Optical Thickness Data: Bruegge (FIFE)

Summary:

The NIPS and Reagan Sunphotometer Optical Thickness study compared various ground and image-based techniques used to characterize the atmosphere. These data are used to remove atmospheric absorption and scattering from remote sensing scenes so that surface parameters can be retrieved. An evaluation of the effects of uncorrected atmospheric absorption and scattering on various vegetation indices and subsequent biophysical parameter estimations was also undertaken. These data can also be used to derive aerosol size distribution (King et al., 1978) and thereby estimate the phase function.

Aerosol optical depths were recorded at various locations within the FIFE site. A Normal Incident Pyrheliometer (NIP) and a Reagan sunphotometer was used to collect data during the IFCs. These data showed that daily averages span a range of 0.05 to 0.28 in the mid-visible wavelength (Bruegge et al., 1992a). Diurnal variations were recorded. The afternoon optical depths are greater than those of the morning by as much as 0.07.

These data are analyzed using the Langley technique. Rayleigh optical depth is subtracted, and aerosol, ozone, and water vapor abundance's simultaneously measured. In retrieving ozone, a Junge aerosol model is assumed, thus, the natural log of aerosol optical depth is linear with wavelength (Bruegge et al., 1992a). This contrasts with other experimental approaches used by investigators in which an ozone abundance is assumed (Halthore and Markham 1992). This approach allows measurement of aerosol, but is limited by the accuracy of the ozone data.

Table of Contents:

1. Data Set Overview:

Data Set Identification:

Optical Thickness Data: Bruegge (FIFE).
(NIPS and Reagan Sunphotometer Optical Thickness).

Data Set Introduction:

The NIPS and Reagan Sunphotometer Optical Thickness study compared various ground and image-based techniques used to characterize the atmosphere. These data can be used to atmospherically correct remotely sensed data (see Markham and Halthore 1992). They can also be used to derive aerosol size distribution (King et al., 1978) and thereby estimate the phase function.

Aerosol optical depths were recorded at various locations within the FIFE site. A Normal Incident Pyrheliometer (NIP) and a Reagan sunphotometer was used to collect data during the IFCs. These data are analyzed using the Langley technique. The NIPS and Reagan Sunphotometer Optical Thickness Data Set contains surface pressure, surface temperature, optical visibility, ozone optical thickness, Rayleigh optical thickness, aerosol optical thickness, and total optical thickness data.

Objective/Purpose:

The objective was to compare various ground and image-based techniques used to characterize the atmosphere. These data are used to remove atmospheric absorption and scattering from remote sensing scenes so that surface parameters can be retrieved. An evaluation of the effects of uncorrected atmospheric absorption and scattering on various vegetation indices and subsequent biophysical parameter estimations was also undertaken.

Summary of Parameters:

Surface pressure, surface temperature, optical visibility, ozone optical thickness, Rayleigh optical thickness, aerosol optical thickness, and total optical thickness.

Discussion:

Aerosol optical depths were recorded at various locations within the FIFE site. A Normal Incident Pyrheliometer (NIP) was used to collect data during IFC-1. During IFC-2 through IFC-5 a Reagan sunphotometer was used. Data are available from the Reagan Instrument for 26 days in 1987, and for 7 days in 1988. These data showed that daily averages span a range of 0.05 to 0.28

in the mid-visible wavelength (Bruegge et al., 1992a). Diurnal variations were recorded. The afternoon optical depths are greater than those of the morning by as much as 0.07.

These data can be used to atmospherically correct remotely sensed data (see Markham and Halthore 1992). They can also be used to derive aerosol size distribution (King et al., 1978) and thereby estimate the phase function.

Related Data Sets:

- Sunphotometer Optical Thickness Data from C130 Aircraft.
- Solar Transmissometer Aerosol Optical Thickness.
- Optical Thickness Calibration Reference.
- Aerosol Optical Thickness from GSFC.

FIS Data Base Table Name:

OPTICAL_THICK_BRUEGGE_DATA.

2. Investigator(s):

Investigator(s) Name and Title:

Dr. Carol J. Bruegge
Jet Propulsion Laboratory

Title of Investigation:

Assessment of Techniques to Characterize the Atmosphere and to Extract Vegetation Cover Metrics.

Contact Information:

Dr. Carol J. Bruegge
Jet Propulsion Laboratory
Pasadena, CA 91109
Tel.: (818) 354-4956
Email: cjb@jord.jpl.nasa.gov

Requested Form of Acknowledgment.

Please cite the following paper in any work or publication using these data:

Bruegge, C.J., et al., 1992. Aerosol optical depth retrievals over the Konza Prairie. J. Geophys. Res. 97:18743-18758.

3. Theory of Measurements:

In FIFE, the Reagan sunphotometer was used to track the Sun through a range of airmasses. NIP, which is an autotracking sunphotometer was also used. These data are analyzed using the Langley technique. Rayleigh optical depth is subtracted, and aerosol, ozone, and water vapor abundance's simultaneously measured. In retrieving ozone, a Junge aerosol model is assumed, thus, the natural log of aerosol optical depth is linear with wavelength (Bruegge et al., 1992a). This contrasts with other experimental approaches used by investigators in which an ozone abundance is assumed (Halthore and Markham 1992). This approach allows measurement of aerosol, but is limited by the accuracy of the ozone data. For more details, see the *Theory of Measurements Section* in the Optical Thickness Calibration Reference Guide Document on FIFE CD-ROM Volume 1.

4. Equipment:

Sensor/Instrument Description:

The Reagan Sunphotometer is a spectrally filtered, solar-pointing radiometer. It has 10 spectral channels, each about 10 nm in bandwidth, fast response, low noise, and an internal filter wheel. Features of Reagan Sunphotometer are:

- Number of channels: 10, manual filter wheel
- Aerosol wavelengths, um: 0.37,0.40,0.44,0.52,0.67,0.78,0.87,1.03
- Ozone wavelength, um: 0.61
- Water-vapor wavelength, um: 0.94
- Bandpass, nm: 10
- Field-of-view, deg: 2, full-field
- Detector: photodiode, temperature stabilized to 40 +/- 0.5 degrees C
- Output: 2.0 - 0.2 V with 5 decade gain selector
- Tracking: manual

The Normal Incident Pyrheliometer (NIP) is an Eppley-type autotracking sunphotometer. The NIP measures at six wavelength channels: 0.485, 0.56, 0.66, 0.83, 1.65, and 2.2 um. The instrument has a thermopile detector, low output voltage (millivolts) and a slow response (seconds). The instrument used for FIFE in 1987 frequently required a dark current reading to be subtracted from the direct beam results.

Collection Environment:

Ground-based.

Source/Platform:

Ground-based stationary tripod.

Source/Platform Mission Objectives:

The aim was to measure aerosol optical thickness and characterize the effects of atmospheric absorption and scattering on remotely sensed imagery.

Key Variables:

Aerosol optical thickness, pressure, and temperature.

Principles of Operation:

The output voltages of the instruments are proportional to the incident irradiances within a given band, although no calibration relating voltage to physical units is required. Data are acquired every minute at high airmass, and every 15 minutes near Solar noon. A Langley plot method is used to obtain optical thickness.

Sensor/Instrument Measurement Geometry:

The instrument tracks the Sun, and the full field of view is about 2 degrees for both the Reagan and NIP sunphotometers.

Manufacturer of Sensor/Instrument:

Reagan Sunphotometer
University of Arizona
Tucson, AZ 85721

NIP
Eppley Laboratory
12 Sheffield Avenue
Newport, RI 24840

5.2 Calibration.

Instrument calibration for each sunphotometer was achieved using in-situ data acquired on clear days, with a minimal airmass span of 3. Only morning data collections were considered for a calibration.

Calibration:

Specifications:

See the *Sensor/Instrument Description Section*.

Tolerance:

Temperature stability of +/- 0.5 degrees C.

Frequency of Calibration:

Calibration was made continuously throughout the experiment, using data acquired under clear conditions (i.e., aerosol optical depth of less than 0.17 in the mid-visible wavelength).

Other Calibration Information:

The Reagan was calibrated alongside the SXM-2 (a Goddard instrument also used to report FIFE optical depth data) during IFC-5. Pre- and post-FIFE calibration were performed at mountain sites for SXM-2 with frequent inter-comparisons with both Reagan sunphotometer and the C-130 airborne tracking sunphotometer. A description of the calibration performed during IFC-4 is given in the Optical Thickness Calibration Reference Document. found on FIFE CD-ROM Volume 1.

5. Data Acquisition Methods:

Data were acquired during the first IFC with the NIPS, and during the rest of the FIFE study with the Reagan sunphotometer. The Reagan instrument was first aligned to the Sun, then a 10-position filter wheel was manually rotated allowing relative spectral irradiances to be recorded. Data acquisition cycle was about 30 seconds. The next cycle was repeated 30 seconds to 15 minutes later, depending upon time of day. NIPS was used in a similar manner to acquire data, except that the instrument tracks the Sun automatically and measures radiation in only six channels.

6. Observations:

Data Notes:

Not available.

Field Notes:

Available from PI upon request (see the *Investigator(s) Name And Title Section*).

7. Data Description:

Spatial Characteristics:

The FIFE study area, with areal extent of 15 km by 15 km, is located south of the Tuttle Reservoir and Kansas River, and about 10 km from Manhattan, Kansas, USA. The northwest corner of the area has UTM coordinates of 4,334,000 Northing and 705,000 Easting in UTM Zone 14.

Spatial Coverage:

The sunphotometer measurements were made at the following locations for the NIPS and Reagan instruments:

SITEGRID	INSTRUMENT	NORTHING	EASTING	LATITUDE	LONGITUDE	ELEV
0506-SPN	NIPS	4332962	706132	39 07 24	-96 36 56	315
2730-SPN	NIPS	4328558	711081	39 04 57	-96 33 35	440
1140-SPR	REAGAN	4331819	713013	39 06 41	-96 32 11	420
1709-SPR	REAGAN	4330541	706748	39 06 05	-96 36 33	345
2730-SPR	REAGAN	4328558	711081	39 04 57	-96 33 35	440
3639-SPR	REAGAN	4326756	712885	39 03 57	-96 32 22	443
4631-SPR	REAGAN	4324830	711253	39 02 56	-96 33 32	405
8739-SPR	REAGAN	4316698	712892	38 58 31	-96 32 33	440

Spatial Coverage Map:

Not available.

Spatial Resolution:

These are point data. Retrieved optical depth data is valid for 0.5 km horizontally. The atmosphere is assumed to be spatially homogeneous over this scale.

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

Temporal Coverage:

NIPS data were collected during IFC-1, from May 30, through June 6, 1987. The REAGAN data were collected during IFCs 2-5, from June 26, 1987 through October 8, 1987, and from July 28 through August 8 in 1989.

Temporal Coverage Map:

Not available.

Temporal Resolution:

Sampling frequency varies between 1 and 15 minutes. Data were recorded continuously from morning until Solar noon during cloud-free days. Several afternoon data sets were recorded for comparison. Data were always collected coincident with an aircraft or satellite overpass.

Data Characteristics:

The SQL definition for this table is found in the OT_BRUG.TDF file located on FIFE CD-ROM Volume 1.

Parameter/Variable Name

Parameter/Variable Description **Range** **Units** **Source**

SITEGRID_ID
This is a FIS grid location code.
Site grid codes (SSEE-III) give
the south (SS) and the east (EE)
cell number in a 100 x 100 array
of 200 m square cells. The last 3
characters (III) are an instrument

STATION_ID
The station ID designating the
location of the observations.

OBS_DATE
The date of the observations, in
the format (DD-MMM-YY).

START_TIME
The starting time of the [GMT]
observation run in GMT. The format
is (HHMM).

DURATION
The duration of the observation
run in the format HHMM. The data
are averaged over this interval
starting at START_TIME.

INSTR_ID
The code name for the instrument
used to make the observations.

SURFACE_PRESS The surface pressure at the time of the observation.	[millibars]
SURFACE_TEMP The temperature during the observation.	[degrees Celsius]
OPTCL_VISIBILITY The optical visibility in km, as computed from AEROSOL at 550 nm using Elterman vertical profile. [km]	[km]
WAVLEN The wavelength at which the observation was made.	[nm]
OZONE_OPTCL_THICK The Ozone Optical Thickness, caused by ozone particles in the air.	
RAYLEIGH_OPTCL_THICK The Rayleigh Optical Thickness, caused by molecular scattering.	
AEROSOL_OPTCL_THICK The Aerosol Optical Thickness, caused by colloidal particles suspended in the air.	
TOTAL_OPTCL_THICK The Total Optical Thickness, on a vertical path from surface to space.	
MIE_CONSTANT_1 MIE_1 and MIE_2 are used to compute AEROSOL_OPTCL_THICK at arbitrary wavelengths.	
MIE_CONSTANT_2 MIE_1 and MIE_2 are used to compute AEROSOL_OPTICAL_THICK at arbitrary wavelengths.	

ABUNDANCE_OF_OZONE
The column abundance of ozone,
reduced to Standard Temperature
and Pressure.

WEATHER
A comment on the weather
conditions at the time of the
observation.

FIFE_DATA_CRTFCN_CODE *
The FIFE Certification Code for
the data, in the following format:
CPI (Certified by PI), CPI-???
(CPI - questionable data).

LAST_REVISION_DATE
data, in the format (DD-MMM-YY).

Footnote:

Valid levels.

The primary certification codes are: EXM Example or Test data (not for release). PRE Preliminary (unchecked, use at your own risk). CPI Checked by Principal Investigator (reviewed for quality). CGR Checked by a group and reconciled (data comparisons and cross-checks).

The certification code modifiers are: PRE-NFP Preliminary - Not for publication, at the request of investigator. CPI-MRG PAMS data that are "merged" from two separate receiving stations to eliminate transmission errors. CPI-??? Investigator thinks data item may be questionable.

Sample Data Record:

SITEGRID_ID	STATION_ID	OBS_DATE	START_TIME	DURATION	INSTR_ID
0506-SPN	401	30-MAY-87	1900	300	NIPS
0506-SPN	401	30-MAY-87	1900	300	NIPS
0506-SPN	401	30-MAY-87	1900	300	NIPS
0506-SPN	401	30-MAY-87	1900	300	NIPS

SURFACE_PRESS	SURFACE_TEMP	OPTCL_VISIBILITY	WAVLEN	OZONE_OPTCL_THICK
950.00	27.0	83.2	485.0	9.9999
950.00	27.0	83.2	560.0	9.9999
950.00	27.0	83.2	660.0	9.9999
950.00	27.0	83.2	830.0	9.9999

RAYLEIGH_OPTCL_THICK	AEROSOL_OPTCL_THICK	TOTAL_OPTCL_THICK	MIE_CONSTANT_1
.1541	.1605	.3210	-1.354

.0856	.1243	.2393	-1.354
.0439	.0927	.1884	-1.354
.0174	.0617	.0810	-1.354

MIE_CONSTANT_2	ABUNDANCE_OF_OZONE	WEATHER
-1.780	999.90	CLDY/CIR
-1.780	999.90	CLDY/CIR
-1.780	999.90	CLDY/CIR
-1.780	999.90	CLDY/CIR

FIFE_DATA_CRTFCN_CODE	LAST_REVISION_DATE
CPI	04-AUG-88
CPI	04-AUG-88
CPI	04-AUG-88
CPI	04-AUG-88

8. Data Organization:

Data Granularity:

These are point data. Retrieved optical depth data is valid for 0.5 km horizontally. Sampling frequency varied between 1 and 15 minutes.

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary.

Data Format:

The CD-ROM file format consists of numerical and character fields of varying length separated by commas. The character fields are enclosed with a single apostrophe. There are no spaces between the fields. Each file begins with five header records. Header records contain the following information: Record 1 Name of this file, its table name, number of records in this file, path and name of the document that describes the data in this file, and name of principal investigator for these data. Record 2 Path and filename of the previous data set, and path and filename of the next data set. (Path and filenames for files that contain another set of data taken at the same site on the same day.) Record 3 Path and filename of the previous site, and path and filename of the next site. (Path and filenames for files of the same data set taken on the same day for the previous and next sites (sequentially numbered by SITEGRID_ID)). Record 4 Path and filename of the previous date, and path and filename of the next date. (Path and filenames for files of the same data set taken at the same site for the previous and next date.) Record 5 Column names for the data within the file, delimited by commas. Record 6 Data records begin. Each field represents one of the attributes listed in the chart in the *Data Characteristics Section* and described in detail in the TDF file. These fields are in the same order as in the chart.

9. Data Manipulations:

Formulae:

Derivation Techniques and Algorithms:

Junge aerosol model was assumed (Bruegge et al., 1992a). Langley plot method was used. This method has been discussed extensively in the literature (Shaw et al., 1973; Halthore et al., 1992). Average optical depths are reported. The following formulae were used to derive aerosol and column abundance of ozone:

Aerosol(Lambda)= 10^(amie + bmie * alog10(Lambda))

Noz(P(o),T(o)) = Ozone(Lambda)*P*T(o)/Sigma(Lambda)*P(o)*(Tempc+293)

where:

T(o) = standard temperature
Tempc = temperature in Celsius
P(o) = standard atmospheric pressure
Sigma = ozone cross-section
Lambda = wavelength
P = pressure
Noz = column abundance of ozone at standard temperature and pressure

Data Processing Sequence:

Processing Steps:

The optical thickness data is created by:

1. Determining the total optical depth from slope of the Langley plot.
2. Subtracting Rayleigh optical thickness, a determined from surface pressure, from total optical thickness.
3. Retrieving ozone optical thickness using 440 and 870 nm data.
4. Residual is assumed to be aerosol outside of waterbands.

Processing Changes:

None.

Calculations:

None available at this revision.

Special Corrections/Adjustments:

None available at this revision.

Calculated Variables:

Aerosol and column abundance of ozone.

Graphs and Plots:

None.

10. Errors:

Sources of Error:

Temporally varying atmosphere may introduce errors when using average optical depth, rather than instantaneous values. Instantaneous data were available and reported for latter IFCs only.

Quality Assessment:

Data Validation by Source:

Extensive intercomparison was done with other sunphotometer teams in 1989. For a full description see the Optical Thickness Calibration Reference Document. on FIFE CD-ROM Volume 1.

Confidence Level/Accuracy Judgment:

Reagan data had the state-of-art accuracy. The total optical depth data obtained during IFCs 2-5 are believed to be accurate to within +/- 0.01 absolute. These data are sufficient to retrieve surface reflectance to within 0.01. The accuracy of data acquired during IFC-1 are believed less accurate (to 0.05) due to the NIPS instrument limitations.

All data submitted to FIFE have an uncertainty of 1% in the calibration, which translates to an absolute uncertainty in aerosol optical thickness of 0.01 per airmass.

Measurement Error for Parameters:

Sensitivity studies and intercomparisons were used to infer error. The Reagan data were believed to be good to 0.01 in optical depth.

No quantitative assessment was made for the NIPS data, or the errors referred to in the *Sources of Error Section*.

Additional Quality Assessments:

FIS staff applied a general Quality Assessment (QA) procedure to these data to identify inconsistencies and problems for potential users. As a general procedure, the FIS QA consisted of examining the maximum, minimum, average, and standard deviation for each numerical field in the data table. An attempt was made to find an explanation for unexpected high or low values, values outside of the normal physical range for a variable, or standard deviations that appeared

inconsistent with the mean. In some cases, histograms were examined to determine whether outliers were consistent with the overall distribution of the data.

The discrepancies, which were identified, are reported as problems in the *Known Problems with the Data Section*.

Data Verification by Data Center:

The data verification performed by the ORNL DAAC deals with the quality of the data format, media, and readability. The ORNL DAAC does not make an assessment of the quality of the data itself except during the course of performing other QA procedures as described below.

The FIFE data were transferred to the ORNL DAAC via CD-ROM. These CD-ROMs are distributed by the ORNL DAAC unmodified as a set or in individual volumes, as requested. In addition, the DAAC has incorporated each of the 98 FIFE tabular datasets from the CD-ROMs into its online data holdings. Incorporation of these data involved the following steps:

- Copying the entire FIFE Volume 1, maintaining the directory structure on the CD-ROM.
- Using data files, documentation, and SQL code provided on the CD-ROM to create a database in Statistical Analysis System (SAS).
- Creating transfer files to transfer the SAS metadata database to Sybase tables.

Each distinct type of data (i.e. "data set" on the CD-ROM), is accompanied by a documentation file (i.e., .doc file) and a data format/structure definition file (i.e., .tdf file). The data format files on the CD-ROM are Oracle SQL commands (e.g., "create table") that can be used to set up a relational database table structure. This file provides column/variable names, character/numeric type, length, and format, and labels/comments. These SQL commands were converted to SAS code and were used to create SAS data sets and subsequently to input data files directly from the CD-ROM into a SAS dataset. During this process, file names and directory paths were captured and metadata was extracted to the extent possible electronically. No files were found to be corrupted or unreadable during the conversion process.

Additional Quality Assurance procedures were performed as follows:

- Statistical operations were performed to calculate minimum and maximum values for all numeric fields and to create a listing of all values of the character fields. During this process, it was determined that various conventions were used to represent missing values. (Note: no modifications were made to any data by the DAAC). In most cases, missing value identification conventions were discussed in the accompanying .doc file. Based on a visual check of the minimum and maximum values, no glaring errors or holes were identified that might indicate errors introduced during CD-ROM mastering by the FIFE project or data ingest by the DAAC.
- Some minor inconsistencies and typographical errors were identified in some of the character fields and column labels, however, no modifications were made to the data by the DAAC.

- Some conversions of ASCII data were necessary to move the data from a DOS platform to a UNIX platform. Standard operating system conversion utilities were used (e.g., dos2unix).
- Much of the metadata required for archival is imbedded in the narrative documentation accompanying the data sets and extracted manually by DAAC staff who have read the .doc files provided on the CD-ROM and have hand entered this information into the metadata database maintained by the DAAC. QA procedures have been performed on these metadata to identify and eliminate typographical errors and inconsistencies in naming conventions, to ensure that all required metadata is present, and to ensure the accuracy of file names and paths for retrieval.
- Data requested for distribution to users are checked to verify that files copied from disk to other media remain uncorrupted.

As errors are discovered in the online tabular data by investigators, users, or DAAC staff, corrections are made in cooperation with the principal investigators. These corrections are then distributed to users. CD-ROM data are corrected when re-mastering occurs for replenishment of CD-ROM stock.

11. Notes:

Limitations of the Data:

Not available.

Known Problems with the Data:

None known at this revision.

Usage Guidance:

Among all the optical thickness data reported by the various FIFE teams, IFC-2 data had the largest (0.05) discrepancy. This was believed to be an instrument calibration problem. Data quality was still good.

Any Other Relevant Information about the Study:

None.

12. Application of the Data Set:

These data can be used to atmospherically correct remotely sensed data (see Markham and Halthore 1992). They can also be used to derive aerosol size distribution (King et al., 1978) and thereby estimate the phase function.

13. Future Modifications and Plans:

The FIFE field campaigns were held in 1987 and 1989 and there are no plans for new data collection. Field work continues near the FIFE site at the Long-Term Ecological Research (LTER) Network Konza research site (i.e., LTER continues to monitor the site). The FIFE investigators are continuing to analyze and model the data from the field campaigns to produce new data products.

14. Software:

Software to access the data set is available on the all volumes of the FIFE CD-ROM set. For a detailed description of the available software see the *Software Description Document*.

15. Data Access:

Contact Information:

ORNL DAAC User Services
Oak Ridge National Laboratory

Telephone: (865) 241-3952
FAX: (865) 574-4665

Email: ornldaac@ornl.gov

Data Center Identification:

ORNL Distributed Active Archive Center
Oak Ridge National Laboratory
USA

Telephone: (865) 241-3952
FAX: (865) 574-4665

Email: ornldaac@ornl.gov

Procedures for Obtaining Data:

Users may place requests by telephone, electronic mail, or FAX. Data is also available via the World Wide Web at http://daac.ornl.gov.

Data Center Status/Plans:

FIFE data are available from the ORNL DAAC. Please contact the ORNL DAAC User Services Office for the most current information about these data.

16. Output Products and Availability:

The NIPS and Reagan Sunphotometer Optical Thickness data are available on FIFE CD-ROM Volume 1. The CD-ROM filename is as follows:

\DATA\OPTICAL\OT_BRUG\GRIDxxxx\ydddgrid.0TB.

Where *xxxx* is the four digit code for the location within the FIFE sitegrid. Note: capital letters indicate fixed values that appear on the CD-ROM exactly as shown here, lower case indicates characters (values) that change for each path and file.

The format used for the filename is: *ydddgrid.sfx*, where *grid* is the four-number code for the location within the FIFE sitegrid, *y* is the last digit of the year (e.g., 7 = 1987, and 9 = 1989), and *ddd* is the day of the year (e.g., 061 = sixty-first day in the year). The filename extension (.*sfx*), identifies the data set content for the file (see the *Data Characteristics Section*) and is equal to .OTB for this data set.

17. References:

Satellite/Instrument/Data Processing Documentation.

Halthore, R.N., C.J. Bruegge, and B.L. Markham. 1990. Aerosol optical thickness measurements during FIFE'89. Presented at the AMS Symposium on the First ISLSCP Field Experiment (FIFE). Anaheim, CA.

Journal Articles and Study Reports.

Bruegge, C.J., R.N. Halthore, B.L. Markham, M. Spanner and R. Wrigley. 1992a. Aerosol optical depth retrievals over the Konza Prairie. J. Geophys. Res. 97:18,743-18,758.

Bruegge, C.J., J.E. Conel, R.O. Green, J.S. Margolis, G. Toon and R.G. Holm. 1992b. Water-vapor column abundance retrievals. J. Geophys. Res. 97:18,759-18,768.

Halthore, R.N., and B.L. Markham. 1992. Overview of Atmospheric Correction and radiometric calibration efforts during FIFE. J. Geophys. Res. 97:18,731-18,742.

King, M., D. Bryne, B. Herman, and J. Reagan. 1978. Aerosol size distributions obtained by inversion of spectral optical depth measurements. J. Atmos. Sci. 35:2153-2167.

Markham, B.L., R.N. Halthore, and S.J. Goetz. 1992. Surface reflectance retrieval from satellite and aircraft sensors during FIFE. J. Geophys. Res. 97:18,785-18,795.

Shaw, G.E., J.A. Reagan, and B.M. Herman. 1973. Investigations of atmospheric extinction using direct solar radiation measurements made with a multiple wavelength radiometer. J. Appl. Meteorol. 12:374-380.

Archive/DBMS Usage Documentation.

Contact the EOS Distributed Active Archive Center (DAAC) at Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee (see the *Data Center Identification Section*). Documentation about using the archive and/or online access to the data at the ORNL DAAC is not available at this revision.

18. Glossary of Terms:

A general glossary for the DAAC is located at Glossary.

19. List of Acronyms:

AMS American Meteorological Society CD-ROM Compact Disk-Read Only Memory DAAC Distributed Active Archive Center EOSDIS Earth Observing System Data and Information System FIFE First ISLSCP Field Experiment FIS FIFE Information System IFOV Instantaneous Field of View ISLSCP International Satellite Land Surface Climatology Project JPL Jet Propulsion Laboratory ORNL Oak Ridge National Laboratory NIPS Normal Incident Pyrheliometer URL Uniform Resource Locator UTM Universal Transverse Mercator

A general list of acronyms for the DAAC is available at Acronyms.

20. Document Information:

April 26, 1994 (citation revised on October 14, 2002).

This document has been reviewed by the FIFE Information Scientist to eliminate technical and editorial inaccuracies. Previous versions of this document have been reviewed by the Principal Investigator, the person who transmitted the data to FIS, a FIS staff member, or a FIFE scientist generally familiar with the data. It is believed that the document accurately describes the data as collected and as archived on the FIFE CD-ROM series.

Document Review Date:

September 5, 1996.

Document ID:

ORNL-FIFE_OT_BRUG.

Citation:

Cite this data set as follows:

Bruegge, C. J. 1994. Optical Thickness Data: Bruegge (FIFE). Data set. Available on-line [http://www.daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/62. Also published in D. E. Strebel, D. R. Landis, K. F. Huemmrich, and B. W. Meeson (eds.), Collected Data of the First ISLSCP Field Experiment, Vol. 1: Surface Observations and Non-Image Data Sets. CD-ROM. National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Maryland, U.S.A. (available from http://www.daac.ornl.gov).

Document Curator:

DAAC Staff

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