOR
00277        DO 10 I=2,LIMIT
00277   C
00277   C    EXTRACT A LEVEL"S DATA
00277   C
00302        READ(5,12) PRESS(I),DEWPT,TEMPER(I),HEIGHT(I),OZONE(I)
00311        DEFAUL(I)=0
00311   C
00311   C    CONVERT HEIGHT TO FEET IF NEEDED
00311   C
00312        IF(HEAD1.EQ."METERS") HEIGHT(I)=HEIGHT(I)*3.2808
00312   C
00312   C    COMPUTE AVERAGE PRESSURE OF A LAYER
00312   C
00314        PRESUR=(PRESS(I)+PRESS(I-1))/2.
00314   C
00314   C    CONVERT FROM CENTIGRADE TO KELVIN IF NEEDED
00314   C
00315        IF(HEAD2.NE."KELVIN") DEWPT=DEWPT+273.16
00317        IF(HEAD2.NE."KELVIN") TEMPER(I)=TEMPER(I)+273.16
00317   C
00317   C    IMPOSE A CONSTANT OZONE PROFILE IF NEEDED
00317   C
00321        IF(HEAD3.NE."OZONE") OZONE(I)=4.67E-8
00323        IF(HEAD3.NE."OZONE ") FLD(2,1,DEFAUL(I))=1
00323   C
00323   C    COMPUTE THE AVERAGE LAYER DEW POINT
00323   C
00325        DEWAVG=(DEWPNT+DEWPT)/2.
00325   C
```

```
00325     C      COMPUTE THE VAPOR PRESSURE
00325     C
00326            VAPER=VAPRESαDEWAVG)
00326     C
00326     C      USE DEW-POINT GREATER THAN 77 DEGREES TO ASSUME 10 PERCENT
00326     C      RELATIVE HUMIDITY
00326     C
00327            IFαDEWPT.GE.350.) VAPER=VAPRESαTEMPERαI))*.1
00331            IFαDEWPT.GE.350.) FLDα3,1,DEFAULαI))=1
00331     C
00331     C      COMPUTE THE MIXING RATIO OF THIS LAYER
00331     C
00333            HUMID=622.*VAPER/αPRESUR-VAPER)
00333     C
00333     C      COMPUTE THE AVERAGE TEMPERATURE OF THIS LAYER
00333     C
00334            TEMPOR=αTEMPERαI)+TEMPERαI-1))/2.
00334     C
00334     C      COMPUTE THE HEIGHT OF THE TOP OF THIS LAYER IF NEEDED
00334     C
00335            IFαHEIGHTαI).LE.0.)
00335           *HEIGHTαI)=HEIGHTαI-1)+29.3*TEMPOR*ALOGαPRESSαI-1)/PRESSαI))
00335           **α1.+.00061*HUMID)*3.2808
00335     C
00335     C      STORE THE SPECIFIC HUMIDITY AT EACH LAYER TOP
00335     C
00337            HUMαI)=RATMIXαVAPER,PRESUR)
00337     C
00337     C      COMPUTE THE PRECIPITABLE WATER AT THIS LEVEL
00337     C
00340            WATERαI)=WATERαI-1)+αHUMαI)*SPHEREα$10,I)*αPRESSαI-1)-PRESSαI)))/
00340           *  980.
00340     C
00340     C      COMPUTE THE ATMOS-CENTIMETERS OF CARBON-DIOXIDE AND OZONE TO THIS
00340     C      LAYER
00340     C
00341            ATCENTαI)=αPRESSα1)-PRESSαI))*.260
00342            OTCENTαI)=OTCENTαI-1)+αPRESSαI-1)-PRESSαI))*αOZONEαI)+OZONEαI-1))*
00342           *  237.968
00342     C
00342     C      COMPUTE THE EFFECTIVE TEMPERATURES AND PRESSURES USED TO RELATE
00342     C      HOMOGENEOUS PATH TRANSMISSION FUNCTIONS TO INHOMOGENEOUS SLANT
00342     C      PATHS THROUGH THE ATMOSPHERE
00342     C
00343            EWHOLE=EWHOLE+αWATERαI)-WATERαI-1))*PRESUR
00344            TWHOLE=TWHOLE+αWATERαI)-WATERαI-1))*TEMPOR
00345            CPRESSαI)=αPRESSα1)+PRESSαI))/2.
00346            EPRESSαI)=EWHOLE/WATERαI)
00347            ETEMPSαI)=TWHOLE/WATERαI)
00347     C
00347     C      COMPUTE CENTIGRADE VALUES FOR DISPLAY
00347     C
00350            DEWAVG=DEWPT-273.16
00351            TEMPOR=TEMPERαI)-273.16
00351     C
00351     C      PRINT INTERMEDIATE RESULTS OF THIS PROCESS
00351     C
```

```
00352          WRITE(6,13) PRESS(I),DEWAVG,TEMPOR,HEIGHT(I),WATER(I),ATCENT(I),
00352         *   OTCENT(I),EPRESS(I),CPRESS(I),ETEMPS(I)
00366          DEWPNT=DEWPT
00367     10   CONTINUE
00371          GO TO 100                                                          NEW
00372     11   FORMAT(I10,A6,6X,3A6)
00373     12   FORMAT(1X,F7.1,2X,F6.1,4X,F7.1,3X,F10.1,E10.5)
00374     13   FORMAT(1X,F7.1,2X,F6.1,4X,F7.1,3X,F10.1,1X,F7.4,1X,F6.1,F6.3,2X,
00374         *F6.1,
00374         *6X,F6.1,6X,F5.1)
00375     14   FORMAT(" PRESSURE  DEW POINT  TEMPERATURE HEIGHT  PRECIP  ATMOS-CE
00375         *NT  EFFECTIVE  CONSTANT      EFFECTIVE",/," ",F7.1,2X,F6.1,4X,F7.1
00375         *,"         FEET     WATER     CO2  OZONE PRESSURE   CONCENTRATION TEMP
00375         *ERATURE")
00376     15   FORMAT(F7.1,F7.4)
00377     16   FORMAT(1X,F7.1,F7.4)
00400     17   FORMAT(7H ANGLE ,F4.1,20H DEGREES FROM NADIR ,/,20H SURFACE TEMPER
00400         *ATURE,F7.1)
00401     18   FORMAT(1X,36HTEMPERATURE RANGE OF 100 POINT TABLE)
00402     19   FORMAT(  42H1WAVENUMBER MIDPOINTS AND PERCENT RESPONSE)
00403     21   FORMAT(  37H1TEMPERATURE RANGE OF 100 POINT TABLE)
00404     22   FORMAT(" PRESSURE PRECIP   HEIGHT     SPECIFIC    TEMP        CORRECTI
00404         *ON",/, "            WATER                HUMIDITY    SOUNDING",/,
00404         *        " MB         CM         FT        GM/KGM      K            K")
00405     23   FORMAT(1H ,3A6)
00406     24   FORMAT(F4.1,14H DEG. TO NADIR)
00407     25   FORMAT(F5.1,13H SURFACE TEMP)
00410     26   FORMAT(10A6)
00411     27   FORMAT(1H1,10A6,/)
00412     28   FORMAT(4E10.5)
00413     29   FORMAT(1X,F6.1,"-",F6.1,4(3X,F7.4))
00414     31   FORMAT(1H0,3A6,/," WAVENUMBER       A*(ATMOS-CENT**B)*(EP**C)",/,
00414         *" INTERVAL            A            B            C          WEIGHT")
00415     33   FORMAT(1X,F7.1,2X,E10.5,2X,F6.1,2X,E10.5)
00416     35   FORMAT("1DEFAULTED STRATOSPHERE PROFILES",/,                       NEW
00416         *        " PRESSURE OZONE         TEMP        SPECIFIC",/,            NEW
00416         *        "                        SOUNDING    HUMIDITY",/,            NEW
00416         *        " MB         GM/KGM      K           GM/KGM")                NEW
00417    390   CONTINUE
00420          IF(STEPSZ.GT.0.) CALL STEPER
00422          IF(STEPSZ.GT.0.) CALL DISPLY
00422     C
00422     C    ESTABLISH A TEMPERATURE BLACKBODY INTENSITY SCALE
00422     C
00424          CALL TABTEM(TEMPER(1),TRANGE)
00424     C
00424     C    PRODUCE A DISPLAY TO SHOW TEMPERATURE CORRECTION AS A FUNCTION OF
00424     C    LINE OF SIGHT ANGLE, HEIGHT IN METERS, AND PRECIPITABLE WATER.
00424     C
00425          WRITE(6,27) (MESSAG(I),I=1,10)
00433          IF(SHELL) LEADER(3)="SPHERE"
00435          WRITE(6,23) LEADER(1),LEADER(2),LEADER(3)
00442          WRITE(6,17) ANGLE,TEMPER(1)
00446          WRITE(6,22)
00450          CALL SETMIV(100,100,100,50)
00451          CALL GRID1V(1,AMIN,AMAX,0.,60000.,1.,70000.,0,0,1,1,3,3)
00452          CALL PRINTV(18,LEADER,703,48)
```

```
 FOR,S    RADMOD/SLANT1,RADMOD,RADMOD/SLANT1
FOR 9AL-08/25-18'50 (0,0)

   SUBROUTINE RADMOD    ENTRY POINT 000210

   STORAGE USED' CODE(1) 000222  DATA(0) 000046  BLANK COMMON(2) 000000

    COMMON BLOCKS'

    0003    Z1       001464
    0004    Z2       002570
    0005    Z3       000005

   EXTERNAL REFERENCES (BLOCK, NAME)

    0006    TRANS
    0007    TEMTAD
    0010    COS
    0011    EXP
    0012    NERR3$

   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000005 121G      0001    000020 127G      0001    000126 143G      0001    000157 30L       0003    000000 ABSOR
    0003    007620 ABSORC    0003    001320 ABSORO    0005    000001 ANGLE     0004 R 000764 ATCENT    0000 R 000013 ATMOS
    0004    001750 CPRESS    0004    002260 CETAUL    0004 R 001440 DELTRA    0000 R 000014 DETECT    0000 R 000015 DRTEMP
    0004    001604 EPRESS    0004    002114 ETEMPS    0003    001010 EXPOMO    0003    000144 EXPON     0003    000632 EXPONC
    0003    001154 EXPOND    0004    000454 HEIGHT    0004    000620 HUM       0000 I 000004 I         0000    000024 INJP$
    0000 R 000001 INTEN     0003 R 000310 INTER     0000 R 000000 INTERV    0000 I 000002 J         0005    000004 LEVELS
    0005 I 000000 LIMIT     0004 R 001130 OTCENT    0004    002424 OZONE     0004    000000 PRESS     0003 R 000454 RESPON
    0000 R 000011 SFCDB     0005 L 000003 SHELL     0004 R 000310 TEMPER    0000 R 000012 TEMPOR    0005 R 000002 THETA
    0006 R 000000 TRANS     0004 R 001274 TRANSM    0004 R 000144 WATER     0000 R 000006 WATERC    0000 R 000007 WATERO
    0000 R 000005 WATERS    0000 R 000003 WAVEND    0003    000644 WEIGHT    0000 R 000010 WHOLE


00101           SUBROUTINE RADMOD(DLTEMP)
00101        C
00101        C     THIS SUBROUTINE INTEGRATES THE RADIATIVE TRANSFER FUNCTION USING
00101        C     THE TRAPEZOID RULE.
00101        C
00103           LOGICAL SHELL
00104           EXTERNAL  TRANS
00105           REAL  INTER
00106           REAL  INTERV,INTEN
00107           PARAMETER SIZTRA=100
00110           PARAMETER SIZPTH=100
00111           COMMON/Z1/   ABSOR(SIZTRA), EXPON(SIZTRA), INTER(SIZTRA),
00111          *             RESPON(SIZTRA),ABSORC(10),    EXPONC(10),
00111          *             WEIGHT(SIZTRA),EXPOMO(SIZTRA),EXPOND(SIZTRA),
00111          *             ABSORO(SIZTRA)
00112           COMMON/Z2/   PRESS(SIZPTH), WATER(SIZPTH), TEMPER(SIZPTH),
```

```
00112        *              HEIGHTαSIZFTH),HUMαSIZFTH),   ATCENTαSIZFTH),
00112        *              OTCENTαSIZFTH),TRANSMαSIZFTH),DELTRAαSIZFTH),
00112        *              EPRESSαSIZFTH),CPRESSαSIZFTH),ETEMPSαSIZFTH),
00112        *              DEFAULαSIZFTH),OZONEαSIZFTH)
00113             COMMON/Z3/  LIMIT,    ANGLE,    THETA,    SHELL,    LEVELS
00113        C
00113        C    ARITHMETIC FUNCTIONS
00113        C
00114             BBODYαV,T)=α8.9349E-13*V**3)/αEXPαα1.4385*V)/T)-1.0)
00115             TEMPαD,V,W)=α1.4385*V)/ALOGαααW*8.9346E-13*V**3)/D)+1.)
00115        C
00115        C    INTEN IS THE SUMMATION OF PRODUCTS αRADIANT INTENSITY TIMES
00115        C    WAVE NUMBER INTERVAL)
00115        C
00116             INTEN=0.
00116        C
00116        C    INTERV IS THE WAVE NUMBER INTERVAL
00116        C
00117             INTERV=25.
00120             DO 30 J=1,85
00120        C
00120        C    SKIP INTERVALS HAVING A ZERO RESPONSE FUNCTION.
00120        C
00123             IFαRESPONαJ).LE.0.) GO TO 30
00123        C
00123        C    WAVENO IS THE MEAN WAVENUMBER OF THE INTERVAL BEING EVALUATED
00123        C
00125             WAVENO=INTERαJ)
00126             DO 10 I=1,LIMIT
00126        C
00126        C    COMPUTE THE OPTICAL PATHS OF ABSORBING GASES
00126        C
00131             WATERS=αWATERαLIMIT)-WATERαI))/COSαTHETA)
00131        C
00131        C    FOR SATELLITE ALTITUDE COMPUTATIONS THE OPTICAL PATH OF WATER
00131        C    VAPOR MUST INCLUDE THE INDEX OF REFRACTION CHANGES
00131        C
00132             IFαSHELL) WATERS = WATERαLIMIT)-WATERαI)
00134             WATERC=αATCENTαLIMIT)-ATCENTαI))/COSαTHETA)
00135             WATERO=αOTCENTαLIMIT)-OTCENTαI))/COSαTHETA)
00135        C
00135        C    COMPUTE THE TRANSMISSIVITY FOR EACH LEVEL
00135        C
00136        10   TRANSMαI)=TRANSαWAVENO,WATERS,WATERC,WATERO,I)
00136        C
00136        C    INITIALIZE THE UPWELLING RADIATION
00136        C
00140             ANGLE=0.
00140        C
00140        C    FOR THIS INTERVAL COMPUTE THE EXTINCTION OF A SURFACE IMAGE.
00140        C
00141             SFCBB=TRANSMα1)*BBODYαWAVENO,TEMPERα1))
00141        C
00141        C    USING WATER VAPOR, CARBON DIOXIDE AND OZONE AS THE INDEPENDENT
00141        C    VARIABLES INTEGRATE THE CONTRIBUTIONS OF EACH ATMOSPHERIC LAYER
00141        C    TO THE IMAGE IN THIS INTERVAL
00141        C
```

```
00142          DO 20 I=2,LIMIT
00142     C
00142     C    FIND THE CHANGE IN TRANSMISSION BETWEEN LAYERS
00142     C
00145          DELTRA(I)=TRANSM(I)-TRANSM(I-1)
00145     C
00145     C    FIND THE AVERAGE TEMPERATURE OF A LAYER
00145     C
00146          TEMPOR=(TEMPER(I)+TEMPER(I-1))/2.
00146     C
00146     C    COMPUTE THE EMISSION FROM THAT LAYER
00146     C
00147          ATMOS=BBODY(WAVENO,TEMPOR)
00147     C
00147     C    WHOLE IS THE SUM OF PRODUCTS (ATMOSPHERIC INTENSITY TIMES CHANGE
00147     C    IN TRANSMISSION)
00147     C
00150          WHOLE=WHOLE+(ATMOS*DELTRA(I))
00151     20   CONTINUE
00151     C
00151     C    INTEGRATE UPWELLING RADIATION FOR THIS INSTRUMENT
00151     C
00153          INTEN=INTEN+(WHOLE+SFCBB)*RESPON(J)
00154     30   CONTINUE
00156          DETECT=INTEN*INTERV
00156     C
00156     C    EXTRACT A MATCHING DETECTOR TEMPERATURE FROM THE CALIBRATION TABLE
00156     C
00157          CALL TEMTAB(DETECT,DRTEMP)
00160          DLTEMP=TEMPER(1)-DRTEMP
00160     C
00160     C    DISPLAY TEMPERATURE CORRECTION AS A FUNCTION OF PRECIPITABLE WATER
00160     C    HEIGHT OF THE OBSERVATION PLATFORM.
00160     C
00161          RETURN
00162          END

      END OF COMPILATION:        NO DIAGNOSTICS.
```

```
FOR,S    RADMIC/SLANT,RADMIC,RADMIC/SLANT
FOR 9*L-08/20-18'50 *0,0)


   SUBROUTINE RADMIC      ENTRY POINT 000276


   STORAGE USED' CODE*1) 000306  DATA*0) 000065  BLANK COMMON*2) 000000

    COMMON BLOCKS'

    0003    Z1        001464
    0004    Z2        015530
    0005    Z3        000005


   EXTERNAL REFERENCES *BLOCK, NAME)

    0006    TRANS
    0007    TEMTAB
    0010    LINEV
    0011    NXV
    0012    NYV
    0013    COS
    0014    EXP
    0015    NWDU$
    0016    NIO2$
    0017    NERR3$


   STORAGE ASSIGNMENT  *BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0000    000023 11F      0001    000021 125G     0001    000034 133G     0001    000142 147G     0001    000173 30L
    0003    000000 ABSOR    0003    000620 ABSORC   0003    001320 ABSORO   0005    000001 ANGLE    0004 R 004704 ATCENT
    0000 R 000015 ATMOS    0004    011610 CPRESS   0004    013500 DEFAUL   0004 R 007640 DELTRA   0000 R 000016 DETECT
    0000 R 000020 DLTEMP   0000 R 000017 DRTEMP   0004    010624 EPRESS   0004    012574 ETEMPS   0003    001010 EXPOND
    0003    000144 EXPON    0003    000632 EXPONC   0003    001154 EXPOND   0004 R 002734 HEIGHT   0004 R 003720 HUM
    0000 I 000006 I        0000    000042 INJP$    0000 R 000001 INTEN    0003 R 000310 INTER    0000 R 000000 INTERV
    0000 I 000004 J        0005    000004 LEVELS   0005 I 000000 LIMIT    0011 I 000000 NXV      0012 I 000000 NYV
    0004 R 005670 OTCENT   0004    014544 OZONE    0004 R 000000 PRESS    0003 R 000454 RESPON   0000 R 000013 SFCEB
    0005 L 000003 SHELL    0004 R 001750 TEMPER   0000 R 000014 TEMPOR   0005 R 000002 THETA    0006 R 000000 TRANS
    0004 R 006654 TRANSM   0004 R 000764 WATER    0000 R 000010 WATERC   0000 R 000011 WATERO   0000 R 000007 WATERS
    0000 R 000005 WAVEND   0003    000644 WEIGHT   0000 R 000012 WHOLE    0000 R 000021 X        0000 R 000002 XP
    0000 R 000022 Y        0000 R 000003 YP



 00101      1*          SUBROUTINE RADMIC
 00101      2*     C
 00101      3*     C    THIS SUBROUTINE INTEGRATES THE RADIATIVE TRANSFER FUNCTION USING
 00101      4*     C    THE TRAPEZOID RULE.
 00101      5*     C
 00103      6*          LOGICAL SHELL
 00104      7*          EXTERNAL TRANS
 00105      8*          REAL INTER
 00106      9*          REAL INTERV,INTEN
```

```
      PARAMETER SIZPTH=500
      PARAMETER SIZTRA=100
      COMMON/Z1/  ABSORB(SIZTRA), EXPON(SIZTRA), INTER(SIZTRA),
     *            RESPON(SIZTRA),ABSORC(10),    EXPONC(10),
     *            WEIGHT(SIZTRA),EXPONO(SIZTRA),EXPOND(SIZTRA),
     *            ABSORO(SIZTRA)
      COMMON/Z2/  PRESS(SIZPTH), WATER(SIZPTH), TEMPER(SIZPTH),
     *            HEIGHT(SIZPTH),HUM(SIZPTH),   ATCENT(SIZPTH),
     *            OTCENT(SIZPTH),TRANSM(SIZPTH),DELTRA(SIZPTH),
     *            EPRESS(SIZPTH),CPRESS(SIZPTH),ETEMPS(SIZPTH),
     *            DEFAUL(SIZPTH),OZONE(SIZPTH)
      COMMON/Z3/  LIMIT,    ANGLE,    THETA,    SHELL,    LEVELS
C
C     ARITHMETIC FUNCTIONS
C
      BBODY(V,T)=(8.9349E-13*V**3)/(EXP((1.4385*V)/T)-1.0)
      TEMP(D,V,W)=(1.4385*V)/ALOG(((W*8.9346E-13*V**3)/D)+1.)
      IF(LIMIT.EQ.2) XP=0.0
      IF(LIMIT.EQ.2) YP=0.0
C
C     INTEN IS THE SUMMATION OF PRODUCTS (RADIANT INTENSITY TIMES
C     WAVE NUMBER INTERVAL)
C
      INTEN=0.
C
C     INTERV IS THE WAVE NUMBER INTERVAL
C
      INTERV=25.
      DO 30 J=1,85
C
C     SKIP INTERVALS HAVING A ZERO RESPONSE FUNCTION.
C
      IF(RESPON(J).LE.0.) GO TO 30
C
C     WAVENO IS THE MEAN WAVENUMBER OF THE INTERVAL BEING EVALUATED
C
      WAVENO=INTER(J)
      DO 10 I=1,LIMIT
C
C     COMPUTE THE OPTICAL PATHS OF ABSORBING GASES
C
      WATERS=(WATER(LIMIT)-WATER(I))/COS(THETA)
C
C     FOR SATELLITE ALTITUDE COMPUTATIONS THE OPTICAL PATH OF WATER
C     VAPOR MUST INCLUDE THE INDEX OF REFRACTION CHANGES
C
      IF(SHELL) WATERS = WATER(LIMIT)-WATER(I)
      WATERC=(ATCENT(LIMIT)-ATCENT(I))/COS(THETA)
      WATERO=(OTCENT(LIMIT)-OTCENT(I))/COS(THETA)
C
C     COMPUTE THE TRANSMISSIVITY FOR EACH LEVEL
C
   10 TRANSM(I)=TRANS(WAVENO,WATERS,WATERC,WATERO,I)
C
C     INITIALIZE THE UPWELLING RADIATION
C
      WHOLE=0.
```

```
00144    C
00144    C       FOR THIS INTERVAL COMPUTE THE EXTINCTION OF A SURFACE IMAGE.
00144    C
00145            SFCBB=TRANSM(1)*BBODY(WAVEND,TEMPER(1))
00145    C
00145    C       USING WATER VAPOR, CARBON DIOXIDE AND OZONE AS THE INDEPENDENT
00145    C       VARIABLES INTEGRATE THE CONTRIBUTIONS OF EACH ATMOSPHERIC LAYER
00145    C       TO THE IMAGE IN THIS INTERVAL
00145    C
00146            DO 20 I=2,LIMIT
00146    C
00146    C       FIND THE CHANGE IN TRANSMISSION BETWEEN LAYERS
00146    C
00151            DELTRA(I)=TRANSM(I)-TRANSM(I-1)
00151    C
00151    C       FIND THE AVERAGE TEMPERATURE OF A LAYER
00151    C
00152            TEMPOR=(TEMPER(I)+TEMPER(I-1))/2.
00152    C
00152    C       COMPUTE THE EMISSION FROM THAT LAYER
00152    C
00153            ATMOS=BBODY(WAVEND,TEMPOR)
00153    C
00153    C       WHOLE IS THE SUM OF PRODUCTS (ATMOSPHERIC INTENSITY TIMES CHANGE
00153    C       IN TRANSMISSION)
00153    C
00154            WHOLE=WHOLE+(ATMOS*DELTRA(I))
00155    20      CONTINUE
00155    C
00155    C       INTEGRATE UPWELLING RADIATION FOR THIS INSTRUMENT
00155    C
00157            INTEN=INTEN+(WHOLE+SFCBB)*RESPON(J)
00160    11      FORMAT(1X,F7.1,2X,F7.4,1X,F8.1,E10.5,3X,F7.2,4X,F7.2)
00161    30      CONTINUE
00163            DETECT=INTEN*INTERV
00163    C
00163    C       EXTRACT A MATCHING DETECTOR TEMPERATURE FROM THE CALIBRATION TABLE
00163    C
00164            CALL TEMTAB(DETECT,DRTEMP)
00165            DLTEMP=TEMPER(1)-DRTEMP
00165    C
00165    C       DISPLAY TEMPERATURE CORRECTION AS A FUNCTION OF PRECIPITABLE WATER
00165    C       HEIGHT OF THE OBSERVATION PLATFORM.
00165    C
00166            WRITE(6,11)PRESS(LIMIT),WATER(LIMIT),HEIGHT(LIMIT),HUM(LIMIT),
00166           *  TEMPER(LIMIT),DLTEMP
00176            X=DLTEMP
00177            Y=HEIGHT(LIMIT)
00200            CALL LINEV(NXV(XP),NYV(YP),NXV(X),NYV(Y))
00201            XP=X
00202            YP=Y
00203            RETURN
00204            END

      END OF COMPILATION:        NO DIAGNOSTICS.
```

```
 FOR,S    TRANS/SLANT1,TRANS,TRANS/SLANT1
FOR 9AL-08/25-18:55 (0,0)


   FUNCTION TRANS        ENTRY POINT 000066


   STORAGE USED: CODE(1) 000510  DATA(0) 000103  BLANK COMMON(2) 000000

    COMMON BLOCKS:

    0003    Z1      001464
    0004    Z2      002570


   EXTERNAL REFERENCES (BLOCK, NAME)

    0005    NEXP6$
    0006    ALOG10
    0007    EXP
    0010    NERR3$


   STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001     000447 10L       0001     000045 100L      0001     000266 1200L     0001     000400 1760      0001     000353 2150L
    0001     000146 550L      0001     000233 800L      0000 R 000007 A         0003 R 000000 ABSOR     0003 R 000620 ABSORC
    0003 R 001320 ABSORO     0004 R 000764 ATCENT     0000 R 000010 B         0000 R 000013 BETA      0000 R 000011 C
    0004 R 001750 CPRESS     0000 R 000012 D          0004 R 002200 DEFAUL    0004 R 001440 DELTRA    0004 R 001604 EPRESS
    0004 R 002114 ETEMPS     0003 R 001010 EXPOND     0003 R 000144 EXPON     0003 R 000030 EXPONC    0003 R 001154 EXPONO
    0004 R 000454 HEIGHT     0004 R 000620 HUM        0000 I 000001 I         0000 I 000020 INDEX     0000   000052 INJP$
    0000   000056 INJP$      0003 R 000310 INTER      0000 I 000017 J         0000 R 000002 ONE       0004 R 001130 OTCENT
    0004 R 002424 OZONE      0000 R 000005 PRATIC     0000 R 000004 PRATIO    0004 R 000000 PRESS     0003 R 000454 RESPON
    0004 R 000310 TEMPER     0000 R 000000 TRANS      0000 R 000006 TRANSC    0004 R 001274 TRANSM    0001 R 000471 TRANSO
    0000 R 000015 TRANSO     0000 R 000014 TRANSR     0000 R 000016 TRASUM    0000 R 000003 TRATIO    0004 R 000144 WATER
    0000 R 000021 WEIGH      0003 R 000644 WEIGHT


00101         FUNCTION TRANS(F,W,WC,WO,LEVEL)
00101   C
00101   C     THIS FUNCTION COMPUTES THE PERCENT TRANSMISSION THROUGH WATER VAPOR
00101   C     IN THE MANNER SUGGESTED BY DAVIS AND VIEZEE FOR THE WAVE NUMBER RANGE
00101   C     25 TO 2150 1/CM.  IT IS SUPPLEMENTED BY MOSKALENKO  TRANSMISSION
00101   C     FUNCTIONS FOR OZONE
00101   C
00103         REAL INTER
00104         PARAMETER SIZPTH=150
00105         PARAMETER SIZTRA=150
00106         COMMON/Z1/   ABSOR(SIZTRA), EXPON(SIZTRA), INTER(SIZTRA),
00106        *             RESPON(SIZTRA),ABSORC(15),     EXPONC(15),
00106        *             WEIGHT(SIZTRA),EXPOND(SIZTRA),EXPONO(SIZTRA),
00106        *             ABSORO(SIZTRA)
00107         COMMON/Z2/   PRESS(SIZPTH), WATER(SIZPTH), TEMPER(SIZPTH),
00107        *             HEIGHT(SIZPTH),HUM(SIZPTH),    ATCENT(SIZPTH),
00107        *             OTCENT(SIZPTH),TRANSM(SIZPTH),DELTRA(SIZPTH),
```

```
00107         *            EPRESS(SIZPTH),CPRESS(SIZPTH),ETEMPS(SIZPTH),
00107         *            DEFAUL(SIZPTH),OZONE(SIZPTH)
00110                 TRANS=1.
00111                 IF(W.LE.0.) GO TO 2150
00111         C
00111         C       USE WAVENUMBER TO COMPUTE AN INDEX
00111         C
00113                 I=(F-12.5)/25.
00114                 ONE=1.
00114         C
00114         C       COMPUTE PRESSURE AND TEMPERATURE RATIOS AT THESE STANDARD VALUES
00114         C
00115                 TRATIO=1.
00116                 FRATIO=1.
00117                 PRATIC=1.
00120                 IF(LEVEL.EQ.1) GO TO 100
00122                 TRATIO=(ETEMPS(LEVEL)+ETEMPS(LEVEL-1))/546.32
00123                 FRATIO=(EPRESS(LEVEL)+EPRESS(LEVEL-1))/2026.4
00124                 PRATIC=(CPRESS(LEVEL)+CPRESS(LEVEL-1))/2026.4
00125         100     CONTINUE
00126                 IF(I.GE.32) GO TO 800
00130                 TRANSC=1.
00131                 IF(I.LT.22) GO TO 550
00131         C
00131         C       COMPUTE TRANSMISSION DUE TO CARBON DIOXIDE
00131         C
00133                 A=.4-(.15)*ALOG10(FRATIC)-1.6
00134                 B=ABSORC(I-21)*W*(.67+(FRATIC**(.8)))*FRATIC**A
00135                 C=TRATIO**EXPONC(I-21)
00136                 D=(.4)*(FRATIC**(.8))
00137                 TRANSC=EXP(-(D*((D*C+ONE)**.5)-ONE)))
00137         C
00137         C       SEARCH AND INCLUDE OZONE TRANSMISSION FOR THIS INTERVAL
00137         C
00140                 TRANSC=TRANSC*TRANSO(I)
00140         C
00140         C       COMPUTE TRANSMISSION DUE TO WATER VAPOR
00140         C
00141         550     CONTINUE
00142                 BETA=.76+(.58+(.48*(FRATIO**2)))**.5
00143                 A=ABSOR(I)*W*(TRATIO**EXPON(I))
00144                 B=1.+(3.17*BETA*(FRATIO**(-1.1))*A)
00145                 C=BETA*(FRATIO**(-.1))*A
00146                 TRANSR=EXP(-C*(B**(-.5)))
00146         C
00146         C       MULTIPLY THE CARBON-DIOXIDE AND WATER VAPOR TRANSMISSIONS
00146         C
00147                 TRANS=TRANSR*TRANSC
00150                 GO TO 2150
00150         C
00150         C       COMPUTE TRANSMISSION IN THE WATER VAPOR "WINDOW".
00150         C
00151         800     CONTINUE
00152                 IF(I.GE.48) GO TO 1200
00154                 TRANS=EXP(-(ABSOR(I)*W*FRATIO)**EXPON(I)))
00154         C
00154         C       SEARCH AND INCLUDE OZONE TRANSMISSION FOR THIS INTERVAL
```

```
00453            DO 311 J=1,84
00456            IFUNCT =(RESPON(J)*100.)+48
00457            JFUNCT =(RESPON(J+1)*100.)+48
00460     311    CALL LINEV(920+J,IFUNCT ,921+J,JFUNCT)
00462            Y=0.
00463            DO 312 J=1,5
00466            Y=Y+10000.
00467            X=11.
00470            XP=-2.
00471     312    CALL LINEV(NXV(XP),NYV(Y),NXV(X),NYV(Y))
00473            HEADER(3)=" "
00474            ENCODE(24,HEADER) ANGLE
00477            CALL PRINTV(18,HEADER,703,64)
00500            HEADER(3)=" "
00501            ENCODE(25,HEADER) TEMPER(1)
00504            CALL PRINTV(18,HEADER,703,80)
00505            HEADER(1)="TEMP C"
00506            HEADER(2)="ORRECT"
00507            HEADER(3)="ION  C"
00510            CALL PRINTV(18,HEADER,500,80)
00511            HEADER(1)="ALTITU"
00512            HEADER(2)="DE"
00513            HEADER(3)="FEET"
00514            CALL APRNTV(0,-14,18,HEADER,60,900)
00515            HEADER(1)="SURFAC"
00516            HEADER(2)="E"
00517            CALL PRINTV(7,HEADER,60,110)
00520            HEADER(1)="10000"
00521            CALL PRINTV(5,HEADER,70,252)
00522            HEADER(1)="20000"
00523            CALL PRINTV(5,HEADER,70,393)
00524            HEADER(1)="30000"
00525            CALL PRINTV(5,HEADER,70,535)
00526            HEADER(1)="40000"
00527            CALL PRINTV(5,HEADER,70,675)
00530            HEADER(1)="50000"
00531            CALL PRINTV(5,HEADER,70,818)
00532            HEADER(1)="60000"
00533            CALL PRINTV(5,HEADER,70,959)
00534            CALL CHSIZV(3,5)
00535            CALL RITE2V(100,1000,1000,90,1,60,1,MESSAG,NLAST)
00536            THETA=RAD(ANGLE)
00537            LIM=LIMIT-1
00540            CALL OPATHS
00541            LIMIT=1
00542            DO 20 J=1,LIM
00545            LIMIT=LIMIT+1
00546            CALL RADMID
00547     20     CONTINUE
00551            GO TO 100
00551     C
00551     C      INPUT RESPONSE FUNCTIONS AS PERCENTAGES AT MIDPOINTS OF EACH
00551     C      INTERVAL
00551     C
00552     200    CONTINUE
00553            LEADER(1)=HEAD1
00554            LEADER(2)=HEAD2
```

```
00555          LEADER(3)=HEAD3
00556          WRITE(6,19)
00560          DO 30 I=1,85
00563     30   RESPON(I)=0.
00565          DO 40 I=1,LIMIT
00570          READ(5,15) INTERV,FUNCTI
00574          WRITE(6,16) INTERV,FUNCTI
00600          J=(INTERV-12.5)/25.
00601     40   RESPON(J)=FUNCTI
00603          GO TO 100
00603     C
00603     C    INPUT THE TEMPERATURE RANGE OF THE BLACK-BODY INTENSITY/
00603     C    TEMPERATURE SCALE IN CENTIGRADE
00603     C
00604     400  READ(5,15) TRANGE
00607          WRITE(6,18)
00611          WRITE(6,16) TRANGE
00614          GO TO 100
00615     500  CONTINUE
00616          CALL PLTND(0)
00617          CALL PLTERM
00620          STOP
00620     C
00620     C    INPUT DISPLAY LABELS
00620     C
00621     600  READ(5,26)(MESSAG(I),I=1,10)
00627          GO TO 100
00630     800  CONTINUE
00630     C
00630     C    READ DEFAULT PROFILES AND INTERPOLATE MISSING DATA
00630     C
00631          IF(STEPSZ.GT.0) CALL STEPER                                          NEW
00633          WRITE(6,35)                                                          NEW
00635          READ(5,33,END=100) PRESSP,OZONEP,TEMPRE,HUMIDP
00643          WRITE(6,33)        PRESSP,OZONEP,TEMPRE,HUMIDP
00651          DO 820 J=2,LIMIT
00654          READ(5,33,END=100) PRESUR,OZONES,TEMPOR,HUMID
00662          WRITE(6,33)        PRESUR,OZONES,TEMPOR,HUMID
00662     C
00662     C    SCAN REQUESTED LEVELS FOR DEFAULT PRESSURE WINDOW
00662     C
00670          DO 810 I=2,LEVELS
00673          IF(PRESS(I).LT.PRESSP.AND.PRESS(I).GE.PRESUR) GO TO 815
00675          GO TO 810
00676     815  CONTINUE
00676     C
00676     C    INTERPOLATE MISSING TEMPERATURE
00676     C
00677          IF(TEMPER(I).GT.1000.) TEMPER(I)=TERP(PRESSP,PRESUR,TEMPRE,TEMPOR,
00677         +    PRESS(I))
00677     C
00677     C    INTERPOLATE MISSING SPECIFIC HUMIDITY
00677     C
00701          IF(FLD(3,1,DEFAUL(I)).EQ.1) HUM(I)=TERP(PRESSP,PRESUR,HUMIDP,HUMID
00701         *    ,PRESS(I))
00701     C
00701     C    INTERPOLATE MISSING OZONE
```

```
00701      C
00703            IFαFLDα2,1,DEFAULα1)).EQ.1) OZONEαI)=TERPαPRESSP,PRESUR,OZONEP,
00703           *  OZONES,PRESSαI))
00705      810   CONTINUE
00705      C
00705      C     FETCH NEXT LEVEL DEFAULT PARAMETERS
00705      C
00707            PRESSP=PRESUR
00710            OZONEP=OZONES
00711            TEMPRE=TEMPOR
00712            HUMIDP=HUMID
00713      820   CONTINUE
00715            GO TO 100
00715      C
00715      C     INPUT TRACE GAS TRANSMISSION FUNCTIONS WHERE
00715      C
00715      C     WEIGHT TRUNCATED TO AN INTEGER IS AN INDEX TO THE WAVENUMBER
00715      C            INTERVAL FOR WHICH THIS ANALYTIC FUNCTION APPLYS
00715      C
00715      C     WEIGHT FRACTION IS THE GEOMETRIC MEAN WEIGHTING MODIFIED BY THE
00715      C            PLANCKIAN FUNCTION FOR THE WAVE-NUMBER INTERVAL FRACTION
00715      C            OF THIS ANALYTIC FUNCTION
00715      C
00715      C     ABSORO = A         THESE ARE PARAMETERS APPEARING IN ANALYTIC
00715      C     EXPOMO = B         FUNCTIONS OF THE FORM  A**αATMOS-CENT**C)**αEP**C)
00715      C     EXPONO = C         FOR THE INTERVAL AND WEIGHTING DESCRIBED ABOVE
00715      C
00716      1100  CONTINUE
00717            WRITEα6,31) HEAD1,HEAD2,HEAD3
00724            DO 1110 I=1,LIMIT
00727            IFαI.GT.100) GO TO 100
00731            READα5,28,END=100) WEIGHTαI),ABSOROαI),EXPOMOαI),EXPONOαI)
00737            II=WEIGHTαI)
00740            WEIGH=WEIGHTαI)-II
00741            BEGIN=INTERαII)-12.5
00742            FINIS=INTERαII)+12.5
00743            WRITEα6,29) BEGIN,FINIS,ABSOROαI),EXPOMOαI),EXPONOαI),WEIGH
00753      1110  CONTINUE
00755            GO TO 100
00756            FUNCTION SPHEREα*,L)
00756      C
00756      C     THIS IS A CONDITIONAL FUNCTION WHICH MODIFIES THE PRECIPITABLE
00756      C     WATER AT SATELLITE ALTITUDES FOR THE SPHERICAL SHAPE OF THE
00756      C     EARTH
00756      C
00761            SPHERE=1.
00762            IFα.NOT.SHELL) RETURN
00762      C
00762      C     TEST IS THE SINE OF THE ANGLE OF OBSERVATION TO THE HORIZON
00762      C
00764            TEST=20898696./α20898696.+HEIGHTαL))
00764      C
00764      C     NO COMPUTATIONS ARE MADE WHEN THE FIELD OF VIEW IS ABOVE THE
00764      C     HORIZON
00764      C
00765            IFαTHETA.GT.ASINαTEST)) RETURN1
00765      C
```

```
C      HIGH IS THE AVERAGE HEIGHT OF THE WATER VAPOR LAYER
C
       HIGH=(HEIGHT(L)+HEIGHT(L-1))/2.
C
C      ADD THE AVERAGE HEIGHT OF THE LAYER TO THE RADIUS OF THE EARTH
C
       PART1=HIGH+20898696.
C
C      MULTIPLY BY THE MEAN INDEX OF REFRACTION AT THE AVERAGE HEIGHT
C      OF THIS LAYER
C
       PART2=PART1*(REFRAX(L)+REFRAX(L-1))/2.
C
C      MULTIPLY BY THE INDEX OF REFRACTION AT THE HEIGHT OF THE SENSOR
C      AND BY THE SINE OF THE ANGLE OF OBSERVATION
C
       PART3=PART1*REFRAX(L)*SIN(THETA)
       PART4=SQRT((PART2*PART2)-(PART3*PART3))
C
C      COMPUTE THE MEAN FUNCTION ASSUMING THE OBSERVING SENSOR IS JUST
C      ABOVE THE MEAN LAYER TO WHICH IT IS APPLIED
C
       SPHERE=PART2/PART4
       RETURN
       SUBROUTINE DISPLY
C
C      THIS SUBROUTINE DISPLAYS THE MODIFIED DATA BASE
C
       WRITE(6,11)
       DO 10 I=1,LEVELS
10     WRITE(6,12) PRESS(I),HUM(I),TEMPER(I),OZONE(I)
11     FORMAT("1PRESS     SPECIFIC     TEMP     OZONE",/,
      *      "              HUMIDITY     SOUNDING",/,
      *      " MB           GM/KGM       K        GM/KGM")
12     FORMAT(1X,F7.1,1X,E10.5,2X,F6.2,1X,E10.5)
       LIMIT=LEVELS
       RETURN
       FUNCTION TERP(X1,X2,Y1,Y2,X)
C
C      THIS FUNCTION PERFORMS LAGRANGIAN INTERPOLATION
C
       SLOPEA=(X-X2)/(X1-X2)
       SLOPEB=(X-X1)/(X2-X1)
       TERP=SLOPEA*Y1+SLOPEB*Y2
       RETURN
       SUBROUTINE OPATHS
C
C      THIS SUBROUTINE COMPUTES ANGLE DEPENDENT OPTICAL PATHS
C
       PWHITE=0.
       TWHOLE=0.
       DO 10 I=2,LIMIT
       OTCENT(I)=OTCENT(I-1)+(PRESS(I-1)-PRESS(I))*(OZONE(I)+OZONE(I-1))*
      *  237.968
       WATER(I)=WATER(I-1)+(HUM(I)*SPHERE($10,I)*(PRESS(I-1)-PRESS(I)))/
      *  980.
       PRESUR=(PRESS(I)+PRESS(I-1))/2.
```

```
01043          TEMPOR=«TEMPER«I)+TEMPER«I-1))/2.
01044          IF«I.GT.1)
01044         *HEIGHT«I)=HEIGHT«I-1)+29.3*TEMPOR*ALOG«PRESS«I-1)/PRESS«I))
01044         **«1.+.00061*HUM«I))*3.2808
01046          ATCENT«I)=«PRESS«1)-PRESS«I))*.200
01047          EWHOLE=EWHOLE+«WATER«I)-WATER«I-1))*PRESUR
01050          TWHOLE=TWHOLE+«WATER«I)-WATER«I-1))*TEMPOR
01051          CPRESS«I)=«PRESS«1)+PRESS«I))/2.
01052          EPRESS«I)=EWHOLE/WATER«I)
01053          ETEMPS«I)=TWHOLE/WATER«I)
01054     10   CONTINUE
01056          RETURN
01057          SUBROUTINE STEPER
01057     C
01057     C    THIS SUBROUTINE EXPANDS OR CONTRACTS THE DATA TO THE NEEDED STEP SIZE
01057     C
01062          J=1
01063          LODINT=MIN«PRESS«1)/STEPSZ,SIZPTH)
01063     C
01063     C    TEST FOR END OF AVAILABLE DATA
01063     C
01064     5    IF«J.GT.LODINT) RETURN
01064     C
01064     C    SET AVAILABLE DATA
01064     C
01066          PRESSP=PRESS«J)
01067          PRESUR=PRESS«J+1)
01070          TEMPRE=TEMPER«J)
01071          TEMPOR=TEMPER«J+1)
01072          OZONEP=OZONE«J)
01073          OZONES=OZONE«J+1)
01074          HUMIDP=HUM«J)
01075          HUMID=HUM«J+1)
01075     C
01075     C    SET WANTED DATA
01075     C
01076          PREWAN=PRESS«1)-STEPSZ*J
01076     C
01076     C    IS WANTED DATA WITHIN AVAILABLE DATA WINDOW
01076     C
01077          IF«PREWAN.LT.PRESSP.AND.PREWAN.GE.PRESUR) GO TO 10
01101          GO TO 40
01102     10   CONTINUE
01102     C
01102     C    HOW MANY LEVELS OF WANTED DATA ARE WITHIN WINDOW
01102     C
01103          LODSIZ=«PRESSP-PRESUR)/STEPSZ
01103     C
01103     C    MAKE SPACE IN AVAILABLE DATA FOR WANTED DATA
01103     C
01104          DO 20 K=LEVELS,J,-1
01107          PRESS«K+LODSIZ)=PRESS«K)
01110          TEMPER«K+LODSIZ)=TEMPER«K)
01111          OZONE«K+LODSIZ)=OZONE«K)
01112     20   HUM«K+LODSIZ)=HUM«K)
01114          LEVELS=LEVELS+LODSIZ
01114     C
```

```
01114   C     LOAD DATA OVER WANTED INTERVAL
01114   C
01115         DO 30 K=1,LOCSIZ
01120         J=J+1
01121         TEMPER(J)=TERP(PRESSP,PRESUR,TEMPRE,TEMPCR,PREWAN)
01122         OZONE(J)=TERP(PRESSP,PRESUR,OZONEP,OZONES,PREWAN)
01123         HUM(J)=TERP(PRESSP,PRESUR,HUMIDP,HUMID,PREWAN)
01124         PRESS(J)=PREWAN
01125         PREWAN=PREWAN-STEPSZ
01126         DEFAUL(J)=DEFAUL(J-1)
01127   30    CONTINUE
01127   C
01127   C     RESET BOTTOM LEVEL OF AVAILABLE DATA
01127   C
01131         GO TO 5
01132   40    CONTINUE
01132   C
01132   C     DESTROY TOP LEVEL OF AVAILABLE DATA
01132   C
01133         DO 50 K=J,LEVELS
01136         PRESS(K+1)=PRESS(K+2)
01137         TEMPER(K+1)=TEMPER(K+2)
01140         OZONE(K+1)=OZONE(K+2)
01141         HUM(K+1)=HUM(K+2)
01142         DEFAUL(K+1)=DEFAUL(K+2)
01143   50    CONTINUE
01145         LEVELS=LEVELS-1
01146         GO TO 5
01147         END

      END OF COMPILATION'        NO DIAGNOSTICS.


 PREP   TPF$.
FURPUR 025D-08/20-18'50
```

```
00154      C
00155                TRANS=TRANS*TRANSO(I)
00156                GO TO 2150
00156      C
00156      C         COMPUTE TRANSMISSION DUE TO WATER VAPOR.
00156      C
00157      1200      CONTINUE
00160                BETA=1.18+ (1.38+.48*(PRATIO**2))**.5
00161                A=ABSOR(I)*W
00162                B=BETA*(PRATIO**(-.15))*A
00163                C=(1.+(4.9*BETA*(PRATIO**(-1.15))*A))**(-.5)
00164                TRANS=EXP(-(B*C))
00164      C
00164      C         SEARCH AND INCLUDE OZONE TRANSMISSION FOR THIS INTERVAL
00164      C
00165                IF(I.GE.78) TRANS=TRANS*TRANSO(I)
00167      2150      RETURN
00170                FUNCTION TRANSO(I)
00173                TRASUM=0.
00174                TRANSO=1.
00175                DO 10 J=1,100
00200                INDEX=WEIGHT(J)
00200      C
00200      C         USE DATA WITHIN THE CURRENT WAVENUMBER INTERVAL
00200      C
00201                IF(INDEX.NE.I) GO TO 10
00203                WEIGH=WEIGHT(J)-INDEX
00203      C
00203      C         COMPUTE MOSKALENKO TRANSMISSION FUNCTIONS FOR OZONE USING TRACE
00203      C         GAS COEFFICIENTS
00203      C
00204                B=ABSORO(J)*(WO**EXPOMO(J))*(PRATIO**EXPONO(J))
00204      C
00204      C         APPLY PLANKIAN WEIGHTING FUNCTIONS TO THE TRANSMISSION VALUES
00204      C
00205                TRASUM=TRASUM+EXP(-B)*WEIGH
00206      10        CONTINUE
00210                IF(TRASUM.GT.0.)TRANSO=TRASUM
00212                RETURN
00213                END

     END OF COMPILATION:        NO  DIAGNOSTICS.
```

```
 FOR,S   TRANS/SLANT,TRANS,TRANS/SLANT
FOR 94L-08/25-18'55 «0,0)

   FUNCTION TRANS        ENTRY POINT 000356

   STORAGE USED' CODE«1) 000510  DATA«0) 000103  BLANK COMMON«2) 000000

    COMMON BLOCKS'

    0003   Z1       001464
    0004   Z2       015530

   EXTERNAL REFERENCES «BLOCK, NAME)

    0005   NEXF6$
    0006   ALOG10
    0007   EXP
    0010   NERR3$

   STORAGE ASSIGNMENT  «BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001     000447 10L       0001     000045 100L      0001     000266 1200L     0001     000400 1766      0001     000353 2150L
    0001     000146 550L      0001     000233 800L      0000 R 000007 A         0003 R 000000 ABSOR     0003 R 000620 ABSOR
    0003 R 001320 ABSORO     0004 R 004704 ATCENT     0000 R 000010 B         0000 R 000013 BETA      0000 R 000011 C
    0004 R 011610 CPRESS     0000 R 000012 D          0004 R 013560 DEFAUL    0004 R 007640 DELTRA    0004 R 010624 EPRES
    0004 R 012574 ETEMPS     0003 R 001010 EXPOND     0003 R 000144 EXPON     0003 R 000632 EXPONC    0003 R 001151 EXPON
    0004 R 002734 HEIGHT     0004 R 003720 HUM        0000 I 000001 I         0000 I 000020 INDEX     0000     000052 INJF$
    0000     000056 INJF$    0003 R 000310 INTER      0000 I 000017 J         0000 R 000002 ONE       0004 R 005670 OTCENT
    0004 R 014544 OZONE      0000 R 000005 PRATIC     0000 R 000004 PRATIO    0004 R 000000 PRESS     0003 R 000454 RESPO
    0004 R 001750 TEMPER     0000 R 000000 TRANS      0000 R 000006 TRANSC    0004 R 006654 TRANSM    0001 R 000471 TRANS
    0000 R 000015 TRANSO     0000 R 000014 TRANSR     0000 R 000016 TRASUM    0000 R 000003 TRATIO    0004 R 000764 WATER
    0000 R 000021 WEIGH      0003 R 000644 WEIGHT


00101          FUNCTION TRANS«F,W,WC,WO,LEVEL)
00101     C
00101     C    THIS FUNCTION COMPUTES THE PERCENT TRANSMISSION THROUGH WATER VAPOR
00101     C    IN THE MANNER SUGGESTED BY DAVIS AND VIEZEE FOR THE WAVE NUMBER RANGE
00101     C    25 TO 2150 1/CM.  IT IS SUPPLEMENTED BY MOSKALENKO  TRANSMISSION
00101     C    FUNCTIONS FOR OZONE
00101     C
00103          REAL INTER
00104          PARAMETER SIZPTH=500
00105          PARAMETER SIZTRA=100
00106          COMMON/Z1/   ABSOR«SIZTRA), EXPON«SIZTRA), INTER«SIZTRA),
00106         *             RESPON«SIZTRA),ABSORC«10),     EXPONC«10),
00106         *             WEIGHT«SIZTRA),EXPOMO«SIZTRA),EXPONO«SIZTRA),
00106         *             ABSORO«SIZTRA)
00107          COMMON/Z2/   PRESS«SIZPTH), WATER«SIZPTH), TEMPER«SIZPTH),
00107         *             HEIGHT«SIZPTH),HUM«SIZPTH),    ATCENT«SIZPTH),
00107         *             OTCENT«SIZPTH),TRANSM«SIZPTH),DELTRA«SIZPTH),
```

```
00107           *             EPRESS(SIZPTH),CPRESS(SIZPTH),ETEMPS(SIZPTH),
00107           *             DEFAUL(SIZPTH),OZONE(SIZPTH)
00110            TRANS=1.
00111            IF(W.LE.0.) GO TO 2150
00111      C
00111      C     USE WAVENUMBER TO COMPUTE AN INDEX
00111      C
00113            I=(F-12.5)/25.
00114            ONE=1.
00114      C
00114      C     COMPUTE PRESSURE AND TEMPERATURE RATIOS AT THESE STANDARD VALUES
00114      C
00115            TRATIO=1.
00116            PRATIO=1.
00117            PRATIC=1.
00120            IF(LEVEL.EQ.1) GO TO 100
00122            TRATIO=(ETEMPS(LEVEL)+ETEMPS(LEVEL-1))/546.32
00123            PRATIO=(EPRESS(LEVEL)+EPRESS(LEVEL-1))/2026.4
00124            PRATIC=(CPRESS(LEVEL)+CPRESS(LEVEL-1))/2026.4
00125      100   CONTINUE
00126            IF(I.GE.32) GO TO 800
00130            TRANSC=1.
00131            IF(I.LT.22) GO TO 550
00131      C
00131      C     COMPUTE TRANSMISSION DUE TO CARBON DIOXIDE
00131      C
00133            A=.4-(.15)*ALOG10(PRATIC)-1.6
00134            B=ABSORC(I-21)*WC**(.87+(PRATIC**(.8)))*PRATIC**A
00135            C=TRATIO**EXPONC(I-21)
00136            D=(.4)*(PRATIC**(.8))
00137            TRANSC=EXP(-(D*((B*C+ONE)**.5)-ONE)))
00137      C
00137      C     SEARCH AND INCLUDE OZONE TRANSMISSION FOR THIS INTERVAL
00137      C
00140            TRANSC=TRANSC*TRANSO(I)
00140      C
00140      C     COMPUTE TRANSMISSION DUE TO WATER VAPOR
00140      C
00141      550   CONTINUE
00142            BETA=.76+(.58+(.48*(PRATIO**2)))**.5
00143            A=ABSOR(I)*W*(TRATIO**EXPON(I))
00144            B=1.+(3.17*BETA*(PRATIO**(-1.1))*A)
00145            C=BETA*(PRATIO**(-.1))*A
00146            TRANSR=EXP(-C*(B**(-.5)))
00146      C
00146      C     MULTIPLY THE CARBON-DIOXIDE AND WATER VAPOR TRANSMISSIONS
00146      C
00147            TRANS=TRANSR*TRANSC
00150            GO TO 2150
00150      C
00150      C     COMPUTE TRANSMISSION IN THE WATER VAPOR "WINDOW".
00150      C
00151      800   CONTINUE
00152            IF(I.GE.48) GO TO 1200
00154            TRANS=EXP(-(ABSOR(I)*W*PRATIO)**EXPON(I))
00154      C
00154      C     SEARCH AND INCLUDE OZONE TRANSMISSION FOR THIS INTERVAL
```

```
00154      C
00155                TRANS=TRANS*TRANSO(I)
00156                GO TO 2150
00156      C
00156      C         COMPUTE TRANSMISSION DUE TO WATER VAPOR.
00156      C
00157      1200      CONTINUE
00160                BETA=1.18+ (1.38+.48*(RATIO**2))**.5
00161                A=ABSOR(I)*W
00162                B=BETA*(RATIO**(-.15))*A
00163                C=(1.+(4.9*BETA*(RATIO**(-1.15))*A))**(-.5)
00164                TRANS=EXP(-B*C)
00164      C
00164      C         SEARCH AND INCLUDE OZONE TRANSMISSION FOR THIS INTERVAL
00164      C
00165                IF(I.GE.78) TRANS=TRANS*TRANSO(I)
00167      2150      RETURN
00170                FUNCTION TRANSO(I)
00173                TRASUM=0.
00174                TRANSO=1.
00175                DO 10 J=1,100
00200                INDEX=WEIGHT(J)
00200      C
00200      C         USE DATA WITHIN THE CURRENT WAVENUMBER INTERVAL
00200      C
00201                IF(INDEX.NE.I) GO TO 10
00203                WEIGH=WEIGHT(J)-INDEX
00203      C
00203      C         COMPUTE MOSKALENKO TRANSMISSION FUNCTIONS FOR OZONE USING TRACE
00203      C         GAS COEFFICIENTS
00203      C
00204                B=ABSCRO(J)*(WO**EXPOM(J))*(RATIO**EXPON(J))
00204      C
00204      C         APPLY PLANKIAN WEIGHTING FUNCTIONS TO THE TRANSMISSION VALUES
00204      C
00205                TRASUM=TRASUM+EXP(-B)*WEIGH
00206      10        CONTINUE
00210                IF(TRASUM.GT.0.)TRANSO=TRASUM
00212                RETURN
00213                END

        END OF COMPILATION:        NO DIAGNOSTICS.
```

```
FOR,S   CCCF/SLANT,CCCF,CCCF/SLANT
FOR 9αL-08/20-18:55 α0,0)

 BLOCK DATA

 STORAGE USED' CODEα1) 000000  DATAα0) 000002  BLANK COMMONα2) 000000

  COMMON BLOCKS'

  0003   Z1      001464

 STORAGE ASSIGNMENT  αBLOCK, TYPE, RELATIVE LOCATION, NAME)

  0003 R 000000 ABSOR     0003 R 000620 ABSORC    0003   001320 ABSORD    0003   001010 EXPOND    0003 R 000144 EXPON
  0003 R 000632 EXPONC    0003   001154 EXPOND    0000 I 000000 I         0003 R 000310 INTER      0000 I 000001 J
  0003 R 000454 RESPON    0003   000644 WEIGHT


00101              BLOCK DATA
00102              REAL INTER
00103              PARAMETER SIZTRA=100
00104              COMMON/Z1/   ABSORαSIZTRA), EXPONαSIZTRA), INTERαSIZTRA),
00104             *             RESPONαSIZTRA),ABSORCα10),    EXPONCα10),
00104             *             WEIGHTαSIZTRA),EXPONDαSIZTRA),EXPONDαSIZTRA),
00104             *             ABSORDαSIZTRA)
00104        C
00104        C     PARAMETERS APPEARING IN ANALYTIC EXPRESSIONS OF TRANSMISSION
00104        C     THROUGH WATER VAPOR IN THE WAVE NUMBER RANGE 25 TO 550 1/CM.
00104        C
00105              DATAαABSORαI),EXPONαI),I=1,21)/
00105             1   670.,     0.,      1350.,    0.,
00105             2   2450.,    0.,      2500.,    0.,
00105             3   2550.,    0.,      2100.,    0.,
00105             4   1250.,    0.,      1050.,    0.,
00105             5   955.,     .45,     710.,     1.15,
00105             6   410.,     1.65,    290.,     1.95,
00105             7   265.,     2.6,     140.,     3.,
00105             8   53.5,     2.45,    37.5,     2.55,
00105             9   30.5,     2.75,    20.5,     1.55,
00105             1   11.,      1.85,    6.05,     2.3,
00105             2   3.7,      1.55/
00105        C
00105        C     PARAMETERS APPEARING IN ANALYTIC EXPRESSIONS OF TRANSMISSION
00105        C     THROUGH CARBON DIOXIDE AND WATER VAPOR IN THE WAVE NUMBER RANGE
00105        C     555 TO [illegible]  1/CM.
00105        C
00110              DATAαABSORαI),EXPONαI),I=22,31)/
00110             1  2.8,      1.35,     2.1,      .6,
00110             2  1.55,      .0,      1.1,      .0,
00110             3   .82,      .0,       .615,    .0,
00110             4   .47,      .0,       .37,     .0,
00110             5   .29,      .0,       .23,     .0/
00113              DATAαABSORCαI),EXPONCαI),I=1,10)/
```

```
00113          1   .00145,   4.7,     .0385,   4.1,
00113          1   .180,     3.1,     1.7,     2.2,
00113          1   6.95,     0.,      4.8,     1.,
00113          1   .53,      3.0,     .115,    3.6,
00113          1   .0105,    4.1,     .00096,  4.7/
00113    C
00113    C      PARAMETERS APPEARING IN ANALYTIC EXPRESSIONS OF TRANSMISSION
00113    C      THROUGH WATER VAPOR IN THE WAVE NUMBER RANGE 800 TO 1200 1/CM.
00113    C
00116          DATA(ABSOR(I),EXPON(I),I=32,47)/
00116          1   .170,.775,    .135,.820,    .115,.860,    .105,.880,
00116          2   .095,.885,    .091,.865,    .091,.885,    .091,.885,
00116          3   .091,.885,    .091,.865,    .091,.885,    .091,.880,
00116          4   .095,.860,    .105,.830,    .115,.795,    .125,.760/
00116    C
00116    C      PARAMETERS APPEARING IN ANALYTIC EXPRESSIONS OF TRANSMISSION
00116    C      THROUGH WATER VAPOR IN THE WAVE NUMBER RANGE 1200 TO 2150 1/CM.
00116    C
00121          DATA(ABSOR(I),I=48,85)/
00121          1  .28,     .42,     .75,     1.5,
00121          2  3.1,     6.4,     13.5,    30.,
00121          3 45.,      79.,     120.,    220.,
00121          4470.,      570.,    295.,    87.,
00121          5110.,      235.,    370.,    405.,
00121          6320.,      220.,    135.,    87.,
00121          7 52.,      30.,     18.,     11.,
00121          8  7.7,     6.,      4.2,     2.8,
00121          9  1.5,     .9,      .6,      .4,
00121          1  .28,     .2/
00121    C
00121    C      WAVENUMBER INTERVAL MIDPOINTS
00121    C
00123          DATA(INTER(I),I=1,47)/
00123          1               37.5,     62.5,     87.5,
00123          1    112.5,    137.5,    162.5,    187.5,
00123          1    212.5,    237.5,    262.5,    287.5,
00123          1    312.5,    337.5,    362.5,    387.5,
00123          1    412.5,    437.5,    462.5,    487.5,
00123          1    512.5,    537.5,    562.5,    587.5,
00123          1    612.5,    637.5,    662.5,    687.5,
00123          1    712.5,    737.5,    762.5,    787.5,
00123          1    812.5,    837.5,    862.5,    887.5,
00123          1    912.5,    937.5,    962.5,    987.5,
00123          1   1012.5,   1037.5,   1062.5,   1087.5,
00123          1   1112.5,   1137.5,   1162.5,   1187.5/
00125          DATA(INTER(I),I=48,85)/
00125          1   1212.5,   1237.5,   1262.5,   1287.5,
00125          1   1312.5,   1337.5,   1362.5,   1387.5,
00125          1   1412.5,   1437.5,   1462.5,   1487.5,
00125          1   1512.5,   1537.5,   1562.5,   1587.5,
00125          1   1612.5,   1637.5,   1662.5,   1687.5,
00125          1   1712.5,   1737.5,   1762.5,   1787.5,
00125          1   1812.5,   1837.5,   1862.5,   1887.5,
00125          1   1912.5,   1937.5,   1962.5,   1987.5,
00125          1   2012.5,   2037.5,   2062.5,   2087.5,
00125          1   2112.5,   2137.5/
00127          DATA(RESPON(J),J=1,85)/85*0./
00131          END

     END OF COMPILATION:        NO DIAGNOSTICS.
```

```
 FOR,S   TEMTAB/SLANT,TEMTAB,TEMTAB/SLANT
FOR 9αL-08/20-18:59 α0,0)

   SUBROUTINE TEMTAB     ENTRY POINT 000166
              TABTEM     ENTRY POINT 000177

   STORAGE USED: CODEα1) 000210  DATAα0) 000343  BLANK COMMONα2) 000000

    COMMON BLOCKS:

    0003   Z1      001464

   EXTERNAL REFERENCES αBLOCK, NAME)

    0004   EXP
    0005   NERR3$

   STORAGE ASSIGNMENT  αBLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001     000002 10L       0001     000071 133G      0001     000075 137G      0001     000031 20L       0001     000053 30L
    0001     000137 40L       0001     000123 50L       0003     000000 ABSOR     0003     000620 ABSORC    0003     001320 ABSORO
    0000 R 000145 DEGREE      0003     001010 EXPONO    0003     000144 EXPON     0003     000632 EXPONC    0003     001154 EXPOND
    0000 R 000001 HEATER      0000 I 000311 I           0000     000325 INJP$     0000 R 000000 INTEN      0003 R 000310 INTER
    0000 I 000314 J           0003 R 000454 RESPON      0000 R 000316 SPCCB      0000 R 000312 SLOPEA     0000 R 000313 SLOPEB
    0000 R 000315 WAVEND      0003     000644 WEIGHT


00101              SUBROUTINE TEMTABαDETECT,TEMPOR)
00101          C
00101          C   THIS ENTRY POINT RETURNS A TEMPERATURE IN DEGREES KELVIN WHICH
00101          C   MATCHES A DETECTOR INTENSITY.  IF NO MATCH IS MADE A ZERO IS
00101          C   RETURNED.
00101          C
00103              REAL INTEN
00104              REAL INTER
00105              PARAMETER SIZTRA=100
00106              COMMON/Z1/   ABSORαSIZTRA), EXPONαSIZTRA), INTERαSIZTRA),
00106         *                 RESPONαSIZTRA),ABSORCα15),    EXPONCα15),
00106         *                 WEIGHTαSIZTRA),EXPONOαSIZTRA),EXPONDαSIZTRA),
00106         *                 ABSOROαSIZTRA)
00107              DIMENSION HEATERα100),DEGREEα100)
00110              BBODYαV,T)=α8.9349E-13*V**3)/αEXPαα1.4385*V)/T)-1.0)
00110          C
00110          C   SEARCH FOR THE NEAREST INTERVAL
00110          C
00111              I=1
00112          10  I=I+1
00113              IFαI.GT.100) GO TO 30
00115              IFαDETECT.GT.HEATERαI-1).AND.DETECT.LE.HEATERαI)) GO TO 20
00117              GO TO 10
00117          C
```

```
00117     C      RETURN THE SOUGHT TEMPERATURE
00117     C
00120     20     CONTINUE
00121            SLOPEA=(DETECT-HEATER(I))/(HEATER(I-1)-HEATER(I))
00122            SLOPEB=(DETECT-HEATER(I-1))/(HEATER(I)-HEATER(I-1))
00123            TEMPOR=SLOPEA*DEGREE(I-1)+SLOPEB*DEGREE(I)
00124            RETURN
00124     C
00124     C      ERROR RETURN ZERO TEMPERATURE
00124     C
00125     30     TEMPOR=0.
00126            RETURN
00127            ENTRY TABTEM(TEMPOR,TRANGE)
00127     C
00127     C      THIS ENTRY POINT GENERATES A TEMPERATURE/INTENSITY CALIBRATION
00127     C      TABLE 100 DEGREES WIDE IN STEPS OF ONE DEGREE.
00127     C
00131            DEGREE(1)=TEMPOR-TRANGE/2.
00132            DO 40 I=1,100
00132     C
00132     C      INTEN IS THE TOTAL BLACKBODY INTENSITY ACCEPTED BY THIS INSTRUMENT'S
00132     C      RESPONSE FUNCTION.
00132     C
00135            INTEN=0.
00136            DO 50 J=1,85
00141            IF(RESPON(J).LE.0.) GO TO 50
00143            WAVENO=INTER(J)
00143     C
00143     C      COMPUTE A BLACK-BODY INTENSITY AT THIS WAVENUMBER AND TEMPERATURE.
00143     C
00144            SPCBB=BBODY(WAVENO,DEGREE(I))
00145            INTEN=INTEN+SPCBB*RESPON(J)
00146     50     CONTINUE
00146     C
00146     C      MULTIPLY BY THE 25 1/CM INTERVAL AND DIVIDE BY 2.
00146     C
00146     C      CONSTRUCT A TEMPERATURE DETECTOR TABLE.
00146     C
00150            HEATER(I)=INTEN*25.
00151            IF(I.EQ.100) GO TO 40
00151     C
00151     C      INCREMENT TEMPERATURE.
00151     C
00153            DEGREE(I+1)=DEGREE(I)+TRANGE/100.
00154     40     CONTINUE
00156            RETURN
00157            END

     END OF COMPILATION:        NO DIAGNOSTICS.
```

```
FOR,S   VAPRES/SLANT,VAPRES,VAPRES/SLANT
FOR 9(L-08/20-18:59 (0,5)

FUNCTION VAPRES        ENTRY POINT 000066

STORAGE USED: CODE(1) 000070  DATA(0) 000031  BLANK COMMON(2) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

 0003   ALOG10
 0004   NEXP6$
 0005   NERR3$

STORAGE ASSIGNMENT  (BLOCK, TYPE, RELATIVE LOCATION, NAME)

 0000   000023 INJP$   0000 R 000002 PART1   0000 R 000003 PART2   0000 R 000007 PART3   0000 R 000005 PART4
 0000 R 000010 PART5   0000 R 000004 PART6   0000 R 000006 PART7   0000 R 000001 TRATIO  0000 R 000000 VAPRES

00101        FUNCTION VAPRES(T)
00101    C
00101    C   THIS FUNCTION COMPUTES A VAPOR PRESSURE GIVEN A DEW POINT TEMPERATURE
00101    C   IT USES THE "GOFF-GRATCH" RELATION SPECIFIED IN THE "SMITHSONIAN
00101    C   METEOROLOGICAL TABLES".
00101    C
00103        TRATIO=373.16/T
00104        PART1=( 7.90298*(TRATIO-1.))
00105        PART2=5.02808*ALOG10(TRATIO)
00106        PART6=( 3.49149*(TRATIO-1.))
00107        PART4=(((1./(10.**PART6))-1.)*8.1328E-03)+3.005714
00110        PART7=11.344*(1.-(1./TRATIO))
00111        PART3=( ((10.**PART7)-1.)*1.3816E-07)
00112        PART5=PART2-PART3+PART4-PART1
00113        VAPRES=10.**PART5
00114        RETURN
00115        END

     END OF COMPILATION:        NO  DIAGNOSTICS.
```

```
 MAP,S    RACMAP/SLANT,TL0007/SLANT
MAP 0023-08/20-10:55 -40,1

     1.          LIB   LIV$#RLIB.

     2.          IN    MAIN

     3.          IN    RACMIO

     4.          IN    COEF

     5.          IN    VAPRES

     6.          IN    TRANS

     7.          IN    TEMTAB



ADDRESS LIMITS      001000 025412       040000 073377
STARTING ADDRESS   021320

WORDS DECIMAL        10507 IBANK         14080 DBANK


             SEGMENT MAIN             001000 025412        040000 073377

NSWTC$/FOR              1   001000 001021
NRBLK$/FOR              1   001022 001047
NRWND$/FOR              1   001050 001127       2   040000 040011
NWEF$/FOR               1   001130 001333       2   040012 040031
NFTCH$/FOR              1   001334 001634       2   040032 040067
NBDCV$/FOR              1   001635 001770       2   040070 040127
NFTV$/FOR               1   001771 002013
NCNVT$/FOR              1   002014 002246       2   040130 040217
NCLOS$/FOR              1   002247 002407       2   040220 040244
NWBLK$/FOR              1   002410 002532
NBSEL$/FOR              1   002533 002604
NUFDA$/FOR              1   002605 002640
NDF00$/FOR                                      2   040245 042446
BBCLOR/UTL              1   002641 002703
BBIN/UTL                                        0   042447 043031
BBINOT/UTL                                      0   043032 043305
BBCOM/UTL                                       0   043306 043657
NININ$/FOR              1   002704 003132       2   043660 043702
NINFT$/FOR              1   003133 004012       2   043703 043725
NOTIN$/FOR              1   004013 004340       2   043726 043736
NOUT$/FOR               1   004341 005315       2   043737 043770
NFMT$/FOR               1   005316 006223       2   043771 044007
```

NICER$/FOR	1	006224	006356	2	044010	044112
NFCHK$/FOR	1	006357	007160	2	044113	044254
				4	044255	044326
NIAD$/FOR				2	044327	044370
NEXP5$/FOR	1	007161	007244	2	044371	044400
BDCLOT/UTL	1	007245	007314			
BDOPEN/UTL	1	007315	007516	0	044401	044440
ERU$/UTL						
BDOUT/UTL				0	044441	044704
SQRT$/FOR	1	007517	007556	2	044705	044716
ASINCOS$/FOR	1	007557	007772	0	044717	044744
NIBUF$/FOR	1	007773	010034			
UDHSYS (COMMON BLOCK)					044745	045006
HIMONITOR/FOR	1	010035	011216	2	045007	045533
				4	UDHSYS	
NOSYM$/FOR	1	011217	011446	2	045534	045540
NIER$/FOR	1	011447	011531	2	045541	045670
NOBUF$/FOR	1	011532	011571			
SINCOS$/FOR	1	011572	011723	2	045671	045712
ALOG$/FOR	1	011724	012041	2	045713	045753
NEXP6$/FOR	1	012042	012234	2	045754	046025
NERR$/FOR	1	012235	012571	2	046026	046202
EXP$/FOR	1	012572	012660	2	046203	046223
BNDCO	1	012661	012753	0	046224	046262
				30	046263	046300
VLAGM	1	012754	013023	30	046301	046316
LABLV	1	013024	013367	0	046317	046376
				30	046377	046414
ERMRKV/MSFC	1	013370	013417	0	046415	046430
				2	BLANK$COMMON	
COMPAT/MSFC	1	013420	013422	0	046431	046432
XMODV/MSFC	1	013423	013450	0	046433	046441
				2	BLANK$COMMON	
PLOTV	1	013451	013472	30	046442	046457
HOLLV	1	013473	013530	0	046460	046460
				30	046461	046476
SCCTAB				0	046477	046576
XAXISV	1	013531	013617	30	046577	046614
LINRV	1	013620	014255	0	046615	046677
				2	BLANK$COMMON	
NONLNV	1	014256	014573	0	046700	046744
				2	BLANK$COMMON	
ERRLNV	1	014574	014675	0	046745	046761
				2	BLANK$COMMON	
ERRNLV	1	014676	015011	0	046762	046774
				2	BLANK$COMMON	
HOLDV/MSFC	1	015012	015046	0	046775	047002
				2	BLANK$COMMON	
SFTCIV/MSFC	1	015047	015107	0	047003	047013
				2	BLANK$COMMON	
GRAC$	1	015110	015142	0	047014	047015
				30	047016	047033
GGG (COMMON BLOCK)					047034	047036
SIZEV/MSFC	1	015143	015224	0	047037	047052
	3	GGG		2	BLANK$COMMON	
MDGENR	1	015225	015372	0	047053	047140
				2	BLANK$COMMON	

```
TADLIV                                             0   047141 047461
EDIT                                               0   047462 047576
CAMRAV                    1   015373 015605        0   047577 047642
                                                  30   047643 047666
SMXYV                     1   015606 015646        0   047667 047667
                                                  30   047670 047705
RITE2V                    1   015647 016114        0   047706 047734
                                                  30   047735 047760
VCHARV                    1   016115 016357        0   047761 050001
                                                  30   050002 050033
AFRNTV                    1   016360 016436        0   050034 050052
                                                   2   BLANK$COMMON
PRINTV                    1   016437 016556        0   050053 050061
                                                  30   050062 050105
GRIDIV                    1   016557 017353        0   050106 050222
                                                   2   BLANK$COMMON
SETMIV/MSFC               1   017354 017432        0   050223 050237
                                                   2   BLANK$COMMON
IDFRM$                    1   017433 017755        0   050240 050277
                                                   4   SCOMM$
                                                   8   050300 050413
                                                  30   050414 050431
SCOMM$ (COMMON BLOCK)                                  050432 050561
PLOT$                     1   017756 020630        0   050562 052237
                                                   4   SCOMM$
                                                  30   052240 052345
XSCALV                    1   020631 021171        0   052346 052375
                                                  30   052376 052416
LINEV                     1   021172 021317        0   052417 052420
Z3 (COMMON BLOCK)                                      052421 052425
Z2 (COMMON BLOCK)                                      052426 070155
Z1 (COMMON BLOCK)                                      070156 071641
BLANK$COMMON (COMMON BLOCK)
MAIN                      1   021320 024074        0   071642 072611
                          3   Z1                   2   BLANK$COMMON
                          5   Z3                   4   Z2
RADMOD                    1   024075 024402        0   072612 072676
                          3   Z1                   2   BLANK$COMMON
                          5   Z3                   4   Z2
COEF                      3   Z1                   0   072677 072700
                                                   2   BLANK$COMMON
VAPRES                    1   024403 024472        0   072701 072731
                                                   2   BLANK$COMMON
TRANS                     1   024473 025202        0   072732 073034
                          3   Z1                   2   BLANK$COMMON
                                                   4   Z2
TEMTAB                    1   025203 025412        0   073035 073377
                          3   Z1                   2   BLANK$COMMON

SYS$*RLIB$. LEVEL 57N
END OF COLLECTION - TIME 3.293 SECONDS
```

```
 MAF,S    RADMAF/SLANT,TL0007/SLANT1
MAP 0023-08/20-18'51 -45,)

     1.          LIB   LTV$*RLIB.

     2.           IN   MAIN

     3.           IN   RADMOC

     4.           IN   COEF

     5.           IN   VAFRES

     6.           IN   TRANS

     7.           IN   TEMTAD



ADDRESS LIMITS      001000 024567     040000 060372
STARTING ADDRESS    020767

WORDS DECIMAL        10104 IBANK        8443 DBANK


               SEGMENT MAIN             001000 024567      040000 060372

NSWTC$/FOR               1   001000 001021
NRBLK$/FOR               1   001022 001047
NRWND$/FOR               1   001050 001127        2   040000 040011
NWEF$/FOR                1   001130 001333        2   040012 040031
NBDCV$/FOR               1   001334 001467        2   040032 040071
NFTCH$/FOR               1   001470 001770        2   040072 040127
NFTV$/FOR                1   001771 002013
NCNVT$/FOR               1   002014 002246        2   040130 040217
NCLOG$/FOR               1   002247 002407        2   040220 040244
NWBLK$/FOR               1   002410 002532
NDSBL$/FOR               1   002533 002604
NUPDA$/FOR               1   002605 002640
NBF00$/FOR                                        2   040245 042446
BSCLOR/UTL               1   002641 002703
BDIN/UTL                                          0   042447 043031
BDINOT/UTL                                        0   043032 043305
BBCOM/UTL                                         0   043306 043657
NOTIN$/FOR               1   002704 003231        2   043660 043670
NOUT$/FOR                1   003232 004256        2   043671 043722
NIOER$/FOR               1   004257 004341        2   043723 044025
NININ$/FOR               1   004342 004570        2   044026 044050
NINPT$/FOR               1   004571 005450        2   044051 044073
```

NFMT$/FOR	1	005451	006356	2	044074	044112
NFCHK$/FOR	1	006357	007160	2	044113	044254
				4	044255	044326
NTAB$/FOR				2	044327	044370
NEXP5$/FOR	1	007161	007244	2	044371	044400
EDCLOF/UTL	1	007245	007314			
EDOPEN/UTL	1	007315	007516	0	044401	044440
ERU$/UTL						
EDOUT/UTL				0	044441	044704
SORT$/FOR	1	007517	007556	2	044705	044716
ASINCOS$/FOR	1	007557	007772	0	044717	044744
NOBUF$/FOR	1	007773	010032			
NIER$/FOR	1	010033	010115	2	044745	045074
NIBUF$/FOR	1	010116	010157			
UCMSYS (COMMON BLOCK)					045075	045136
H$MONITOR/FOR	1	010160	011341	2	045137	045663
				4	UCMSYS	
SINCOS$/FOR	1	011342	011473	2	045664	045705
ALOG$/FOR	1	011474	011611	2	045706	045746
NEXP6$/FOR	1	011612	012704	2	045747	046020
NERR$/FOR	1	012705	012341	2	046021	046175
EXP$/FOR	1	012342	012430	2	046176	046216
PRINTV	1	012431	012550	0	046217	046225
				30	046226	046251
SCCTAB				0	046252	046351
ENDCD	1	012551	012643	0	046352	046410
				30	046411	046426
VLAGM	1	012644	012713	30	046427	046444
LABLV	1	012714	013257	0	046445	046524
				30	046525	046542
ERMRKV/MSFC	1	013260	013307	0	046543	046556
				2	BLANK$COMMON	
COMPAT/MSFC	1	013310	013312	0	046557	046560
XMODV/MSFC	1	013313	013340	0	046561	046567
				2	BLANK$COMMON	
HOLLV	1	013341	013376	0	046570	046570
				30	046571	046606
XAXISV	1	013377	013465	30	046607	046624
LINRV	1	013466	014123	0	046625	046707
				2	BLANK$COMMON	
NONLNV	1	014124	014441	0	046710	046754
				2	BLANK$COMMON	
ERRLNV	1	014442	014543	0	046755	046771
				2	BLANK$COMMON	
ERRNLV	1	014544	014657	0	046772	047004
				2	BLANK$COMMON	
HOLDV/MSFC	1	014660	014714	0	047005	047012
				2	BLANK$COMMON	
SHXTV	1	014715	014755	0	047013	047013
				30	047014	047031
SETCIV/MSFC	1	014756	015016	0	047032	047042
				2	BLANK$COMMON	
SETMIV/MSFC	1	015017	015075	0	047043	047057
				2	BLANK$COMMON	
GRAC$	1	015076	015130	0	047060	047061
				30	047062	047077
GGG (COMMON BLOCK)					047100	047102

SIZEV/MSFC	1	015131 015212	0	047103 047116
	3	GGG	2	BLANK$COMMON
MDGENR	1	015213 015360	0	047117 047204
			2	BLANK$COMMON
TABL1V			0	047205 047525
RITE2V	1	015361 015626	0	047526 047554
			30	047555 047600
VCHARV	1	015627 016071	0	047601 047621
			30	047622 047653
EDIT			0	047654 047770
CAMRAV	1	016072 016304	0	047771 050034
			30	050035 050060
XSCALV	1	016305 016645	0	050061 050110
			30	050111 050131
LINEV	1	016646 016773	0	050132 050133
GRID1V	1	016774 017570	0	050134 050250
			2	BLANK$COMMON
IDFRM$	1	017571 020113	0	050251 050310
			4	SCOMM$
			8	050311 050424
			30	050425 050442
SCOMM$ (COMMON BLOCK)				050443 050572
PLOTS	1	020114 020766	0	050573 052250
			4	SCOMM$
			30	052251 052356
Z3 (COMMON BLOCK)				052357 052363
Z2 (COMMON BLOCK)				052364 055153
Z1 (COMMON BLOCK)				055154 056637
BLANK$COMMON (COMMON BLOCK)				
MAIN	1	020767 023335	0	056640 057623
	3	Z1	2	BLANK$COMMON
	5	Z3	4	Z2
RADMOD	1	023336 023557	0	057624 057671
	3	Z1	2	BLANK$COMMON
	5	Z3	4	Z2
COEF	3	Z1	0	057672 057673
			2	BLANK$COMMON
VAPRES	1	023560 023647	0	057674 057724
			2	BLANK$COMMON
TRANS	1	023650 024357	0	057725 060027
	3	Z1	2	BLANK$COMMON
			4	Z2
TEMTAB	1	024360 024567	0	060030 060372
	3	Z1	2	BLANK$COMMON

SYS$*RLIB$. LEVEL 57N

END OF COLLECTION - TIME 3.123 SECONDS

REFERENCES

Boudreau, R.D., 1968: A solution to the integral equations for radiative transfer of heat in the stmosphere. Ph.D. Dissertation, Texas A&M University, 78 pp.

Boudreau, R. D., 1972: A radiation model for calculating atmospheric corrections to remotely sensed infrared measurements. NASA Earth Resources Lab., Miss. Test Facility, 71 pp.

Clark, R., 1973: Model water vapor profiles between 10° and 1 millibars. Report NASA J.O. 63-0301-0043, Lockheed Electronics Co., Bay St. Louis, MS., 7 pp.

Davis, P.A. and W. Viezee, 1964: A model for computing infrared transmission through atmospheric water vapor and carbon dioxide. J. Geophys. Res., 69, 3785-3794.

Goldman, A., D. G. Murcray, F. H. Murcray, W. J. Williams, and J. N. Brooks, 1973: Distribution of water vapor in the stratosphere as determined for balloon measurements of atmospheric emission spectra in the 24 - 29μ region. Appl. Opt., 12, 1045-1053.

Goody, R. M., 1964: Atmospheric Radiation, Vol. 1, Oxford, Clarendon Press, 436 pp.

Halbach, J., 1973: Program documentation: Radiation model for calculating atmospheric corrections for IR sensors, Version 2. Report NASA J.O. 63-0301-0044, Lockheed Electronics Co., Bay St. Louis, MS, 83 pp.

Haltiner, G. J., and F. L. Martin, 1957: Dynamical and Physical Meteorology, New York, McGraw-Hill Book Co., 470 pp.

Hering, W. S., and T. R. Borden, Jr., 1964: Ozonesonde observations over North America, Vol. 2. Environmental Research Papers No. 38, AFCRL-64-30 (II), Air Force Cambridge Research Laboratories, Bedford, Mass., 280 pp.

List, R. J., 1971: Smithsonian Meteorological Tables. Washington, D.C., Smithsonian Institute, 527 pp.

Mastenbrook, H. J., 1971: The variability of water vapor in the stratosphere. J. Atmos. Sci., 28, 1495 - 1501.

McDonald, J. E., 1960: Absorption of atmospheric radiation by water films and clouds. J. of Meteor., 17, 232-238.

McKinnon, D., and H. W. Morewood, 1970: Water vapor distribution in the lower stratosphere over North and South America. J. Atmos. Sci., 27, 483-492.

Moskalenko, N. I., 1969: The spectral transmission function in bands of the water-vapor, O_3, N_2O, and N_2 atmospheric components. Isv., Atmospheric and Oceanic Physics, 5 (11), 678-685.

Moskalenko, N. I., 1971: Absorption of radiation in the 4.75, 9.6, and 14.2 - μm bands of ozone. Isv., Atmospheric and Oceanic Physics, 7(5), 545 - 547.

Murcray, D. G., T. G. Kyle, and W. J. Williams, 1969: Distribution of water vapor in the stratosphere as derived from setting sun absorption data. J. Geophys. Res., 74, 5369 - 5373.

Valley, S. L., 1965: Handbook of Geophysics and Space Environments. New York, McGraw-Hill Book Co., p. 2-11, 2-12.

Wark, D. O., J. Alishouse, and G. Yamamoto, 1963: Calculations of the earth's spectral radiance for large zenith angles. Report No. 21, Meteorological Satellite Lab., Washington, D. C., 45 pp.