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DAYCOR USERS MANUAL

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SECTION 1

INTRODUCTION

The DAYton temperature CORrection model (DAYCOR) calculates the temperature correction that must be applied to the temperature measured by the VIZ radiosonde's white rod thermistor to deduce the atmospheric temperature. The temperature correction calculation takes into account all the significant heat transfer processes that influence the temperature of the rod thermistor. These processes include the convective heat transfer with the air, the solar and infrared radiation absorbed by the thermistor, the radiation emitted by the thermistor, and the heat conducted to the thermistor through the lead wires. The DAYCOR model ignores the influence, on the thermistor, of reflected and emitted radiation from the balloon and radiosonde instrument. Luers'(1989) shows these influences to contribute less than 10% to the temperature correction. The heating of the thermistor from the electric current passing through the circuit is small and is also neglected in the model calculations.

The radiation absorbed by the thermistor is calculated using output from the LOWTRAN7 atmospheric transmission model. The LOWTRAN7 model takes into consideration the effect of both solar and infrared radiation in its calculations. LOWTRAN7 requires input profiles of the atmospheric thermodynamic parameters, aerosols, ozone, minor constituents, clouds, surface temperature and albedo. When these values are not available, default or standard atmosphere type profiles can be specified. Using LOWTRAN7 the radiation environment of the thermistor is derived at altitude intervals of 5 km from all angular directions. The radiation environment derived from the LOWTRAN7 model is combined with the dimensions and absorption properties of the thermistor, the balloon rise rate, and other parameters in order to solve the heat balance equation of the thermistor at each temperature measurement altitude. The temperature correction is then output from the calculation.

The DAYCOR model can be run on any VIZ rod thermistor radiosonde flight, at any location, provided the surface, environment, and cloud cover conditions are known. A detailed description of the physics incorporated into the model are contained in References 1 and 2.

The DAYCOR model has been evaluated by comparing its predicted values of temperature correction with actual measured values of the temperature correction derived from the NASA multi-thermistor radiosonde. The DAYCOR model has been found capable of calculating the temperature correction to an accuracy of 0.3 C provided the cloud parameters are precisely known. The accuracy of the DAYCOR model deteriorates with the presence of cirrus clouds or partially cloudy conditions when the percent cloud cover, multi-layer cloud decks, and unknown amounts of cirrus clouds can not be accurately defined. Under these ill defined conditions the temperature correction may be in error by as much as 0.5 to 1.0 C.

SECTION 2

PROGRAM ENVIRONMENT

2.1 HARDWARE REQUIREMENTS

The DAYCOR program was developed to run on an IBM PC compatible computer that has a VGA graphics adapter, MS-DOS 3.3 (or higher) operating system and a postscript laser printer. Though the program is set for the VGA graphics adapter and postscript printer, these parameters may be changed to suit other systems, as outlined in the following section. Due to the time involved in performing the calculations and the size of the files, it is recommended that the computer also have a math co-processor, minimum 20 Mg hard drive, and at least a 20 MHz clock. The program was run on computers with a 486, 386, and 286 processor for test runs. The 486 is recommended because its approximate run time for a day flight was five minutes while the 386's run time increased to a half hour and the 286's increased to almost three hours. Night flight runs are considerably faster.

The operation of personal computers and printers is described within the appropriate manuals provided with each computer system. It is assumed that the user has an elementary knowledge of MS-DOS, directory and file structure and execution of programs.

2.2 SOFTWARE SUPPORT

The DAYCOR program is written and linked in standard FORTRAN-77. The program itself is a batch file containing executable files as well as other batch files. All interactive screen input and output options are menu driven. The plots are made using the

GNUPLOT software. To change the monitor or printer type the user must make simple edits and re-compile two of the executable programs contained in the batch file. To change from the current monitor setting of VGA graphics board the user must edit the LOWTEMP.FOR file on lines 520, 532, 544, and 557. Contained in the write statements of those lines is a 'set term vgalib' segment. The 'vgalib' term must be replaced with one of the following terms on the four lines mentioned above. The program must then be re-compiled using FORTRAN-77. The following is a list of the available terminal types and their appropriate call name.

IBM PC/Clone with EGA graphics board:	egalib
IBM PC/Clone with VGA Monochrome graphics board:	vgamono
IBM PC/Clone with MCGA graphics board:	mcga
IBM PC/Clone with CGA graphics board:	cga
IBM PC/Clone with Hercules graphics board:	hercules

To change from the current printer setting of postscript laser printer the user must edit the PLOTTER.FOR file on lines 34, 52, 70 and 89. Contained in the write statements of those lines is a 'set term postscript' segment. The 'postscript' term must be replaced with one of the following terms on the four lines mentioned above. The program must then be re-compiled using FORTRAN-77. The following is a list of the available printer types and their call names.

2.3 STRUCTURE OF PROGRAM

The DAYCOR model contains four major modules, the LOWTRAN7 input module, LOWTRAN7, the temperature correction module, and a graphics module. These modules are designated as LID (LOWTRAN7 input data), LOWTRAN7, LOWTEMP, AND GNUPLOT. A schematic of the structure of DAYCOR is shown in Figure 1.

DAYCOR

Figure 1. Schematic of DAYCOR.

LID Module

The LID module is interactive. It queries the user in order to assemble the input data to run LOWTRAN7. The LOWTRAN7 program requires as input a vertical profile of temperature, pressure, and humidity which can be read from a file containing the radiosonde measurement data, or specified as a standard atmosphere type default profile. If a radiosonde data profile is used, then the format of the data file must be the same as the output format of the multi-thermistor THERST program. The LID module assembles the radiosonde data, as well as other interactively specified data, into one or two files whose format is compatible with the LOWTRAN7 program. For a night flight only one file is generated and designated XXXX.IN7. The first part of the file name is defined by the user and usually identified by a flight number and station identifier. For a day flight two LOWTRAN7 input files are required, one for the direct solar radiation and another for the scattered solar and infrared radiation. These files are usually specified as DSXXXX.IN7 and SSXXXX.IN7 respectively. It should be noted that the user specifies only the first part of the file name while the extension, ".IN7", is added internally by the program. An explanation of the interactive commands used in assembling the input file(s) is contained in section 3. The input files are stored in the same directory as DAYCOR and can be retrieved for checking and verifying of input data after the run is complete.

LOWTRAN7

The LOWTRAN7 module is an atmospheric transmission model developed by the Air Force Geophysics Laboratory (1). The model calculates the solar and atmospheric irradiance by wavelength at a specified location from a specified direction. Flexibility of the model allows user specified profiles or default profiles to be used in defining the atmosphere. For day flights LOWTRAN7 utilizes two input data files, a direct solar and scattered solar file while for night flights only one file is used. In the DAYCOR model the LOWTRAN7 module is run a large number of times so as to calculate the irradiance of the thermistor from all directions and at each 5 km increment of altitude. A sensitivity analysis of the output irradiance values of LOWTRAN7 versus the input parameters has quantified the set of input parameters that must be specified by the user in the LID module. LOWTRAN7 input parameters not sensitive to irradiance output are given default values. The LOWTRAN7 module produces an output file(s) XSXXXX.PRT that

contains all the irradiance values from the numerous LOWTRAN7 runs. This file(s) has the same prefix as the corresponding input file and resides in the same directory as DAYCOR.

LOWTEMP

The LOWTEMP module retrieves the XSXXXX.PRT file(s) and utilizes this and other information to calculate the temperature correction. In this module the heat convection, conduction, and radiation terms are evaluated at each radiosonde altitude and used in the heat balance equation to solve for the temperature correction. Unlike the other modules this module is specific to the VIZ rod thermistor. The dimensions, absorption, and emission properties of the rod thermistor are built into the code, restricting the use of the DAYCOR model to VIZ rod thermistor equipped radiosondes. In addition to the temperature correction this module also calculates the magnitude of each of the heat transfer terms, and for day flights the magnitudes of the direct solar, scattered solar, and infrared heating terms. Output plot files are also generated for plotting parameters. The plot files names are delt.dat, ssrad2.dat, dsrad2.dat, airrad2.dat, athebs.dat, tconv.dat, temis.dat, tcan.dat, tss.dat, temper.dat. The plotting Module requires a separate two column file to plot each curve.

GNUPLOT

The plotting module GNUPLOT generates graphical output for the temperature correction and other heat transfer parameters. Examples of the plots available for day and night flights are shown in Section 4. Tabular output can be obtained by printing any of the LOWTRAN7 or LOWTEMP output files.

SECTION 3

RUNNING THE PROGRAM

The DAYCOR model is executed by specifying the necessary information about the environmental conditions and the radiosonde measurements in an interactive mode. DAYCOR can be run without using the temperature and humidity profiles measured by a radiosonde flight. In this case standard atmosphere type profiles must be specified. However for improved accuracy, it is recommended that the actual radiosonde measurements of temperature, pressure, humidity along with the solar zenith angles be entered into the input data file. This is achieved by reading from an input file the radiosonde output data that are specified in the format of the THERST (multi-thermistor) radiosonde data reduction program. Two sample cases for interactively generating the DAYCOR input are explained below. One case is a night flight that uses standard atmosphere profiles to specify the environment, the second a day flight using the THERST output file to define the environmental profiles. In both cases a THERST radiosonde file is needed.

Sample test case #1 : night flight using standard atmos. profiles

To run the DAYCOR Model type the word "DAYCOR".

The screen returns the prompt;

ENTER 0 FOR NIGHT FLIGHT AND 1 FOR DAY FLIGHT

Type the appropriate response.

0 (indicates processing a night flight)

The screen returns the prompt;

ENTER THE NAME OF FLIGHT DATA FILE

VIZ0020A.A1P

(the file name of the THERST output from VIZ flight 0020)

The screen returns the prompt;

ENTER THE NAME OF INPUT FILE TO CREATE

NF1442

(this file name identifies the input file as night flight 1442. Any name, up to eight characters, can be used as an identifier)

The screen returns the prompt;

SELECT ONE OF THE GEOGRAPHICAL-SEASONAL MODELS

1. TROPICAL ATMOSPHERE
2. MIDLATITUDE SUMMER
3. MIDLATITUDE WINTER
4. SUBARTIC SUMMER
5. SUBARTIC WINTER
6. 1976 US STANDARD
7. TEMPERATURE, PRESSURE & HUMIDITY PROFILES FROM
RADIOSONDE DATAFILE

3

(this specifies the temperature, pressure, water vapor, ozone, carbon dioxide, etc, profiles that are used in the LOWTRAN7 radiation calculations.)

The screen returns the prompt;

ENTER THE ALTITUDE IN KM(X.XXX) OF THE LOWER BOUNDARY FOR RADIATION (i.e. GROUND ELEVATION ABOVE SEA LEVEL IF CLEAR SKY; CLOUD TOP ALTITUDE IF CLOUD DECK)

1.200

(this is the altitude of the surface that is seen looking down from the radiosonde from high altitude. If total cloud cover, it is the cloud top height. If no clouds or partially cloudy it is the average height of the area beneath the radiosonde when the radiosonde is above 20 km)

The screen returns the prompt;

ENTER THE GROUND TEMPERATURE (K)

298

(the average temperature of the surface below the radiosonde when it is at an altitude above 20 km)

The screen returns the prompt;

SELECT TYPE OF GROUND COVER SEEN BY THE RADIOSONDE BETWEEN 20 AND 30 KM

1. WATER
2. SNOW
3. DESERT
4. VEGETATION
5. BARE GROUND

2

(indicates the type of surface below the radiosonde at altitudes above 20 km)

The screen returns the prompt;

SELECT ATMOSPHERIC BOUNDARY LAYER VISIBILITY ENVIRONMENT

1. NO AEROSOL ATTENUATION USED
2. RURAL, VIS=23KM
3. RURAL, VIS=5KM
4. NAVY MARITIME, SETS OWN VIS
5. URBAN, VIS =5KM
6. TROPOSPHERIC, VIS=50KM
7. NOT AVAILABLE
8. FOG1(ADVECTIVE FOG), VIS=0.2KM
9. FOG2(RADIATIVE FOG), VIS=0.5KM
10. NOT AVAILABLE

3

(indicates the type of aerosol profile, with associated visibility for the troposphere. A reference background stratospheric aerosol profile is assumed. See LOWTRAN7 manual for details about these profiles)

The screen returns the prompt;

SELECT CLOUD MODEL

1. NO CLOUDS
2. CLOUD COVER OR PARTIAL CLOUDS
3. CIRRUS CLOUDS
4. CLOUDS & CIRRUS

4 (queries about the existence of clouds so that the appropriate cloud parameters can be defined)

With the choice of "4" the screen returns the prompt;

ENTER PERCENTAGE OF CLOUD COVER (XX.X)

25 (the percentage of the downward view area of the radiosonde when above 20 km, that it sees as clouds)

The screen returns the prompt;

ENTER CIRRUS BASE ALTITUDE (KM)

3.5 (altitude of the base of the cirrus clouds is usually deduced from the radiosonde temperature and dew point temperatures)

The screen returns the prompt;

ENTER CIRRUS CLOUD THICKNESS (KM)

1.5 (the estimated thickness of the cirrus cloud layer)

The screen returns the prompt;

****YOU HAVE ENTERED THE FOLLOWING PARAMETERS:**

1. GEOGRAPHICAL-SEASONAL MODEL:	3
SUPPLEMENTARY PROFILE	3
2. GROUND/CLOUD ALTITUDE (KM)	1.200
3. GROUND TEMPERATURE (K):R	298.000
4. EFFECTIVE ALBEDO IR:	.15
5. VISIBILITY	3

6. CLOUD COVER	CC&CIR
PERCENTAGE CLOUD COVER (%)	25.0
CLOUD TOP TEMPERATURE (K)	277.7
CIRRUS BASE ALTITUDE (KM)	3.5
CIRRUS THICKNESS (KM)	1.5
7. EFFECTIVE LOWER BOUNDARY TEMP (K)	292.9

(note that this screen contains derived as well as specified parameters. The effective albedo and lower boundary parameters are composites of the surface and cloud values weighted by the percentage cloud cover)

The screen returns the prompt

ENTER THE NUMBER OF THE PARAMETER YOU WOULD LIKE TO
CHANGE OF 0 IF ALL ARE CORRECT.

0 (this option allows the user to edit the combined data set)

The screen returns the prompt;

Stop - Program terminated

Sample test case #2 : day flight using THERST radiosonde output

Type the program name "DAYCOR"

ENTER 0 FOR NIGHT FLIGHT AND 1 FOR DAY FLIGHT

1

The screen returns the prompt;

ENTER NAME OF THE FLIGHT DATA FILE

VIZ0007A.A1P (the file name of the THERST output from VIZ flight
0007)

The screen returns the prompt;

ENTER NAME OF DIRECT SOLAR FILE TO CREATE

DS0007 (the file name created is DS0007.IN7)

The screen returns the prompt;

ENTER NAME OF SCATTERED SOLAR FILE TO CREATE

SS0007 (the file name created is SS0007.IN7)

The screen returns the prompt;

SELECT ONE OF THE GEOGRAPHICAL-SEASONAL MODELS

1. TROPICAL ATMOSPHERE
2. MIDLATITUDE SUMMER
3. MIDLATITUDE WINTER
4. SUBARTIC SUMMER
5. SUBARTIC WINTER
6. 1976 US STANDARD
7. TEMPERATURE, PRESSURE & HUMIDITY
PROFILES FROM RADIOSONDE DATA FILE

7 (radiosonde data from VIZ0007 is to be used)

The screen returns the prompt;

SELECT SUPPLEMENTARY PROFILES FROM GEOGRAPHICAL-
SEASONAL MODELS

1. TROPICAL ATMOSPHERE
2. MIDLATITUDE SUMMER
3. MIDLATITUDE WINTER
4. SUBARTIC SUMMER
5. SUBARTIC WINTER
6. 1976 US STANDARD

2 (this defines the supplementary profiles of ozone, carbon
dioxide, etc. not contained in the radiosonde THERST file)

The screen returns the prompt;

ENTER THE ALTITUDE IN KM(X.XXX) OF THE LOWER BOUNDARY
FOR RADIATION (i.e. GROUND ELEVATION ABOVE SEA LEVEL IF
CLEAR SKY; CLOUD TOP ALTITUDE IF CLOUD DECK)

0.024 (average ground elevation of region; clear day)

The screen returns the prompt;

ENTER THE GROUND TEMPERATURE (K)

296 (average temperature of region)

The screen returns the prompt;

SELECT TYPE OF GROUND COVER SEEN BY THE RADIOSONDE
BETWEEN 20 AND 30 KM

1. WATER
2. SNOW
3. DESERT
4. VEGETATION
5. BARE GROUND

3 (ground cover seen by radiosonde at altitudes above 20 km)

The screen returns the prompt;

SELECT ATMOSPHERIC BOUNDARY LAYER VISIBILITY
ENVIRONMENT

1. NO AEROSOL ATTENUATION USED
2. RURAL, VIS=23KM
3. RURAL, VIS=5KM
4. NAVY MARITIME, SETS OWN VIS
5. URBAN, VIS =5KM
6. TROPOSPHERIC, VIS=50KM
7. NOT AVAILABLE
8. FOG1(ADVECTIVE FOG), VIS=0.2KM
9. FOG2(RADIATIVE FOG), VIS=0.5KM
10. NOT AVAILABLE

4 (indicates the type of reference aerosol profile, with associated visibility for the troposphere. A reference background stratospheric aerosol profile is assumed. See LOWTRAN7 manual for details about these profiles)

The screen returns the prompt;

SELECT CLOUD MODEL

1. NO CLOUDS
2. CLOUD COVER OR PARTIAL CLOUDS
3. CIRRUS CLOUDS
4. CLOUDS & CIRRUS

1 (the ground is the lower boundary seen by the radiosonde above 20 km.)

The screen returns the prompt;

**YOU HAVE ENTERED THE FOLLOWING PARAMETERS:

1. GEOGRAPHICAL-SEASONAL MODEL:	7
SUPPLEMENTARY PROFILE:	2
2. GROUND/CLOUD ALTITUDE (KM):	0.024
3. GROUND TEMPERATURE (K):	296.000
4. EFFECTIVE ALBEDO UV:	.20
VIS:	.30
IR:	.07
5. VISIBILITY:	4
6. CLOUD COVER:	NONE
PERCENTAGE CLOUD COVER (%)	.0
7. EFFECTIVE LOWER BOUNDARY TEMP (K):	296.0
8. DAY OF THE YEAR:	51
9. SOLAR ZENITH AT	
30.000 KM:	62.9
25.000 KM	62.9
20.000 KM	62.5
15.000 KM	62.4
10.000 KM	62.4
5.000 KM	62.5
0.025 KM	63.5

(the values of solar zenith angle and day of the year were extracted from the radiosonde THERST file VIZ0012A.A1P)

The screen returns the prompt;

ENTER THE NUMBER OF THE PARAMETER YOU WOULD LIKE TO
CHANGE OF 0 IF ALL ARE CORRECT.

4 (to change the input value of albedo)

The screen returns the prompt;

ALBEDO MAY ALSO CHANGE WITH TYPE OF CLOUD COVER

SELECT TYPE OF GROUND COVER SEEN BY THE RADIOSONDE
BETWEEN 20 AND 30 KM ALTITUDE

- 1.WATER
- 2.SNOW
- 3.DESERT
- 4.VEGETATION
- 5.BARE GROUND

4 (ground cover changed to vegetation)

The screen returns the prompt;

SELECT CLOUD MODEL

1. NO CLOUDS
2. CLOUD COVER OR PARTIAL CLOUDS
3. CIRRUS CLOUDS
4. CLOUDS & CIRRUS

1 (no change)

The screen returns;

****YOU HAVE ENTERED THE FOLLOWING PARAMETERS:**

1. GEOGRAPHICAL-SEASONAL MODEL	7
SUPPLEMENTARY PROFILE:	2
2. GROUND/CLOUD ALTITUDE (KM):	0.024
3. GROUND TEMPERATURE (K):	296.000
4. EFFECTIVE ALBEDO	UV: .10
	VIS: .35
	IR: .05

5. VISIBILITY:	4
6. CLOUD COVER:	NONE
PERCENTAGE CLOUD COVER:	.0
7. EFFECTIVE LOWER BOUNDARY TEMP (K):	296.0
8. DAY OF THE YEAR:	51
9. SOLAR ZENITH AT 30.000 KM:	62.9
25.000 KM	62.9
20.000 KM	62.5
15.000 KM	62.4
10.000 KM	62.4
5.000 KM	62.5
0.024 KM	63.5

ENTER THE NUMBER OF THE PARAMETER YOU WOULD LIKE TO
CHANGE OF 0 IF ALL ARE CORRECT.

0

The screen returns the prompt;

Stop - Program terminated

(the LOWTRAN7 input files SS0012.IN7 and DS0012.IN7 have
now been generated)

SECTION 4

OUTPUT

After completing the LOWTEMP segment of the DAYCOR program, the GNUPLOT software shows the user the plots available on the screen. There are three plots for night flights and four for day flights. After viewing the plots, the user has the option by an interactive menu to send any or all of the plots to the printer. If the selection of 'no plots' is selected, the user will be asked if the LOWTRAN7 input files (XXXX.in7) should be retained or deleted. It is sometimes useful to check these files if errors are suspected, but generally these files are not kept.

The first test case run in this manual was for a night flight and generated three output plots. It should be noted that the title of all plots will contain the flight data file name. The first plot (figure 2) shows the temperature correction predicted by the DAYCOR model versus that measured by the multi-thermistor radiosonde. The second plot (figure 3) is the heat loss/gain to the thermistor by radiation, convection, emission and conduction. The actual value of the radiation term is plotted while all other terms have their negative values plotted. A positive value indicates heat going into the thermistor. The third plot (figure 4) is simply the temperature profile of the flight.

The second test case was for a day flight and generated four plots. The first three are similar to the plots of the night flight (figure 5, 6 and 7) and the additional plot is that of absorbed radiation (figure 8). The scattered solar, direct solar, and infrared radiation terms are shown in this plot.

The program also generates tabular data which the user may access. After the program terminates, the user may view the R.DAT and R.OUT files with any editor or by printing

Figure 2. DAYCOR Predicted vs Measured Temperature Correction: Night Flight 0020.

Altitude (KM)

Figure 3. Magnitude of Heat Transfer Terms.

Figure 4. Background Temperature Profile.

Figure 5. DAYCOR Predicted vs Measured Temperature Correction: Day Flight 0007.

9-7
Altitude (KM)

Figure 6. Magnitude of Heat Transfer Terms.

Figure 7. Background Temperature Profile.

Figure 8. Absorbed Radiation Terms.

them out. In printing these files, it should be noted that they can be very large and some caution should be taken before dumping them to the printer.

The R.DAT file contains various data which is primarily used for debugging purposes. This data file contains information at five kilometer increments. Table 1 shows a sample from night flight VIZ0020A.A1p.

The R.OUT file also contains useful debugging data but at every altitude at which LOWTEMP was run. Table 2 shows a sample from night flight VIZ0020A.A1P.

Epson LX-800, Star NL-10, NX-1000 and lots of others:	Epson_1x800
---	-------------

HP2623A and maybe others:	hp2623A
---------------------------	---------

HP7475 and lots of others (six pens):	hpg1
---------------------------------------	------

HP Laserjet, smallest size:	laserjet1
-----------------------------	-----------

HP Laserjet, Medium size:	laserjet2
---------------------------	-----------

HP Laserjet, largest size:	laserjet3
----------------------------	-----------

LaTeX picture environment:	latex
----------------------------	-------

Postscript, big characters:	psbig
-----------------------------	-------

Encapsulated Postscript, small characters:	epsf1
--	-------

Encapsulated Postscript, big characters	epsf2
---	-------

IBM proprinter:	proprinter
-----------------	------------

TABLE 1

OUTPUT FROM R.DAT FILE

Example output for one altitude in R.DAT

ALTITUDE = 30.0 KM MU/RHO = 8.200

	1	2.140944E-01	0.000000E+00				
	2	1.626208	30.000000				
	3	2.553493	60.000000				
	4	2.437006	85.000000				
	5	1.856855	105.000000				
	6	2.038412	120.000000				
	7	1.362023	150.000000				
	8	4.245255E-01	165.000000				
	9	5.375354E-02	180.000000				
ZN DIR	STER.	IRRAD	IRTH	SUMIR	ABSTH	ABSTW	
.0	.214	.442E-04	.947E-05	.947E-05	.391E-05	.947E-08	
30.0	1.626	.484E-04	.716E-04	.811E-04	.335E-04	.811E-07	
60.0	2.553	.678E-04	.126E-03	.207E-03	.856E-04	.207E-06	
85.0	2.437	.183E-03	.287E-03	.495E-03	.204E-03	.495E-06	
105.0	1.857	.563E-02	.695E-02	.744E-02	.307E-02	.744E-05	
120.0	2.038	.635E-02	.945E-02	.169E-01	.697E-02	.169E-04	
150.0	1.362	.691E-02	.856E-02	.254E-0	.1105E-01	.254E-04	
165.0	.425	.701E-02	.290E-02	.284E-0	.117E-01	.284E-04	
180.0	.054	.704E-02	.379E-03	.287E-01	.119E-01	.287E-04	

THERMISTOR PARAMETERS

LEAD WIRE PARAMETERS

ABS IR RADIATION = .283E-02

CAL/S

ABS IR RADIATION = .686E-05

CAL/SEC

TABLE 2

OUTPUT FROM R.OUT FILE

Example output of one altitude in r.out

Altitude - 1.3 KM MU/RHO = .166

THERMISTOR PARAMETERS LEAD WIRE PARAMETERS

EMISSIVITY = .86	EMISSIVITY = .04
RADIUS = .060 CM	RADIUS = .0125 CM
LENGTH = 4.0 CM	
REYNOLDS NO. = 369.4	REYNOLDS NO. = 76.9
NUSSELT NO. = .962E+01	NUSSELT NO. = .443E+01
HEAT XFER COEF = .385E-02	HEAT XFER COEF = .851E-02

HEAT BALANCE FOR WIRE

RADIATION	CONVECTION	EMISSION	CONDUCTION
CAL/DL*S	CAL/DL*S	CAL/DL*S	CAL*CM/S*K
.185E-04	.653E-025	-.252E-04	.452E-03

HEAT BALANCE FOR THERMISTOR (CAL/S)

RADIATION	CONVECTION	EMISSION	COND/WIRE	TEMP.LAG
.764E-02	.242E-02	-.105E-01	.441E-03	.000E+00

BALLOON RISE RATE = 5.1 M/SEC
 AIR TEMPERTURE = 277.5
 WIRE TEMPERATURE = 277.5
 THERMISTOR TEMPERTURE = 277.10
 TEMPERATURE ERROR .41

SECTION 5

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