Earth Sc #663

ERBS
OZONE NO. DENSITY & MIX RATIO PROFILE
84-108B-02B

AEROSOL DENSITY PROFILE ARCHIVE TAPE
84-018B-02C

NITROGEN DIOXIDE PROFILE TAPE
84-108B-02D

H_2O AEROSOL PROFILE TAPE
84-108B-02E

663	84-108B-02B	ESAC-00059
663	84-108B-02C	ESAC-00050
663	84-108B-02D	ESAC-00011
663	84-108B-02E	ESAC-00033

Table of Contents

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1. INTRODUCTION:

The documentation for this data set was originally on paper, kept in NSSDC's Data Set Catalogs (DSCs). The paper documentation in the Data Set Catalogs have been made into digital images, and then collected into a single PDF file for each Data Set Catalog. The inventory information in these DSCs is current as of July 1, 2004. This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system. The information existing in the DSCs is now not needed for locating the data files, but we did not remove that inventory information.

The offline tape datasets have now been migrated from the original magnetic tape to Archival Information Packages (AIP's).

A prior restoration may have been done on data sets, if a requestor of this data set has questions; they should send an inquiry to the request office to see if additional information exists.

2. ERRATA/CHANGE LOG:

NOTE: Changes are made in a text box, and will show up that way when displayed on screen with a PDF reader.

When printing, special settings may be required to make the text box appear on the printed output.

Version	Date	Person	Page	Description of Change
01				
02				

3 LINKS TO RELEVANT INFORMATION IN THE ONLINE NSSDC INFORMATION SYSTEM:

http://nssdc.gsfc.nasa.gov/nmc/

[NOTE: This link will take you to the main page of the NSSDC Master Catalog. There you will be able to perform searches to find additional information]

4. CATALOG MATERIALS:

a. Associated Documents To find associated documents you will need to know the document ID number and then click here. http://nssdcftp.gsfc.nasa.gov/miscellaneous/documents/

b. Core Catalog Materials

ERBS
SAGE II OZONE NO. DENSITY AND MIXED RATIO PROFILES
84-108B-02B ESAC-00059

THIS DATA SET CONSISTS OF 8 TAPES. THE TAPES ARE 6250 BPI, BINARY 9-TRACK, WITH ONE FILE OF DATA, WRITTEN IN CDC 60 BIT FLOATING POINT WORDS. THE TAPES WERE CREATED ON A CYBER COMPUTER. THE D AND C NUMBERS AND TIME SPAN ARE AS FOLLOWS:

D#	C#	TIME SPANS
D-76273	C-26689	10/24/84-11/30/85
D-78019	C-26706	12/01/85-11/30/86
D-78778	C-26877	12/01/86-11/30/87
D-79350	C-28073	12/01/87-11/30/88
D-83181	C-28074	12/01/88-11/30/89
D-83182	C-28075	12/01/89-11/29/90
D-87892	C-29423	12/12/90-05/29/91
D-104127	C-031247 (3 files)	06/11/91-05/22/93

ERBS
SAGE II AEROSOL PROFILE ACHIVAL TAPES
84-108B-02C ESAC-00050

THIS DAT SET CONSISTS OF 14 TAPES. THE TAPES ARE 6250 BPI,BINARY, 9-TRACK, WITH ONE FILE OF DATA WRITTEN IN CDC 60 BIT FLOATING POINT WORDS. THE TAPES WERE CREATED ON A CYBER COMPUTER. THE D AND C NUMBERS AND THE TIME SPANS ARE AS FOLLOWS:

D#	C#	TIME SPANS
D-78017	C-26719	10/24/84-11/30/85
D-78018	C-26720	12/01/85-11/30/86
D-78779	C-26878	12/01/86-11/30/87
D-79172	C-28076	12/01/87-11/30/88
D-83179	C-28077	12/01/88-11/30/89
D-83180	C-28078	12/01/89-11/29/90
D-84503	C-28694	12/12/90-11/27/91
D-84804	C-28826	12/09/91-09/30/92
D-88266	C-29424	10/01/92-12/31/92
D-95310	C-29438	01/01/93-01/31/93
D-101191	C-030222	02/01/93-04/30/93
D-104024	C-031223	05/01/93-09/30/93
D-104128	C-031248	10/01/93-11/19/93
D-104170	C-031278	12/03/93-12/31/93

ERBS
SAGE II NITROGEN DIOXIDE PROFILE
84-108B-02D ESAC-00011

THIS DATA SET CONSISTS OF 8 TAPES. THE TAPES ARE 6250 BPI,BINARY, 9-TRACK WITH ONE FILE OF DATA WRITTEN IN CDC 60 BIT FLOATING POINT WORDS. THE TAPES WERE CREATED ON A CYBER COMPUTER. THE D AND C NUMBERS AND THE TIME SPANS ARE AS FOLLOWS:

D#	C#	TIME SPAN
D-82823	C-28013	10/24/84-11/30/85
D-82824	C-28014	12/01/85-11/30/86
D-82825	C-28015	12/01/86-11/30/87
D-83176	C-28079	12/01/87-11/30/88
D-83177	C-28080	12/01/88-11/30/89

D-83178	C-28081		12/01/89-11/29/90
D-87893	C-29422		12/12/90-05/29/91
D-104129	C-031249	(3files)	06/11/91-05/22/93

National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia
23665-5225

NASA

Not to be dist
CYN 4/93

Reply to Attn of 475

May 9, 1991

Mr. Ralph Post
NSSDC-Data Repository Receiving
Goddard Space Flight Center
Code 633
Greenbelt, MD 20771

Dear Ralph:

I am sending under separate cover reprocessed/replacement SAGE II (aerosol and ozone) data covering the period November 1984 (launch) through November 1990 for archival. This data set should replace the current archived version at your center. The changes in the updated data set are minor and should not affect the users working with the previously archived data. Specifically, the following changes have been incorporated into the latest reprocessing of the SAGE II data:

1. The word length of the aerosol profile event is lengthened.
2. The error estimates for the profile data have been updated based on the latest validation study.
3. The 525 nanometer channel aerosol data below 10 kilometers has been similarly updated.

Also included is the nitrogen dioxide sunset data for the period November 1984 through November 1990.

We have included copies of the current "Users Guides" which apply to this revised data.

If you have any questions, please call Mr. Mike Rowland at FTS 928-2691 or me at FTS 928-2674.

Sincerely,

George L. Maddrea, Jr.
SAGE II Data Validation Manager

cc:
Ms. Lola Olsen
Goddard Space Flight Center
Code 542.2
Greenbelt, MD 20771

Ms. Carolyn Ng
Goddard Space Flight Center
Code 933.0
Greenbelt, MD 20771

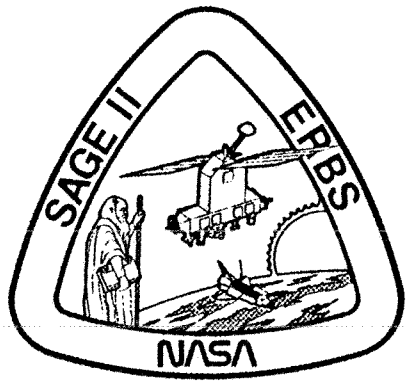
84-108B-02C

Aerosol Profile User's Guide

for

The Stratospheric Aerosol & Gas Experiment

(SAGE II)



Aerosol Research Branch
Atmospheric Sciences Division

NASA/Langley Research Center
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Revision 1: May 09, 1991

Prepared By: _____ Date: 5-7-91
Principal Programmer Analyst, STX

Approved By: _____ Date: 5/9/91
SAGE II Project Scientist, NASA

Released By: _____ Date: May 9, 91
Contract Task Monitor, NASA

The Aerosol Profile User's Guide for the Stratospheric Aerosol and Gas Experiment II (SAGE II)

INTRODUCTION

The Stratospheric Aerosol and Gas Experiment II (SAGE II) is a payload installed aboard the Earth Radiation Budget Satellite (ERBS) that was launched on October 5, 1984, from NASA Space Shuttle Flight 41-G.

The SAGE II instrument is a multi-channel spectral radiometer that measures the attenuation of solar radiation at seven wavelengths as they pass through the Earth's atmosphere during the spacecraft's sunrise and sunset events (see Ref. 4). In one day's time the ERBS spacecraft encounters approximately fifteen sunrise and fifteen sunset events. The SAGE II instrument captures solar radiation data for each event. The data span a vertical distance from about 140 kilometers to the horizon or a cloud top. The ground-track slew distance during data capture varies directly with the duration of the event. Event duration will vary with the beta angle[1] of the event; the larger the absolute beta angle, the longer the event will be.

At various times of the day, the instrument data are transmitted to an Earth station and forwarded to Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. There, the SAGE II experiment data are screened, reformatted, and placed on magnetic tape for shipment to NASA/Langley Research Center in Hampton, Virginia. The Aerosol Research Branch at Langley merges the experiment data with the spacecraft ephemeris information and the corresponding meteorological data. The merged data set is then processed to generate channel transmission information and, finally, the inverted products of vertical profiles of the measured atmospheric constituents.

Reference 6 provides the details about vertical profile inversions of the measured atmospheric constituents measured by SAGE II. The inversion of SAGE II data provides altitude profiles of:

1) aerosol extinctions at 1020, 525, 453, & 385 nm,
2) ozone concentration,
3) nitrogen dioxide concentration, and
4) water vapor concentration.

These data can be used by researchers to study the temporal and spatial variability of each species and their effect on atmospheric processes and climate.

Both unprocessed solar radiance data from the SAGE II instrument and the resulting constituent profile data sets are stored on magnetic tapes and made available to the science community through the National Space Science Data Center (NSSDC) at the NASA/Goddard Space Flight Center, Code 633, Greenbelt, Maryland 20771.

SPATIAL AND TEMPORAL COVERAGE

The ERBS orbital geometry is such that SAGE II sunrise and sunset observations are repeated every orbit (96 to 97 minutes). Tangent locations of the consecutive events of the same type (either sunrise or sunset) are separated by approximately 24 degrees longitude. There are about fifteen sunrises and fifteen sunsets in each 24-hour period. The locations of observation sweep over various latitude ranges, depending on the season, of approximately 130 degrees latitude in a 2- to 3-week period. Maximum latitudinal coverage over a year extends from approximately 80S to 80N degrees latitude.

The vertical resolution of the aerosol profiles is one kilometer and their estimated uncertainty is about ±10%. Error estimates of the values in each altitude level are included in this data set. Aerosol profiles above 45 kilometers are currently not provided and contain "fill" data.

TAPE FORMAT AND CHARACTERISTICS

The aerosol profiles for each event are recorded on 2400 foot magnetic tape reels. The tape recording density is 6250 bpi using a 9-track write format. Each record contains one complete event and all its associated data and profiles.

The record length is the same for all records on the tape. Each record is 1488 CDC Cyber 60-bit floating-point[2] words in length. This translates to 11 160 bytes or 89 280 bits per tape record. A year's profiles are contained on a single tape. Using seasonal boundaries, the tapes start in December of a year and end in November of the next year. Year one of SAGE II data (1985) contains additional data at the beginning of the tape to cover the short period from the instrument's first data day on October 24, 1984, up through the end of November 1984. There are no embedded file marks separating events on a data tape, however, at least one file mark is placed after the last event on the tape to designate the end of information (EOI).

1. Beta angle is defined as the angle generated by the earth-sun vector and the orbit plane of ERBS.

2. Appendix B contains a floating-point format guide.

SAGE II AEROSOL PROFILE RECORD FORMAT

Cyber Words (60-bit)	Size	Field Content Description	Type	Note
		40 Kilometer Reference Data		
0001	1	Event Date (yymmdd.0)	(R)	1
0002	1	Event Time (hhmmss.0)	(R)	1
0003	1	Subtangent Latitude (0.0 ± 90.0 degrees)	(R)	
0004	1	Subtangent Longitude (0.0 ± 180.0 degrees)	(R)	
0005	1	Spacecraft-Referenced Event Type (0.0 = sunrise; 1.0 = sunset)	(R)	2
0006	1	Earth-Referenced Event Type (0.0 = sunrise; 1.0 = sunset)	(R)	2
0007	1	Spacecraft Beta Angle (0.0 ± 61.0 degrees)	(R)	3
0008	1	Coded Time of Year (ddd.fract)	(R)	4
		NMC Meteorological Data (see Appendix A)		
0009-0033	25	Temperature (Kelvin)	(R)	
0034-0058	25	Temperature Error (Kelvin)	(R)	
0059-0083	25	Geometric Altitude (meters)	(R)	
0084-0108	25	Air Density (grams/cubic meter)	(R)	
0109-0133	25	Air Density Error (percent)	(R)	
0134	1	Temperature Correction Value for 5.0 Millibar Level (Kelvin)	(R)	
0135	1	Temperature Correction Value for 2.0 Millibar Level (Kelvin)	(R)	
0136	1	Temperature Correction Value for 1.0 Millibar Level (Kelvin)	(R)	
0137	1	Temperature Correction Value for 0.4 Millibar Level (Kelvin)	(R)	
0138	1	"Meteorological Data Not Complete" Flag (0=complete; 1=incomplete)	(R)	
0139	1	"Start of Model Meteorological Data" Array Index Pointer (1 - 19)	(R)	
0140	1	Model Meteorological Data Selection Code (ssll)	(R)	
0141	1	Revision Date of LaRC Meteorological Model (yymmdd.0)	(R)	
		NASA/LaRC Processing Information		
0142	1	LaRC Driver Revision Level	(R)	
0143	1	LaRC Transmission Revision Level	(R)	
0144	1	LaRC Inversion Revision Level	(R)	
0145	1	LaRC Event Tag (yymmddhhmm.sq)	(R)	5
0146	1	LaRC Processing Date (yymmdd.0)	(R)	1
0147	1	LaRC Processing Time (hhmmss.0)	(R)	1
0148	1	Mean Subtangent Altitude for Event Limb Calibration (kilometers)	(R)	6
0149	1	Value Designated as the Data Fill Number for this Event	(R)	7
		Event Ground-Track Slew Data		
0150-0157	8	Subtangent Altitude (kilometers)	(R)	
0158-0165	8	Corresponding Latitude (0.0 ± 90.0 degrees)	(R)	
0166-0173	8	Corresponding Longitude (0.0 ± 180.0 degrees)	(R)	
0174	1	Time Span of Data from Level 1 through 70 (seconds)	(R)	
		Altitude and Meteorological Data for Profile Arrays		
0175-0244	70	Geometric Altitude (kilometers)	(R)	9
0245-0314	70	Corresponding Pressure (millibars)	(R)	9
0315-0384	70	Corresponding Temperature (Kelvin)	(R)	9
0385-0390	6	Spare		

(continued on the next Page)

SAGE II AEROSOL PROFILE RECORD FORMAT

(continued from previous page)

Cyber Words (60-bit)	Size	Field Content Description	Type	Note
		Channel Optical Depth Profile Quality Estimations		
391	1	1020 nm Wavelength Quality Factor	(R)	8
392	1	Spare		
393	1	Spare		
394	1	525 nm Wavelength Quality Factor	(R)	8
395	1	453 nm Wavelength Quality Factor	(R)	8
396	1	Spare		
397	1	385 nm Wavelength Quality Factor	(R)	8
0398-0400	3	Spare		
		Rayleigh Extinction Profiles		
0401-0460	60	1020 nm Rayleigh Extinction (km^{-1})	(R)	9
0461-0520	60	1020 nm Rayleigh Extinction Error (km^{-1})	(R)	9
0521-0580	60	525 nm Rayleigh Extinction (km^{-1})	(R)	9
0581-0640	60	525 nm Rayleigh Extinction Error (km^{-1})	(R)	9
0641-0700	60	453 nm Rayleigh Extinction (km^{-1})	(R)	9
0701-0760	60	453 nm Rayleigh Extinction Error (km^{-1})	(R)	9
0761-0820	60	385 nm Rayleigh Extinction (km^{-1})	(R)	9
0821-0880	60	385 nm Rayleigh Extinction Error (km^{-1})	(R)	9
		Aerosol Profiles		
0881-0940	60	1020 nm Extinction (km^{-1})	(R)	
0941-1000	60	1020 nm Extinction Error (km^{-1})	(R)	
1001-1060	60	525 nm Extinction (km^{-1})	(R)	
1061-1120	60	525 nm Extinction Error (km^{-1})	(R)	
1121-1180	60	453 nm Extinction (km^{-1})	(R)	
1181-1240	60	453 nm Extinction Error (km^{-1})	(R)	
1241-1300	60	385 nm Extinction (km^{-1})	(R)	
1301-1360	60	385 nm Extinction Error (km^{-1})	(R)	
1361-1420	60	1020 nm Extinction Ratio	(R)	10
1421-1480	60	1020 nm Extinction Ratio Error	(R)	10
1481-1488	8	Spare		

End of Event Record

(Notes on the next page)

SAGE II AEROSOL PROFILE RECORD FORMAT

Record Format Notes

GENERAL NOTES

- Each field of the event record contains one 60-bit CDC-Cyber floating point number.
- All time and data references are to GMT, except Fields 146 and 147 which are LaRC processing time.
- All latitudes and longitudes are given at the event subtangent point.
- If any field in the event record is considered invalid, or has missing data, a fill value will be placed in that field. For each event record, that fill value can be found in Field 149. (See Note 7, below)
- Each profile level is centered at the 0.5 kilometer point and spans 1.0 kilometer.

DATA FIELD NOTES

1. The "yymmdd.0" and "hhmmss.0" fields are generated by the FORTRAN statements:

   DATE = FLOAT (IYY*10000 + IMM*100 + IDD) & TIME = FLOAT(IHH*10000 + IMM*100 + ISS)

2. Spacecraft-Referenced Event Type and Earth-Referenced Event Type fields are normally the same type, but, if the absolute value of the Spacecraft Beta Angle is close to 61 degrees, their types may be different. The Earth-Referenced Event Type field is based on sun mothion from a ground-observer's viewpoint.

3. The Spacecraft Beta Angle field is defined as the angle generated by the intersection of the Earth-Sun vector and the spacecraft orbit plane.

4. The Coded Time of Year field is the time at the beginning of the event (not the same time as Fields 1 and 2), and is generated by the FORTRAN statement:

   CODTIME = FLOAT(DOY) + (SOD/86400.0); where DOY = day of year (1-366) and
   SOD = seconds of the day (0.0-86399.99...)

5. The LaRC Event Tag is generated similarly to Note 1. The ".sq" at the end of the value is the event number of the day divided by 100.

6. The Mean Subtangent Altitude for Event Limb Calibration field contains the altitude at which data for the exoatmospheric solar image was gathered for use in solar limb normalization for the event.

7. The Value Designated as the Data Fill Number for This Event field must be used determine what data in the event record is valid. If any field, other than this one, contains this number, that field has no valid information and should not be used by the investigator.

8. The Quality Factor fields for each wavelength are equal to 1.0 minus the summation of the optical depth errors at each profile level from 20.5 to 59.5 kilomenters. In cases where a 40 kilometer span cannot be realized, the quality factor is proportioned to a 40 kilometer span to allow a better comparison across wavelengths and other events.

9. The values of altitude, pressure, and temperature in their seventy-element arrays correspond to the sixty-element arrays within the record. Altitude coincidence for all these arrays is at element 1.

10. Extinction Ratio = (Extinction + Rayleigh) / Rayleigh

Appendix A

Meteorological Data

Meteorological data are supplied to Langley Research Center by NOAA/National Weather Service - Climate Analysis Branch, in Washington, D.C. Data for temperature, temperature error, geometric altitude, air density, and air density error are provided for eighteen pressure levels and at the derived tropopause pressure. The pressure levels (mb) correspond to the 25-element meteorological data arrays (1 to 25) as follows: 1000, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 10, 5, 2, 1, 0.4, *0.04, 0.01, spare, spare, spare, spare,* and derived tropopause pressure. Elements 19 and 20 contain climatological model data for temperature and altitude only. Elements 21 through 24 contain "fill" values, and element 25 contains the NOAA-supplied tropopause information.

If NOAA cannot supply meteorological data as above, LaRC determines the highest pressure level for which data are supplied and then inserts model data from the next level up to the lowest pressure level of 0.01 millibars. Only temperature and altitude information are supplied using these model data: Temperature error, density, and density error will contain "fill" data for the corresponding levels that contain the LaRC-supplied data.

Meteorological correction factors for temperatures at 5, 2, 1, and 0.4 millibars are already included in the value of the temperatures in elements 15 through 18 of the temperature array (fields 23-26 of the record). These correction values are recorded in fields 134-137 of each record. If it is desired to remove these corrections from the data, subtract them from fields 23-26 of the record and recompute the temperatures in the 70-element array in fields 315-384. These correction factors are only included for the NOAA-supplied data: If model data are in these locations, no correction factors are used.

Meteorological data (fields 245 through 384 of the event record) are interpolated from the meteorological data in fields 9 through 133 of the record. Altitude data in fields 175-244 increments by 1 kilometer with the center of each level at the 0.5 kilometer point of the level bin.

Other meteorological data information is contained in the following record locations:

field 141: date of revision of the LaRC-supplied model

field 138: 1 if NOAA-supplied data is incomplete, 0 if all there

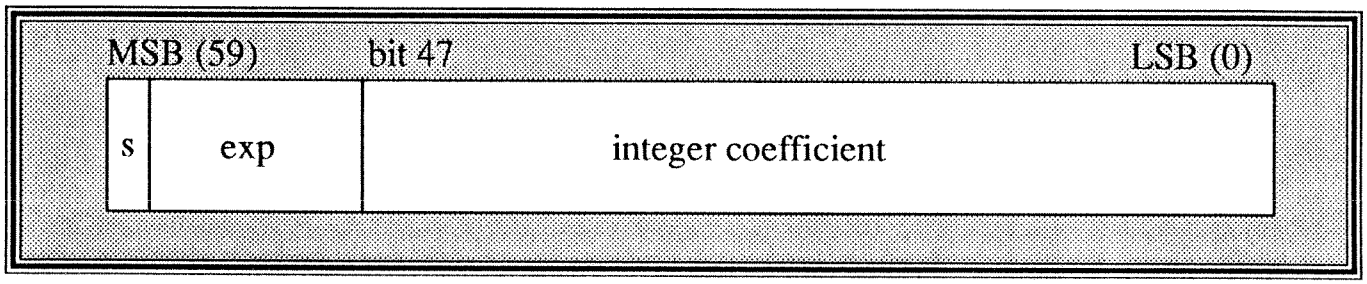
field 140: Model selection code (*ssll*) where *ss* is 01 to 04 for spring through winter;
ll is 0 to 80 in 10 degree increments for absolute latitude.

field 139: The model pointer is the array index that points to the start of LaRC-supplied model data in the temperature and altitude arrays of the meteorological data.

Appendix B

Guide to Floating-point Notation of the CDC Cyber Series Computer

This guide is intended to aid the programmer who is decoding the profile tapes described in this document. All data fields on this tape are in this 60-bit format.



Bits 47 through 0 contain the coefficient of the number (equivalent to about fourteen decimal digits). The binary point is considered to be to the right of bit 0. The exponent is biased by octal 2000: that is, the exponent is represented by an 11-bit quantity (one's complement notation is used for negative numbers), octal 2000 is added to this quantity, and the low order eleven bits are used.

Additionally, real numbers are normalized. A normalized number is one in which bit 47 is the most significant bit; that is, bit 47 is different from bit 59. A special case of a word of all zero bits (positive zero) is also considered a normalized number. For every bit position that the coefficient is shifted to the left to achieve normalization, the exponent is reduced in value by one.

The sign of the number is represented by bit 59; the number is positive if bit 59 is zero and negative if bin 59 is one. Negative numbers are represented in one's complement format.

Minus zero (a word of all one bits) is considered to be equal to positive zero (a word of all zero bits).

The table below summarizes the configuration of bits 58 and 59 and the exponent and coefficient signs resulting from each combination.

Bit 59	Coefficient Sign	Bit 58	Exponent Sign
0	+	1	+
0	+	0	-
1	-	0	+
1	-	1	-

Some examples of floating-point numbers, as they would appear in octal format, are as follows:

Number	Octal Representation
+1.0	1720 4000 0000 0000 0000
+100.0	1726 6200 0000 0000 0000
-100.0	6051 1577 7777 7777 7777
1.0 E64	2245 6047 4037 2237 7720
-1.0 E-64	6404 2570 0025 6605 5305
0	0000 0000 0000 0000 0000

Refrences

1. "Telemetry and Command Handbook," Ball Document No. ERBS-306, Rev. G, June 6, 1984.

2. "Earth Radiation Budget Satellite -- SAGE II Interface Agreement Document," GSFC Title "IPD to SAGE II LaRC Data Transfer Interface," December 1, 1981.

3. "ERBS Interface Specification, Control, and Compliance Document -- Stratospheric Aerosol and Gas Experiment II (SAGE II)," Ball Document 2319-009 January 30, 1981, Rev. D, May 1983.

4. "Stratospheric Aerosol and Gas Experiment II Instrument: A Functional Description," by L.E. Mauldin, III, N.H. Zaun, M.P. McCormick, J.H. Guy, and W.P. Vaughan, Optical Engineering, 24, 2, 307-312, 1985.

5. "FORTRAN Extended Version 4 Refrence Manual," Control Data Corporation, Manual No. 60497800 (Rev. F).

6. "SAGE II Inversion Algorithm," by W.P. Chu, M.P. McCormick, J. Lenoble, C. Brogniez, and P. Provost, J. Geophys. Res. Vol 94, pgs. 8339-8352, 1989.

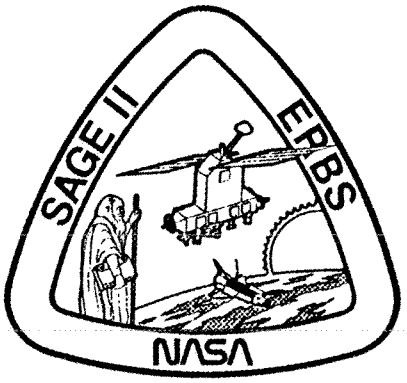
84-108B-02B

Ozone Profile User's Guide

for

The Stratospheric Aerosol & Gas Experiment

(SAGE II)



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Revision 1: May 09, 1991

Prepared By: _____ Date: 5-9-91
Principal Programmer Analyst, STX

Approved By: _____ Date: 5/9/91
SAGE II Project Scientist, NASA

Released By: _____ Date: May 9, 91
Contract Task Monitor, NASA

The Ozone Profile User's Guide for the Stratospheric Aerosol and Gas Experiment II (SAGE II)

INTRODUCTION

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Reference 6 provides the details about vertical profile inversions of the measured atmospheric constituents measured by SAGE II. The inversion of SAGE II data provides altitude profiles of:

1) aerosol extinctions at 1020, 525, 453, & 385 nm,
2) ozone concentration,
3) nitrogen dioxide concentration, and
4) water vapor concentration.

These data can be used by researchers to study the temporal and spatial variability of each species and their effect on atmospheric processes and climate.

Both unprocessed solar radiance data from the SAGE II instrument and the resulting constituent profile data sets are stored on magnetic tapes and made available to the science community through the National Space Science Data Center (NSSDC) at the NASA/Goddard Space Flight Center, Code 633, Greenbelt, Maryland 20771.

SPATIAL AND TEMPORAL COVERAGE

The ERBS orbital geometry is such that SAGE II sunrise and sunset observations are repeated every orbit (96 to 97 minutes). Tangent locations of the consecutive events of the same type (either sunrise or sunset) are separated by approximately 24 degrees longitude. There are about fifteen sunrises and fifteen sunsets in each 24-hour period. The locations of observation sweep over various latitude ranges, depending on the season, of approximately 130 degrees latitude in a 2- to 3-week period. Maximum latitudinal coverage over a year extends from approximately 80S to 80N degrees latitude.

The vertical resolution of the ozone profiles is one kilometer and their estimated uncertainty is within±10%. Error estimates of the values in each altitude level are included in this data set.

TAPE FORMAT AND CHARACTERISTICS

The ozone profiles for each event are recorded on 2400 foot magnetic tape reels. The tape recording density is 6250 bpi using a 9-track write format. Each record contains one complete event and all its associated data and profiles.

The record length is the same for all records on the tape. Each record is 688 CDC Cyber 60-bit floating-point[2] words in length. This translates to 5160 bytes or 41 280 bits per tape record. A year's profiles are contained on a single tape. Using seasonal boundaries, the tapes start in December of a year and end in November of the next year. Year one of SAGE II data (1985) contains additional data at the beginning of the tape to cover the short period from the instrument's first data day on October 24, 1984, up through the end of November 1984. There are no embedded file marks separating events on a data tape, however, at least one file mark is placed after the last event on the tape to designate the end of information (EOI).

1. Beta angle is defined as the angle generated by the earth-sun vector and the orbit plane of ERBS.

2. Appendix B contains a floating-point format guide.

SAGE II OZONE PROFILE RECORD FORMAT

Cyber Words (60-bit)	Size	Field Content Description	Type	Note
40 Kilometer Reference Data				
0001	1	Event Date (yymmdd.0)	(R)	1
0002	1	Event Time (hhmmss.0)	(R)	1
0003	1	Subtangent Latitude (0.0 ± 90.0 degrees)	(R)	
0004	1	Subtangent Longitude (0.0 ± 180.0 degrees)	(R)	
0005	1	Spacecraft-Referenced Event Type (0.0 = sunrise; 1.0 = sunset)	(R)	2
0006	1	Earth-Referenced Event Type (0.0 = sunrise; 1.0 = sunset)	(R)	2
0007	1	Spacecraft Beta Angle (0.0 ± 61.0 degrees)	(R)	3
0008	1	Coded Time of Year (ddd.fract)	(R)	4
NMC Meteorological Data (see Appendix A)				
0009-0033	25	Temperature (Kelvin)	(R)	
0034-0058	25	Temperature Error (Kelvin)	(R)	
0059-0083	25	Geometric Altitude (meters)	(R)	
0084-0108	25	Air Density (grams/cubic meter)	(R)	
0109-0133	25	Air Density Error (percent)	(R)	
0134	1	Temperature Correction Value for 5.0 Millibar Level (Kelvin)	(R)	
0135	1	Temperature Correction Value for 2.0 Millibar Level (Kelvin)	(R)	
0136	1	Temperature Correction Value for 1.0 Millibar Level (Kelvin)	(R)	
0137	1	Temperature Correction Value for 0.4 Millibar Level (Kelvin)	(R)	
0138	1	"Meteorological Data Not Complete" Flag (0=complete; 1=incomplete)	(R)	
0139	1	"Start of Model Meteorological Data" Array Index Pointer (1 - 19)	(R)	
0140	1	Model Meteorological Data Selection Code (ssll)	(R)	
0141	1	Revision Date of LaRC Meteorological Model (yymmdd.0)	(R)	
NASA/LaRC Processing Information				
0142	1	LaRC Driver Revision Level	(R)	
0143	1	LaRC Transmission Revision Level	(R)	
0144	1	LaRC Inversion Revision Level	(R)	
0145	1	LaRC Event Tag (yymmddhhmm.sq)	(R)	5
0146	1	LaRC Processing Date (yymmdd.0)	(R)	1
0147	1	LaRC Processing Time (hhmmss.0)	(R)	1
0148	1	Mean Subtangent Altitude for Event Limb Calibration (kilometers)	(R)	6
0149	1	Value Designated as the Data Fill Number for this Event	(R)	7
Event Ground-Track Slew Data				
0150-0157	8	Subtangent Altitude (kilometers)	(R)	
0158-0165	8	Corresponding Latitude (0.0 ± 90.0 degrees)	(R)	
0166-0173	8	Corresponding Longitude (0.0 ± 180.0 degrees)	(R)	
0174	1	Time Span of Data from Level 1 through 70 (seconds)	(R)	
Altitude and Meteorological Data for Profile Arrays				
0175-0244	70	Geometric Altitude (kilometers)	(R)	9
0245-0314	70	Corresponding Pressure (millibars)	(R)	9
0315-0384	70	Corresponding Temperature (Kelvin)	(R)	9
0385-0390	6	Spare		

(continued on the next Page)

SAGE II OZONE PROFILE RECORD FORMAT

(continued from previous page)

Cyber Words (60-bit)	Size	Field Content Description	Type	Note
Channel Optical Depth Profile--Quality Estimations				
391	1	Spare		
392	1	Spare		
393	1	600 nm Wavelength Quality Factor	(R)	8
394	1	Spare		
395	1	Spare		
396	1	Spare		
397	1	Spare		
0398-0400	3	Spare		
Ozone Profiles				
0401-0470	70	Number Density (molecules/cm^3)	(R)	9
0471-0540	70	Number Density Error (molecules/cm^3)	(R)	9
0541-0610	70	Volumetric Mixing Ratio (v/v)	(R)	9
0611-0680	70	Volumetric Mixing Ratio Error (v/v)	(R)	9
0681-0688	8	Spare		

End of Event Record

(Notes on the next page)

SAGE II OZONE PROFILE RECORD FORMAT

Record Format Notes

GENERAL NOTES

- Each field of the event record contains one 60-bit CDC-Cyber floating point number.
- All time and data references are to GMT, except Fields 146 and 147 which are LaRC processing time.
- All latitudes and longitudes are given at the event subtangent point.
- If any field in the event record is considered invalid, or has missing data, a fill value will be placed in that field. For each event record, that fill value can be found in Field 149. (See Note 7, below)
- Each profile level is centered at the 0.5 kilometer point and spans 1.0 kilometer.

DATA FIELD NOTES

1. The "yymmdd.0" and "hhmmss.0" fields are generated by the FORTRAN statements:

   DATE = FLOAT (IYY*10000 + IMM*100 + IDD) & TIME = FLOAT(IHH*10000 + IMM*100 + ISS)

2. Spacecraft-Referenced Event Type and Earth-Referenced Event Type fields are normally the same type, but, if the absolute value of the Spacecraft Beta Angle is close to 61 degrees, their types may be different. The Earth-Referenced Event Type field is based on sun mothion from a ground-observer's viewpoint.

3. The Spacecraft Beta Angle field is defined as the angle generated by the intersection of the Earth-Sun vector and the spacecraft orbit plane.

4. The Coded Time of Year field is the time at the beginning of the event (not the same time as Fields 1 and 2), and is generated by the FORTRAN statement:

   CODTIME = FLOAT(DOY) + (SOD/86400.0); where DOY = day of year (1-366) and
   SOD = seconds of the day (0.0-86399.99...)

5. The LaRC Event Tag is generated similarly to Note 1. The ".sq" at the end of the value is the event number of the day divided by 100.

6. The Mean Subtangent Altitude for Event Limb Calibration field contains the altitude at which data for the exoatmospheric solar image was gathered for use in solar limb normalization for the event.

7. The Value Designated as the Data Fill Number for This Event field must be used determine what data in the event record is valid. If any field, other than this one, contains this number, that field has no valid information and should not be used by the investigator.

8. The Quality Factor fields for each wavelength are equal to 1.0 minus the summation of the optical depth errors at each profile level from 20.5 to 59.5 kilomenters. In cases where a 40 kilometer span cannot be realized, the quality factor is proportioned to a 40 kilometer span to allow a better comparison across wavelengths and other events.

9. The values of altitude, pressure, and temperature in their seventy-element arrays correspond to other seventy-element arrays within the record. Altitude coincidence for all these arrays is at element 1.

Appendix A

Meteorological Data

Meteorological data are supplied to Langley Research Center by NOAA/National Weather Service - Climate Analysis Branch, in Washington, D.C. Data for temperature, temperature error, geometric altitude, air density, and air density error are provided for eighteen pressure levels and at the derived tropopause pressure. The pressure levels (mb) correspond to the 25-element meteorological data arrays (1 to 25) as follows: 1000, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 10, 5, 2, 1, 0.4, *0.04, 0.01, spare, spare, spare, spare,* and derived tropopause pressure. Elements 19 and 20 contain climatological model data for temperature and altitude only. Elements 21 through 24 contain "fill" values, and element 25 contains the NOAA-supplied tropopause information.

If NOAA cannot supply meteorological data as above, LaRC determines the highest pressure level for which data are supplied and then inserts model data from the next level up to the lowest pressure level of 0.01 millibars. Only temperature and altitude information are supplied using these model data: Temperature error, density, and density error will contain "fill" data for the corresponding levels that contain the LaRC-supplied data.

Meteorological correction factors for temperatures at 5, 2, 1, and 0.4 millibars are already included in the value of the temperatures in elements 15 through 18 of the temperature array (fields 23-26 of the record). These correction values are recorded in fields 134-137 of each record. If it is desired to remove these corrections from the data, subtract them from fields 23-26 of the record and recompute the temperatures in the 70-element array in fields 315-384. These correction factors are only included for the NOAA-supplied data: If model data are in these locations, no correction factors are used.

Meteorological data (fields 245 through 384 of the event record) are interpolated from the meteorological data in fields 9 through 133 of the record. Altitude data in fields 175-244 increments by 1 kilometer with the center of each level at the 0.5 kilometer point of the level bin.

Other meteorological data information is contained in the following record locations:

field 141: date of revision of the LaRC-supplied model

field 138: 1 if NOAA-supplied data is incomplete, 0 if all there

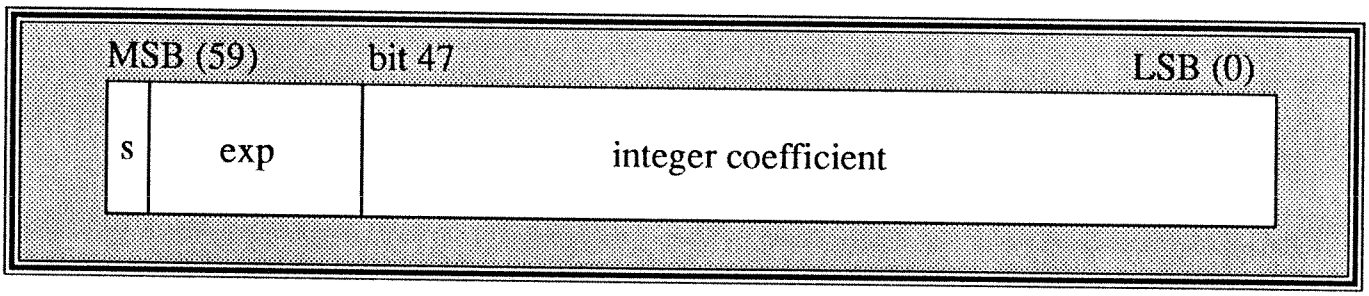
field 140: Model selection code (*ssll*) where *ss* is 01 to 04 for spring through winter;
ll is 0 to 80 in 10 degree increments for absolute latitude.

field 139: The model pointer is the array index that points to the start of LaRC-supplied model data in the temperature and altitude arrays of the meteorological data.

Appendix B

Guide to Floating-point Notation of the CDC Cyber Series Computer

This guide is intended to aid the programmer who is decoding the profile tapes described in this document. All data fields on this tape are in this 60-bit format.



Bits 47 through 0 contain the coefficient of the number (equivalent to about fourteen decimal digits). The binary point is considered to be to the right of bit 0. The exponent is biased by octal 2000: that is, the exponent is represented by an 11-bit quantity (one's complement notation is used for negative numbers), octal 2000 is added to this quantity, and the low order eleven bits are used.

Additionally, real numbers are normalized. A normalized number is one in which bit 47 is the most significant bit; that is, bit 47 is different from bit 59. A special case of a word of all zero bits (positive zero) is also considered a normalized number. For every bit position that the coefficient is shifted to the left to achieve normalization, the exponent is reduced in value by one.

The sign of the number is represented by bit 59; the number is positive if bit 59 is zero and negative if bin 59 is one. Negative numbers are represented in one's complement format.

Minus zero (a word of all one bits) is considered to be equal to positive zero (a word of all zero bits).

The table below summarizes the configuration of bits 58 and 59 and the exponent and coefficient signs resulting from each combination.

Bit 59	Coefficient Sign	Bit 58	Exponent Sign
0	+	1	+
0	+	0	-
1	-	0	+
1	-	1	-

Some examples of floating-point numbers, as they would appear in octal format, are as follows:

Number	Octal Representation
+1.0	1720 4000 0000 0000 0000
+100.0	1726 6200 0000 0000 0000
-100.0	6051 1577 7777 7777 7777
1.0 E64	2245 6047 4037 2237 7720
-1.0 E-64	6404 2570 0025 6605 5305
0	0000 0000 0000 0000 0000

Refrences

1. "Telemetry and Command Handbook," Ball Document No. ERBS-306, Rev. G, June 6, 1984.

2. "Earth Radiation Budget Satellite -- SAGE II Interface Agreement Document," GSFC Title "IPD to SAGE II LaRC Data Transfer Interface," December 1, 1981.

3. "ERBS Interface Specification, Control, and Compliance Document -- Stratospheric Aerosol and Gas Experiment II (SAGE II)," Ball Document 2319-009 January 30, 1981, Rev. D, May 1983.

4. "Stratospheric Aerosol and Gas Experiment II Instrument: A Functional Description," by L.E. Mauldin, III, N.H. Zaun, M.P. McCormick, J.H. Guy, and W.P. Vaughan, Optical Engineering, 24, 2, 307-312, 1985.

5. "FORTRAN Extended Version 4 Refrence Manual," Control Data Corporation, Manual No. 60497800 (Rev. F).

6. "SAGE II Inversion Algorithm," by W.P. Chu, M.P. McCormick, J. Lenoble, C. Brogniez, and P. Provost, J. Geophys. Res. Vol 94, pgs. 8339-8352, 1989.

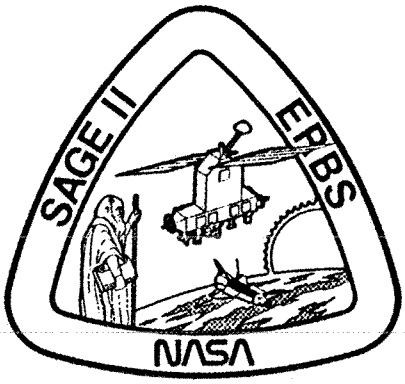
84-108B-02D

NO_2 Profile User's Guide

for

The Stratospheric Aerosol & Gas Experiment

(SAGE II)



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Contract Task Monitor, NASA

The Nitrogen Dioxide Profile User's Guide for the Stratospheric Aerosol and Gas Experiment II (SAGE II)

INTRODUCTION

The Stratospheric Aerosol and Gas Experiment II (SAGE II) is a payload installed aboard the Earth Radiation Budget Satellite (ERBS) that was launched on October 5, 1984, from NASA Space Shuttle Flight 41-G.

The SAGE II instrument is a multi-channel spectral radiometer that measures the attenuation of solar radiation at seven wavelengths as they pass through the Earth's atmosphere during the spacecraft's sunrise and sunset events (see Ref. 4). In one day's time the ERBS spacecraft encounters approximately fifteen sunrise and fifteen sunset events. The SAGE II instrument captures solar radiation data for each event. The data span a vertical distance from about 140 kilometers to the horizon or a cloud top. The ground-track slew distance during data capture varies directly with the duration of the event. Event duration will vary with the beta angle[1] of the event; the larger the absolute beta angle, the longer the event will be.

At various times of the day, the instrument data are transmitted to an Earth station and forwarded to Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. There, the SAGE II experiment data are screened, reformatted, and placed on magnetic tape for shipment to NASA/Langley Research Center in Hampton, Virginia. The Aerosol Research Branch at Langley merges the experiment data with the spacecraft ephemeris information and the corresponding meteorological data. The merged data set is then processed to generate channel transmission information and, finally, the inverted products of vertical profiles of the measured atmospheric constituents.

Reference 6 provides the details about vertical profile inversions of the measured atmospheric constituents measured by SAGE II. The inversion of SAGE II data provides altitude profiles of:

1) aerosol extinctions at 1020, 525, 453, & 385 nm,
2) ozone concentration,
3) nitrogen dioxide concentration, and
4) water vapor concentration.

These data can be used by researchers to study the temporal and spatial variability of each species and their effect on atmospheric processes and climate.

Both unprocessed solar radiance data from the SAGE II instrument and the resulting constituent profile data sets are stored on magnetic tapes and made available to the science community through the National Space Science Data Center (NSSDC) at the NASA/Goddard Space Flight Center, Code 633, Greenbelt, Maryland 20771.

SPATIAL AND TEMPORAL COVERAGE

The ERBS orbital geometry is such that SAGE II sunrise and sunset observations are repeated every orbit (96 to 97 minutes). Tangent locations of the consecutive events of the same type (either sunrise or sunset) are separated by approximately 24 degrees longitude. There are about fifteen sunrises and fifteen sunsets in each 24-hour period. For these NO_2 profiles, only spacecraft sunset events are being released at this time. The locations of observation sweep over various latitude ranges, depending on the season, of approximately 130 degrees latitude in a 2- to 3- week period. Maximum latitudinal coverage over a year extends from approximately 80S to 80N degrees latitude.

The vertical resolution of the NO_2 profiles is one kilometer and their estimated uncertaintybetween 20 and 40 kilometers is about ±10%. Error estimates of the values in each altitude level are included in this data set.

TAPE FORMAT AND CHARACTERISTICS

The NO_2 profiles for each event are recorded on 2400 foot magnetic tape reels. The tape recording density is 6250 bpi using a 9-track write format. Each record contains one complete event and all its associated data and profiles.

The record length is the same for all records on the tape. Each record is 640 CDC Cyber 60-bit floating-point[2] words in length. This translates to 4800 bytes or 38 400 bits per tape record. A year's sunset profiles are contained on a single tape. Using seasonal boundaries, the tapes start in December of a year and end in November of the next year. Year one of SAGE II data (1985) contains additional data at the beginning of the tape to cover the short period from the instrument's first data day on October 24, 1984, up through the end of November 1984. There are no embedded file marks separating events on a data tape, however, at least one file mark is placed after the last event on the tape to designate the end of information (EOI).

1. Beta angle is defined as the angle generated by the earth-sun vector and the orbit plane of ERBS.

2. Appendix B contains a floating-point format guide.

SAGE II NO_2 PROFILE RECORD FORMAT

Cyber Words (60-bit)	Size	Field Content Description	Type	Note
		40 Kilometer Reference Data		
0001	1	Event Date (yymmdd.0)	(R)	1
0002	1	Event Time (hhmmss.0)	(R)	1
0003	1	Subtangent Latitude (0.0 ± 90.0 degrees)	(R)	
0004	1	Subtangent Longitude (0.0 ± 180.0 degrees)	(R)	
0005	1	Spacecraft-Referenced Event Type (0.0 = sunrise; 1.0 = sunset)	(R)	2
0006	1	Earth-Referenced Event Type (0.0 = sunrise; 1.0 = sunset)	(R)	2
0007	1	Spacecraft Beta Angle (0.0 ± 61.0 degrees)	(R)	3
0008	1	Coded Time of Year (ddd.fract)	(R)	4
		NMC Meteorological Data (see Appendix A)		
0009-0033	25	Temperature (Kelvin)	(R)	
0034-0058	25	Temperature Error (Kelvin)	(R)	
0059-0083	25	Geometric Altitude (meters)	(R)	
0084-0108	25	Air Density (grams/cubic meter)	(R)	
0109-0133	25	Air Density Error (percent)	(R)	
0134	1	Temperature Correction Value for 5.0 Millibar Level (Kelvin)	(R)	
0135	1	Temperature Correction Value for 2.0 Millibar Level (Kelvin)	(R)	
0136	1	Temperature Correction Value for 1.0 Millibar Level (Kelvin)	(R)	
0137	1	Temperature Correction Value for 0.4 Millibar Level (Kelvin)	(R)	
0138	1	"Meteorological Data Not Complete" Flag (0=complete; 1=incomplete)	(R)	
0139	1	"Start of Model Meteorological Data" Array Index Pointer (1 - 19)	(R)	
0140	1	Model Meteorological Data Selection Code (ssll)	(R)	
0141	1	Revision Date of LaRC Meteorological Model (yymmdd.0)	(R)	
		NASA/LaRC Processing Information		
0142	1	LaRC Driver Revision Level	(R)	
0143	1	LaRC Transmission Revision Level	(R)	
0144	1	LaRC Inversion Revision Level	(R)	
0145	1	LaRC Event Tag (yymmddhhmm.sq)	(R)	5
0146	1	LaRC Processing Date (yymmdd.0)	(R)	1
0147	1	LaRC Processing Time (hhmmss.0)	(R)	1
0148	1	Mean Subtangent Altitude for Event Limb Calibration (kilometers)	(R)	6
0149	1	Value Designated as the Data Fill Number for this Event	(R)	7
		Event Ground-Track Slew Data		
0150-0157	8	Subtangent Altitude (kilometers)	(R)	
0158-0165	8	Corresponding Latitude (0.0 ± 90.0 degrees)	(R)	
0166-0173	8	Corresponding Longitude (0.0 ± 180.0 degrees)	(R)	
0174	1	Time Span of Data from Level 1 through 70 (seconds)	(R)	
		Altitude and Meteorological Data for Profile Arrays		
0175-0244	70	Geometric Altitude (kilometers)	(R)	9
0245-0314	70	Corresponding Pressure (millibars)	(R)	9
0315-0384	70	Corresponding Temperature (Kelvin)	(R)	9
0385-0390	6	Spare		

(continued on the next Page)

SAGE II NO_2 PROFILE RECORD FORMAT

(continued from previous page)

Cyber Words (60-bit)	Size	Field Content Description	Type	Note
Channel Optical Depth Profile--Quality Estimations				
391	1	Spare		
392	1	Spare		
393	1	Spare		
394	1	Spare		
395	1	453 nm Wavelength Quality Factor	(R)	8
396	1	448 nm Wavelength Quality Factor	)R)	8
397	1	Spare		
0398-0400	3	Spare		
NO_2 Profiles				
0401-0460	70	Number Density (molecules/cm^3)	(R)	9
0461-0520	70	Number Density Error (molecules/cm^3)	(R)	9
0521-0580	70	Volumetric Mixing Ratio (v/v)	(R)	9
0581-0640	70	Volumetric Mixing Ratio Error (v/v)	(R)	9

End of Event Record

(Notes on the next page)

SAGE II NO_2 PROFILE RECORD FORMAT

Record Format Notes

GENERAL NOTES

- Each field of the event record contains one 60-bit CDC-Cyber floating point number.
- All time and data references are to GMT, except Fields 146 and 147 which are LaRC processing time.
- All latitudes and longitudes are given at the event subtangent point.
- If any field in the event record is considered invalid, or has missing data, a fill value will be placed in that field. For each event record, that fill value can be found in Field 149. (See Note 7, below)
- Each profile level is centered at the 0.5 kilometer point and spans 1.0 kilometer.

DATA FIELD NOTES

1. The "yymmdd.0" and "hhmmss.0" fields are generated by the FORTRAN statements:

   DATE = FLOAT (IYY*10000 + IMM*100 + IDD) & TIME = FLOAT(IHH*10000 + IMM*100 + ISS)

2. Spacecraft-Referenced Event Type and Earth-Referenced Event Type fields are normally the same type, but, if the absolute value of the Spacecraft Beta Angle is close to 61 degrees, their types may be different. The Earth-Referenced Event Type field is based on sun mothion from a ground-observer's viewpoint.

3. The Spacecraft Beta Angle field is defined as the angle generated by the intersection of the Earth-Sun vector and the spacecraft orbit plane.

4. The Coded Time of Year field is the time at the beginning of the event (not the same time as Fields 1 and 2), and is generated by the FORTRAN statement:

   CODTIME = FLOAT(DOY) + (SOD/86400.0); where DOY = day of year (1-366) and
   SOD = seconds of the day (0.0-86399.99...)

5. The LaRC Event Tag is generated similarly to Note 1. The ".sq" at the end of the value is the event number of the day divided by 100.

6. The Mean Subtangent Altitude for Event Limb Calibration field contains the altitude at which data for the exoatmospheric solar image was gathered for use in solar limb normalization for the event.

7. The Value Designated as the Data Fill Number for This Event field must be used determine what data in the event record is valid. If any field, other than this one, contains this number, that field has no valid information and should not be used by the investigator.

8. The Quality Factor fields for each wavelength are equal to 1.0 minus the summation of the optical depth errors at each profile level from 20.5 to 59.5 kilomenters. In cases where a 40 kilometer span cannot be realized, the quality factor is proportioned to a 40 kilometer span to allow a better comparison across wavelengths and other events.

9. The values of altitude, pressure, and temperature in their seventy-element arrays correspond to the sixty-element arrays within the record. Altitude coincidence for all these arrays is at element 1.

Appendix A

Meteorological Data

Meteorological data are supplied to Langley Research Center by NOAA/National Weather Service - Climate Analysis Branch, in Washington, D.C. Data for temperature, temperature error, geometric altitude, air density, and air density error are provided for eighteen pressure levels and at the derived tropopause pressure. The pressure levels (mb) correspond to the 25-element meteorological data arrays (1 to 25) as follows: 1000, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 10, 5, 2, 1, 0.4, *0.04, 0.01, spare, spare, spare, spare,* and derived tropopause pressure. Elements 19 and 20 contain climatological model data for temperature and altitude only. Elements 21 through 24 contain "fill" values, and element 25 contains the NOAA-supplied tropopause information.

If NOAA cannot supply meteorological data as above, LaRC determines the highest pressure level for which data are supplied and then inserts model data from the next level up to the lowest pressure level of 0.01 millibars. Only temperature and altitude information are supplied using these model data: Temperature error, density, and density error will contain "fill" data for the corresponding levels that contain the LaRC-supplied data.

Meteorological correction factors for temperatures at 5, 2, 1, and 0.4 millibars are already included in the value of the temperatures in elements 15 through 18 of the temperature array (fields 23-26 of the record). These correction values are recorded in fields 134-137 of each record. If it is desired to remove these corrections from the data, subtract them from fields 23-26 of the record and recompute the temperatures in the 70-element array in fields 315-384. These correction factors are only included for the NOAA-supplied data: If model data are in these locations, no correction factors are used.

Meteorological data (fields 245 through 384 of the event record) are interpolated from the meteorological data in fields 9 through 133 of the record. Altitude data in fields 175-244 increments by 1 kilometer with the center of each level at the 0.5 kilometer point of the level bin.

Other meteorological data information is contained in the following record locations:

field 141: date of revision of the LaRC-supplied model

field 138: 1 if NOAA-supplied data is incomplete, 0 if all there

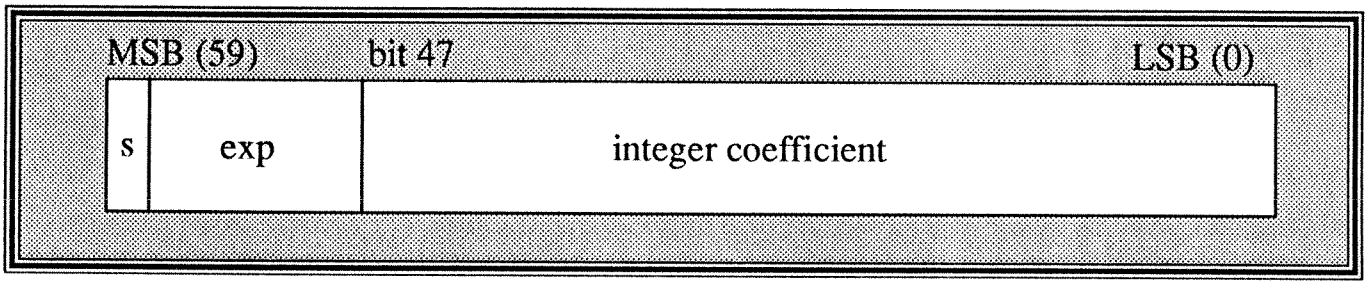
field 140: Model selection code *(ssll)* where *ss* is 01 to 04 for spring through winter;
ll is 0 to 80 in 10 degree increments for absolute latitude.

field 139: The model pointer is the array index that points to the start of LaRC-supplied model data in the temperature and altitude arrays of the meteorological data.

Appendix B

Guide to Floating-point Notation of the CDC Cyber Series Computer

This guide is intended to aid the programmer who is decoding the profile tapes described in this document. All data fields on this tape are in this 60-bit format.



Bits 47 through 0 contain the coefficient of the number (equivalent to about fourteen decimal digits). The binary point is considered to be to the right of bit 0. The exponent is biased by octal 2000: that is, the exponent is represented by an 11-bit quantity (one's complement notation is used for negative numbers), octal 2000 is added to this quantity, and the low order eleven bits are used.

Additionally, real numbers are normalized. A normalized number is one in which bit 47 is the most significant bit; that is, bit 47 is different from bit 59. A special case of a word of all zero bits (positive zero) is also considered a normalized number. For every bit position that the coefficient is shifted to the left to achieve normalization, the exponent is reduced in value by one.

The sign of the number is represented by bit 59; the number is positive if bit 59 is zero and negative if bin 59 is one. Negative numbers are represented in one's complement format.

Minus zero (a word of all one bits) is considered to be equal to positive zero (a word of all zero bits).

The table below summarizes the configuration of bits 58 and 59 and the exponent and coefficient signs resulting from each combination.

Bit 59	Coefficient Sign	Bit 58	Exponent Sign
0	+	1	+
0	+	0	-
1	-	0	+
1	-	1	-

Some examples of floating-point numbers, as they would appear in octal format, are as follows:

Number	Octal Representation
+1.0	1720 4000 0000 0000 0000
+100.0	1726 6200 0000 0000 0000
-100.0	6051 1577 7777 7777 7777
1.0 E64	2245 6047 4037 2237 7720
-1.0 E-64	6404 2570 0025 6605 5305
0	0000 0000 0000 0000 0000

Refrences

1. "Telemetry and Command Handbook," Ball Document No. ERBS-306, Rev. G, June 6, 1984.

2. "Earth Radiation Budget Satellite -- SAGE II Interface Agreement Document," GSFC Title "IPD to SAGE II LaRC Data Transfer Interface," December 1, 1981.

3. "ERBS Interface Specification, Control, and Compliance Document -- Stratospheric Aerosol and Gas Experiment II (SAGE II)," Ball Document 2319-009 January 30, 1981, Rev. D, May 1983.

4. "Stratospheric Aerosol and Gas Experiment II Instrument: A Functional Description," by L.E. Mauldin, III, N.H. Zaun, M.P. McCormick, J.H. Guy, and W.P. Vaughan, Optical Engineering, 24, 2, 307-312, 1985.

5. "FORTRAN Extended Version 4 Refrence Manual," Control Data Corporation, Manual No. 60497800 (Rev. F).

6. "SAGE II Inversion Algorithm," by W.P. Chu, M.P. McCormick, J. Lenoble, C. Brogniez, and P. Provost, J. Geophys. Res. Vol 94, pgs. 8339-8352, 1989.

ERBS
SAGE II WATER AEROSOL PROFILE TAPES
84-108B-02E ESAC-00033

THIS DATA SET CONSISTS OF 5 TAPES. THE TAPES ARE 6250 BPI,BINARY 9-TRACK, WITH ONE FILE OF DATA, WRITTEN IN CDC 60 BIT FLOATING POINT WORDS. THE TAPES WERE CREATED ON A CYBR COMPUTER. THE D AND C NUMBERS AND TIME SPAN ARE AS FOLLOWS:

D#	C#		TIME SPANS
D-83701	C-28137		01/01/86-12/31/86
D-83752	C-28211		01/01/87-12/31/87
D-83753	C-28212		01/01/88-12/31/88
D-88267	C-29425		01/01/89-12/31/89
D-104130	C-031250	(2 files)	01/01/90-05/29/91

National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia
23665-5225

NASA

Reply to Attn of 475

July 3, 1991

Mr. Ralph Post
NSSDC-Data Repository Receiving
Goddard Space Flight Center
Code 633
Greenbelt, MD 20771

Dear Ralph:

I am sending under separate cover SAGE II water vapor data covering calendar years 1986, 1987, and 1988 for archival. This is the first SAGE II water vapor data to be submitted. Data for 1989 and 1990 are currently being processed and will be shipped as it becomes available. Water vapor data from the first year following launch in November 1984 is still being analyzed in an attempt to remove the El Chichon volcanic influence. A format guide is enclosed for your use. A "Water Vapor User's Guide" is being assembled and will be provided soon.

If you have any questions please call Mr. Mike Rowland at FTS 928-2691 or me at FTS 928-2674.

Sincerely,

George L. Maddrea, Jr.
SAGE II Data Validation Manager

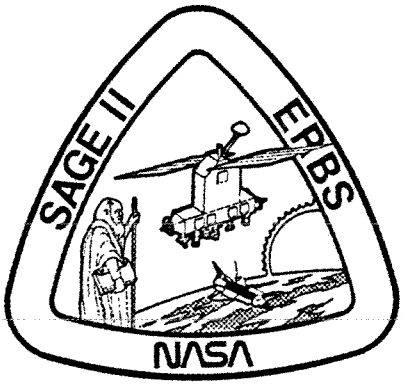
H4-108B-02E

H_2O Profile User's Guide

for

The Stratospheric Aerosol & Gas Experiment

(SAGE II)



Aerosol Research Branch
Atmospheric Sciences Division

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Revision 1: November 8, 1991

Prepared By: Chiou Er Wang Date: Nov. 8, 91
Senior Scientist, STX

Approved By: Wallace T. Chu Date: Nov. 8, 91
SAGE II Project Scientist, NASA

Released By: George T. Maddrea Jr. Date: Nov 8, 91
Contract Task Monitor, NASA

The Water Vapor Profile User's Guide for the Stratospheric Aerosol and Gas Experiment II (SAGE II)

INTRODUCTION

The Stratospheric Aerosol and Gas Experiment II (SAGE II) is a payload installed aboard the Earth Radiation Budget Satellite (ERBS) that was launched on October 5, 1984, from NASA Space Shuttle Flight 41–G.

The SAGE II instrument is a multi–channel spectral radiometer that measures the attenuation of solar radiation at seven wavelengths as they pass through the Earth's atmosphere during the spacecraft's sunrise and sunset events (see Ref. 4). In one day's time the ERBS spacecraft encounters approximately fifteen sunrise and fifteen sunset events. The SAGE II instrument captures solar radiation data for each event. The data span a vertical distance from about 140 kilometers to the horizon or a cloud top. The ground–track slew distance during data capture varies directly with the duration of the event. Event duration will vary with the beta angle of the event; the larger the absolute beta angle, the longer the event will be.

At various times of the day, the instrument data are transmitted to an Earth station and forwarded to Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. There, the SAGE II experiment data are screened, reformatted, and placed on magnetic tape for shipment to NASA/Langley Research Center in Hampton, Virginia. The Aerosol Research Branch at Langley merges the experiment data with the spacecraft ephemeris information and the corresponding meteorological data. The merged data set is then processed to generate channel transmission information and, finally, the inverted products of vertical profiles of the measured atmospheric constituents.

Reference 6 provides the details about vertical profile inversions of the measured atmospheric constituents measured by SAGE II. The inversion of SAGE II data provides altitude profiles of:

1) aerosol extinctions at 1020, 525, 453, & 385 nm,
2) ozone concentration,
3) nitrogen dioxide concentration, and
4) water vapor concentration.

These data can be used by researchers to study the temporal and spatial variability of each species and their effect on atmospheric processes and climate.

Both unprocessed solar radiance data from the SAGE II instrument and the resulting constituent profile data sets are stored on magnetic tapes and made available to the science community through the National Space Science Data Center (NSSDC) at the NASA/Goddard Space Flight Center, Code 633, Greenbelt, Maryland 20771.

SPATIAL AND TEMPORAL COVERAGE

The ERBS orbital geometry is such that SAGE II sunrise and sunset observations are repeated every orbit (96 to 97 minutes). Tangent locations of the consecutive events of the same type (either sunrise or sunset) are separated by approximately 24 degrees longitude. There are about fifteen sunrises and fifteen sunsets in each 24–hour period. The locations of observation sweep over various latitude ranges, depending on the season, of approximately 130 degrees latitude in a 2– to 3–week period. Maximum latitudinal coverage over a year extends from approximately 80S to 80N degrees latitude.

The water vapor profiles are retrieved from the SAGE II measurements between the surface or cloud top to about 40 km altitude. The vertical resolution of the retrieved profiles is 3 km in the stratosphere. The vertical resolution improves to 1 km in the troposphere where SAGE II measurements provide extensive water vapor data into the lower troposphere.

The random component of the uncertainties associated with the retrieved water vapor profiles is estimated to be about 20 percent and is dominated by the measurement errors. The best estimates on the systematic errors of these profiles is one ppmv in the stratosphere where ozone uncertainty dominates the error from 25 km altitude and up, while aerosol uncertainty dominates the error between 10 and 25 km. Below 10km, the systematic error is estimated to be about 10 percent and is caused by the uncertainty in the water vapor line parameters. It should be noted that the aerosol contribution to the systematic error is time dependent, and the above estimates are only valid for the time period after the summer of 1985.

TAPE FORMAT AND CHARACTERISTICS

The H_2O profiles for each event are recorded on 2400 foot magnetic tape reels. The tape recording density is 6250 bpi using a 9–track write format. Each record contains one complete event and all its associated data and profiles.

The record length is the same for all records on the tape. Each record is 760 CDC Cyber 60–bit floating–point words in length. This translates to 5700 bytes or 45 600 bits per tape record. A year's profiles are contained on a single tape. Using seasonal boundaries, the tapes start in December of a year and end in November of the next year. The currently archived water vapor data begins with January 1986 (year 2 of SAGE II) and ends with November 1988 (year 4 of SAGE II). There are no embedded file marks separating events on a data tape, however, at least one file mark is placed after the last event on the tape to designate the end of information (EOI).

SAGE II H_2O PROFILE RECORD FORMAT

Cyber Words (60–bit)	Size	Field Content Description	Type	Note
		40 Kilometer Reference Data		
0001	1	Event Date (yymmdd.0)	(R)	1
0002	1	Event Time (hhmmss.0)	(R)	1
0003	1	Subtangent Latitude (0.0 ± 90.0 degrees)	(R)	
0004	1	Subtangent Longitude (0.0 ± 180.0 degrees)	(R)	
0005	1	Spacecraft–Referenced Event Type (0.0 = sunrise; 1.0 = sunset)	(R)	2
0006	1	Earth–Referenced Event Type (0.0 = sunrise; 1.0 = sunset)	(R)	2
0007	1	Spacecraft Beta Angle (0.0 ± 61.0 degrees)	(R)	3
0008	1	Coded Time of Year (ddd.fract)	(R)	4
		NMC Meteorological Data (see Appendix A)		
0009–0033	25	Temperature (Kelvin)	(R)	
0034–0058	25	Temperature Error (Kelvin)	(R)	
0059–0083	25	Geometric Altitude (meters)	(R)	
0084–0108	25	Air Density (grams/cubic meter)	(R)	
0109–0133	25	Air Density Error (percent)	(R)	
0134	1	Temperature Correction Value for 5.0 Millibar Level (Kelvin)	(R)	
0135	1	Temperature Correction Value for 2.0 Millibar Level (Kelvin)	(R)	
0136	1	Temperature Correction Value for 1.0 Millibar Level (Kelvin)	(R)	
0137	1	Temperature Correction Value for 0.4 Millibar Level (Kelvin)	(R)	
0138	1	"Meteorological Data Not Complete" Flag (0=complete; 1=incomplete)	(R)	
0139	1	"Start of Model Meteorological Data" Array Index Pointer (1 – 19)	(R)	
0140	1	Model Meteorological Data Selection Code (ssll)	(R)	
0141	1	Revision Date of LaRC Meteorological Model (yymmdd.0)	(R)	
		NASA/LaRC Processing Information		
0142	1	LaRC Driver Revision Level	(R)	
0143	1	LaRC Transmission Revision Level	(R)	
0144	1	LaRC Inversion Revision Level	(R)	
0145	1	LaRC Event Tag (yymmddhhmm.sq)	(R)	5
0146	1	LaRC Processing Date (yymmdd.0)	(R)	1
0147	1	LaRC Processing Time (hhmmss.0)	(R)	1
0148	1	Mean Subtangent Altitude for Event Limb Calibration (kilometers)	(R)	6
0149	1	Value Designated as the Data Fill Number for this Event	(R)	7
		Event Ground–Track Slew Data		
0150–0157	8	Subtangent Altitude (kilometers)	(R)	
0158–0165	8	Corresponding Latitude (0.0 ± 90.0 degrees)	(R)	
0166–0173	8	Corresponding Longitude (0.0 ± 180.0 degrees)	(R)	
0174	1	Time Span of Data from Level 1 through 70 (seconds)	(R)	
		Altitude and Meteorological Data for Profile Arrays		
0175–0244	70	Geometric Altitude (kilometers)	(R)	9
0245–0314	70	Corresponding Pressure (millibars)	(R)	9
0315–0384	70	Corresponding Temperature (Kelvin)	(R)	9
0385–0390	6	Spare		

(continued on the next Page)

SAGE II H_2O PROFILE RECORD FORMAT

(continued from previous page)

Cyber Words (60–bit)	Size	Field Content Description	Type	Note
Channel Optical Depth Profile—Quality Estimations				
391	1	Spare		
392	1	940 nm Waveleg ity Factor	(R)	8
393	1	Spare		
394	1	Spare		
395	1	Spare		
396	1	Spare		
397	1	Spare		
0398–0400	3	Spare		
H_2O Profiles				
0401–0460	60	Number Density (molecules/cm^3)	(R)	9/10
0461–0520	60	Number Density Error (molecules/cm^3)	(R)	9
0521–0580	60	Volumetric Mixing Ratio (v/v)	(R)	9/10
0581–0640	60	Volumetric Mixing Ratio Error (v/v)	(R)	9
0641–0700	60	Contribution of Arosol (percent)	(R)	
0701–0760	60	1020 nm Aerosol Extinction (km^{-3})	(R)	

End of Event Record

(Notes on the next page)

SAGE II H_2O PROFILE RECORD FORMAT

Record Format Notes

GENERAL NOTES

- Each field of the event record contains one 60–bit CDC–Cyber floating point number.
- All time and data references are to GMT, except Fields 146 and 147 which are LaRC processing time.
- All latitudes and longitudes are given at the event subtangent point.
- If any field in the event record is considered invalid, or has missing data, a fill value will be placed in that field. For each event record, that fill value can be found in Field 149. (See Note 7, below)
- Each profile level is centered at the 0.5 kilometer point and spans 1.0 kilometer.

DATA FIELD NOTES

1. The "yymmdd.0" and "hhmmss.0" fields are generated by the FORTRAN statements:

   DATE = FLOAT (IYY*10000 + IMM*100 + IDD) & TIME = FLOAT(IHH*10000 + IMM*100 + ISS)

2. Spacecraft–Referenced Event Type and Earth–Referenced Event Type fields are normally the same type, but, if the absolute value of the Spacecraft Beta Angle is close to 61 degrees, their types may be different. The Earth–Referenced Event Type field is based on a ground–observer's viewpoint.

3. The Spacecraft Beta Angle field is defined as the angle generated by the intersection of the Earth–Sun vector and the spacecraft orbit plane.

4. The Coded Time of Year field is the time at the beginning of the event (not the same time as Fields 1 and 2), and is generated by the FORTRAN statement:

   CODTIME = FLOAT(DOY) + (SOD/86400.0); where DOY = day of year (1–366) and
   SOD = seconds of the day (0.0–86399.99...)

5. The LaRC Event Tag is generated similarly to Note 1. The ".sq" at the end of the value is the event number of the day divided by 100.

6. The Mean Subtangent Altitude for Event Limb Calibration field contains the altitude at which data for the exoatmospheric solar image was gathered for use in solar limb normalization for the event.

7. The Value Designated as the Data Fill Number for This Event field must be used determine what data in the event record is valid. If any field, other than this one, contains this number, that field has no valid information and should not be used by the investigator.

8. The Quality Factor fields for each wavelength are equal to 1.0 minus the summation of the optical depth errors at each profile level from 20.5 to 59.5 kilometers. In cases where a 40 kilometer span cannot be realized, the quality factor is proportioned to a 40 kilometer span to allow a better comparison across wavelengths and other events.

9. The values of altitude, pressure, and temperature in their seventy–element arrays correspond to the sixty–element arrays within the record. Altitude coincidence for all these arrays is at element 1.

10. The number density and volumetric mixing ratio will be set negative if (1) the percent contribution of aerosol exceeds 80% and (2) the 1020 nm aerosol extinction exceeds 5.0E–4.km. These are the two threshold criteria indicating the retrieved water vapor concentration values are questionable. Please see references 8 and 10 for detailed discussion.

Appendix A

Meteorological Data

Meteorological data are supplied to Langley Research Center by NOAA/National Weather Service – Climate Analysis Branch, in Washington, D.C. Data for temperature, temperature error, geometric altitude, air density, and air density error are provided for eighteen pressure levels and at the derived tropopause pressure. The pressure levels (mb) correspond to the 25–element meteorological data arrays (1 to 25) as follows: 1000, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 10, 5, 2, 1, 0.4, *0.04, 0.01, spare, spare, spare, spare,* and derived tropopause pressure. Elements 19 and 20 contain climatological model data for temperature and altitude only. Elements 21 through 24 contain "fill" values, and element 25 contains the NOAA–supplied tropopause information.

If NOAA cannot supply meteorological data as above, LaRC determines the highest pressure level for which data are supplied and then inserts model data from the next level up to the lowest pressure level of 0.01 millibars. Only temperature and altitude information are supplied using these model data: Temperature error, density, and density error will contain "fill" data for the corresponding levels that contain the LaRC–supplied data.

Meteorological correction factors for temperatures at 5, 2, 1, and 0.4 millibars are already included in the value of the temperatures in elements 15 through 18 of the temperature array (fields 23–26 of the record). These correction values are recorded in fields 134–137 of each record. If it is desired to remove these corrections from the data, subtract them from fields 23–26 of the record and recompute the temperatures in the 70–element array in fields 315–384. These correction factors are only included for the NOAA–supplied data: If model data are in these locations, no correction factors are used.

Meteorological data (fields 245 through 384 of the event record) are interpolated from the meteorological data in fields 9 through 133 of the record. Altitude data in fields 175–244 increments by 1 kilometer with the center of each level at the 0.5 kilometer point of the level bin.

Other meteorological data information is contained in the following record locations:

field 141: date of revision of the LaRC–supplied model

field 138: 1 if NOAA–supplied data is incomplete, 0 if all there

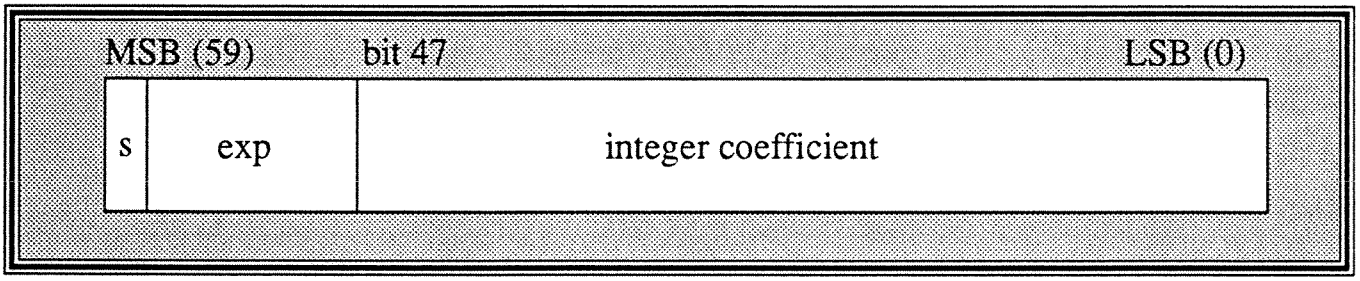
field 140: Model selection code (*ssll*) where *ss* is 01 to 04 for spring through winter; *ll* is 0 to 80 in 10 degree increments for absolute latitude.

field 139: The model pointer is the array index that points to the start of LaRC–supplied model data in the temperature and altitude arrays of the meteorological data.

Appendix B

Guide to Floating–point Notation of the CDC Cyber Series Computer

This guide is intended to aid the programmer who is decoding the profile tapes described in this document. All data fields on this tape are in this 60–bit format.



Bits 47 through 0 contain the coefficient of the number (equivalent to about fourteen decimal digits). The binary point is considered to be to the right of bit 0. The exponent is biased by octal 2000: that is, the exponent is represented by an 11–bit quantity (one's complement notation is used for negative numbers), octal 2000 is added to this quantity, and the low order eleven bits are used.

Additionally, real numbers are normalized. A normalized number is one in which bit 47 is the most significant bit; that is, bit 47 is different from bit 59. A special case of a word of all zero bits (positive zero) is also considered a normalized number. For every bit position that the coefficient is shifted to the left to achieve normalization, the exponent is reduced in value by one.

The sign of the number is represented by bit 59; the number is positive if bit 59 is zero and negative if bin 59 is one. Negative numbers are represented in one's complement format.

Minus zero (a word of all one bits) is considered to be equal to positive zero (a word of all zero bits).

The table below summarizes the configuration of bits 58 and 59 and the exponent and coefficient signs resulting from each combination.

Bit 59	Coefficient Sign	Bit 58	Exponent Sign
0	+	1	+
0	+	0	−
1	−	0	+
1	−	1	−

Some examples of floating–point numbers, as they would appear in octal format, are as follows:

Number	Octal Representation
+1.0	1720 4000 0000 0000 0000
+100.0	1726 6200 0000 0000 0000
−100.0	6051 1577 7777 7777 7777
1.0 E64	2245 6047 4037 2237 7720
−1.0 E−64	6404 2570 0025 6605 5305
0	0000 0000 0000 0000 0000

References

1. "Telemetry and Command Handbook," Ball Document No. ERBS–306, Rev. G, June 6, 1984.

2. "Earth Radiation Budget Satellite — SAGE II Interface Agreement Document," GSFC Title "IPD to SAGE II LaRC Data Transfer Interface," December 1, 1981.

3. "ERBS Interface Specification, Control, and Compliance Document — Stratospheric Aerosol and Gas Experiment II (SAGE II)," Ball Document 2319–009 January 30, 1981, Rev. D, May 1983.

4. "Stratospheric Aerosol and Gas Experiment II Instrument: A Functional Description," by L.E. Mauldin, III, N.H. Zaun, M.P. McCormick, J.H. Guy, and W.P. Vaughan, Optical Engineering, 24, 2, 307–312, 1985.

5. "FORTRAN Extended Version 4 Refrence Manual," Control Data Corporation, Manual No. 60497800 (Rev. F).

6. "SAGE II Inversion Algorithm," by W.P. Chu, M.P. McCormick, J. Lenoble, C. Brogniez, and P. Provost, J. Geophys. Res. Vol 94, pgs. 8339–8352, 1989.

7. "Positive Water Vapor Feedback in Climate Models Confirmed by Satellite Data," D. Rind, E. W. Chiou, W. P. Chu, J. Larsen, S. Oltmans, L. Lerner, M. P. McCormick, and L. R. McMaster, Nature, Vol. 349, 500–503, 1991.

The following references have been submitted to J. Geophys. Res.and are not yet available:

8. "Overview of the SAGE II Water Vapor Observations: Method, Validation, and Data Characteristics," by D. Rind, E–W Chiou, W. P. Chu, S, Oltmans, J. Lerner, J. Larsen, M. P. McCormick, and L. McMaster.

9. "Intercomparison of Stratospheric Water Vapor Observed by Satellite Experiments: SAGE II versus LIMS and ATMOS," by E–W Chiou, et al.

10. "Algorithms and Sensitivity Analyses for SAGE II Water Vapor Retrievals," by W. Chu, et al.

11. "Comparison of SAGE II and Radiosonde Observations,", by J. Larsen, et al.

12. "Validation of SAGE II Stratospheric Water Vapor Profiles from In situ Measurements," by S. Oltmans, W, Chu, E–W Chiou, L. McMaster, M. P. McCormick, D. Rind, and J. Larsen.

13. "Annual Variations of Water Vapor in the Stratosphere and Upper Troposphere Observed by the SAGE II Experiment," by M. P. McCormick, E–W Chiou, L. R. McMaster, W. P. Chu, J. C. Larsen, D. Rind, and S. Oltmans.

D76273
10/24/84 - 11/30/85

DUMP OF TAPE D1OUT2

INPUT TAPE D1OUT2 ON HT1
DATA INPUT C9 NF=1 FL 1 1 1 10/24/84

841024

Contact for replacement tapes:
Nina Iyer - 1-804-864-2718

CDC Floating point words

FILE	1 RECORD	1 LENGTH	6610 BYTES				
(0)	174363252060	000000000727	620000000000	000060522276	217375414370	605127022363	550014471720	400000000000
(48)	000017304230	000000000000	173041400000	000000001730	406000000000	000017277500	000000000000	172772400000
(96)	000300001727	702000000000	000017277000	000000000000	172767600000	000000001727	676000000000	000017276740
(144)	000000000000	172767200000	000000001727	672000000000	000017276760	000000000000	172771000000	000000001727
(192)	722146314631	463217277675	146314631463	173040400000	000000001727	773465146314	631417276540	000000000000
(240)	172757400000	000000001755	734624154000	000017557346	241540000000	175573462415	400000001755	734624154000
(288)	000017277020	000000000000	172250000000	000000001722	500000000000	000017225000	000000000000	172250000000
(336)	000000001722	500000000000	000017225000	000000000000	172250000000	000000001722	500000000000	000017225000
(384)	000000000000	172250000000	000000001722	400000000000	000017224000	000000000000	172250000000	000000001722
(432)	500000000000	000017226000	000000000000	172340000000	000000001723	440000000000	000017236000	000000000000
(480)	175573462415	400000001755	734624154000	000017557346	241540000000	175573462415	400000001755	734624154000
(528)	000017557346	241540000000	172340000000	000000000000	000000000000	000017325025	777777777777	173353600000
(576)	000000001734	513137777777	777717346547	000000000000	173542245777	777777771735	470117777777	777717355456
(624)	400000000000	173564050000	000000001735	763500000000	000017364355	400000000000	173647763777	777777771736
(672)	563647777777	777717367455	377777777777	173742754377	777777771737	512474400000	000017375632	177777777777
(720)	173765241377	777777771740	431200000000	000017404715	277777777777	175573462415	400000001755	734624154000
(768)	000017557346	241540000000	175573462415	400000001735	432217777777	777717324746	000000000000	173242420000
(816)	000000001731	721314631463	146217315447	463146314630	173145157777	777777771730	720377777777	777717306046
(864)	314631463145	173047031463	146314621727	724463146314	631317274716	314631463145	172667114631	463146301726
(912)	473217270243	655617255667	534121727022	172375075341	217270211722	732274324773	715517215475	341217270235
(960)	172053432477	371666121717	426534765263	316717557346	241540000000	175573462415	400000001755	734624154000
(1008)	000017557346	241540000000	175573462415	400000001755	734624154000	000017306773	777777777777	172140000000
(1056)	000000001721	400000000000	000017214000	000000000000	172140000000	000000001721	400000000000	000017214000
(1104)	000000000000	172140000000	000000001721	400000000000	000017214000	000000000000	172140000000	000000001721
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START TIME 01/15/88 01:21:35 STOP TIME 01/15/88 01:24:36

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84-108B-02E

DUMP OF TAPE KM2 17

D83701 — H2O, tape

01/01/86- 01/01/87

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CDC Floating Point

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EOJ         DUMP STOPPED AFTER FILE   1          # OF PERMANENT READ ERRORS   0

START TIME 12/09/91  15:16:21        STOP TIME 12/09/91  15:18:54
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$ASS IN HT
$EXE TPDUMP RS
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